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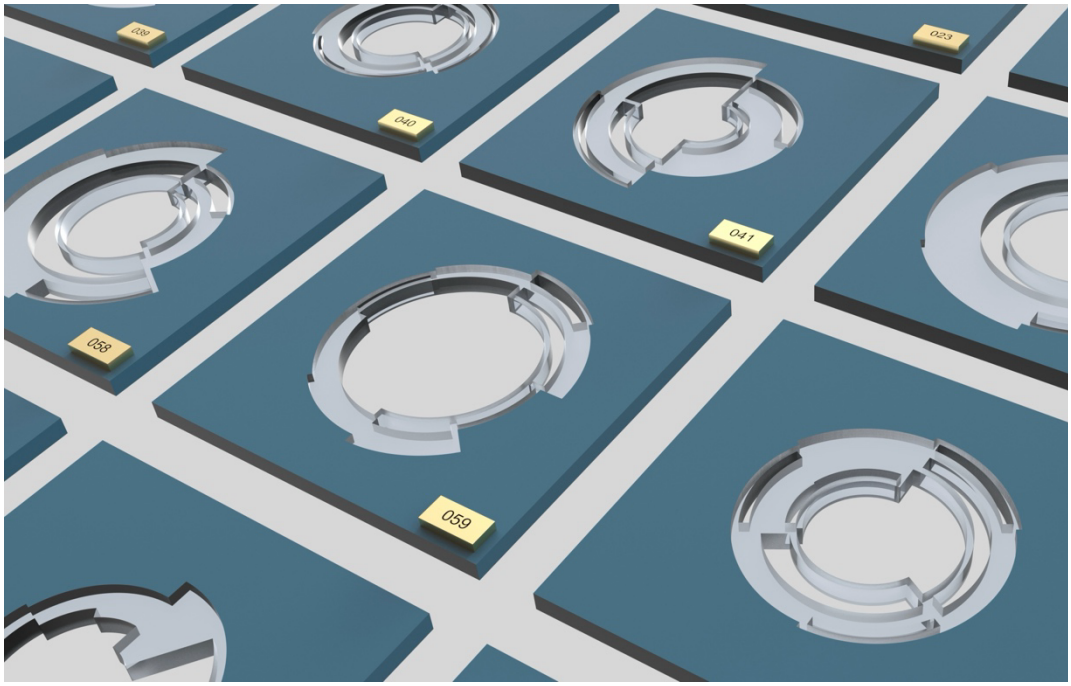
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Cross-disciplinary Jewellery

Boundary Objects and Cross-disciplinary Knowledge

in Contemporary Jewellery



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Acknowledgements

Though acknowledgements are placed at the beginning, they are indeed the final chapter of this dissertation, but the story of life does not end with Chapter Six.

Since stepping into university, I have spent ten years pursuing my studies in the UK. What was once a foreign land has now become my "second home." Ten years, neither too long nor too short, have spanned a third of my life's journey as I reach my thirties. I consider myself incredibly fortunate to have spent these years cultivating my passion in the field I love, freely and passionately, as an artist and researcher, doing what I desire. Unlike those who must choose fields that promise better employment or higher pay due to the demands of life, future prospects, or parental expectations, I have been able to follow my heart. For this, I must first and foremost express my deepest gratitude to my parents and family. It is their open-mindedness, foresight, and respect for my choices that have allowed me to carve out my own path in the field I am passionate about. Their unwavering support over these years has not only nurtured my studies and creative work but also led to my achievements in the field of jewellery and the completion of this doctoral dissertation. Their selfless support and silent support have been the solid foundation upon which I have built my dreams, allowing the seeds of those dreams to take root, grow, and eventually blossom.

The doctoral journey has been, for me, like an adventure under a starry night, much like what Robert Frost (1961) described in his poem *'The Road Not Taken'* that: "I took the one less travelled by, and that has made all the difference." Before embarking on this doctoral journey, I had already spent six years navigating the field of jewellery as a practitioner. Viewing jewellery through the lens of an artist had become second nature to me. However, these five years of doctoral exploration have opened up new perspectives, allowing me to see jewellery, and indeed, the entire world through a fresh lens.

From the initial confusion when I first embarked on this journey, with no understanding of what "research" meant, to the joy and growth that came from grasping a glimmer of light in the darkness, I gradually explored and came to understand what research is, what theories are, and what methodology are. My understanding of jewellery has

continuously evolved: from seeing it as an art of body adornment and a medium for artists to express their concepts, to recognizing it as a specific form of knowledge from the perspective of a craft researcher. I transitioned from being an artist focused on the finished outcome and expression, to a craft researcher interested in the process and knowledge creation. This growth would not have been possible without the dedication and assistance of my supervisory team, Prof. Sarah Kettley, Dr. Jessamy Kelly, and Jennifer Gray. It would not have been possible to pass this challenging doctoral journey and write this thesis without their continuous guidance, patience, and academic expertise.

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With these words, I bring this thesis to a close. I will be gentle and firm, content and always striving forward. The future is vast, and the journey is long.

Dong Ding

2024.09.06 in Edinburgh

Abstract

In European contexts, jewellery has evolved into a diverse and multifaceted art form that can be understood through a range of conceptual and material frameworks, including form, imagery, kinetics, and abstraction. Influenced by developments such as the 1960s studio movement and the rise of modernist studio jewellery, often referred to as contemporary jewellery, the field now includes various recognised categories such as architectonic, narrative, and transformational jewellery. One category that remains conceptually underdefined is that of cross-disciplinary jewellery.

Although more jewellers are developing with cross-disciplinary knowledge and skills in their practice, there has been little mention of cross-disciplinary research related to the jewellery field in existing academic literature. Therefore, this thesis presents a programme of practice research that goes some way to addressing this.

This research follows a craft-thinking methodology as an epistemological framework that structures the entire research process, characterised by a reflective, iterative and generative dynamic. Within this framework, exploratory creative practice is interwoven with moments of structured conceptual analysis and theoretical synthesis in three key phases. The first of these involves the generation of candidate criteria for a definition of cross-disciplinary jewellery through a series of case studies. This is followed by first-person practice research in the form of a distributed collaborative project, *Data-Music-Jewellery,* between myself (a jeweller) and a visual artist, providing an opportunity to reflect on and refine the criteria; and a final third phase, in which insights are synthesised, and a heuristic definition of cross-disciplinary jewellery practice is proposed.

Within the second phase, an additional analysis is undertaken to interrogate the dynamic processes of knowledge exchange, and of deconstruction, transformation, and reconstruction within the cross-disciplinary collaborative project. This is achieved through reflexive thematic analysis using a framework based on boundary objects and their derivative concepts.

The proposed definition of cross-disciplinary jewellery practice includes criteria related to the integration of knowledge, skills, materials, or concepts from other fields and innovative application or reinterpretation of external expertise within jewellery, whether through specific materials, techniques, or conceptual approaches. The cross-disciplinary creative process is driven by a dynamic flow of knowledge, in which ideas are deconstructed from their original fields and reconstructed within jewellery practice, resulting in new and transformative creative outcomes.

The main contributions of this research are twofold. Firstly, it proposes a heuristic definition of cross-disciplinary jewellery (as a category of objects that involves particular patterns of practice and knowledge), enriching the jewellery research literature. Secondly, the analysis identifies the ways in which boundary objects are generated, brought into play and are involved in cross-disciplinary collaboration, opening up the creative process and contributing to the craft and design thinking discourse, as well as deepening the understanding of the dynamic nature of boundary objects, contributing to the study of boundary objects.

Key words: Jewellery, Contemporary Jewellery, Cross-disciplinary Jewellery, Cross-disciplinarity, Cross-disciplinary research, Craft, Craft Research, Collaboration, Boundary Objects

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- Appendices 13–20 are presented in a format larger than A3 due to the size of the tables they contain. These tables require the larger format to ensure better readability and clarity.
- In Section 5.5, between pages 190 and 191, there is an extended figure presented as a concertina fold-out. This format is necessary to maintain the continuity and context of the figure.

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Glossary

1. Multidisciplinarity, interdisciplinarity and transdisciplinarity

Multidisciplinarity

According to Darbellay (2014, pp. 165-166), multidisciplinary represents the interaction between two or more independent disciplinary perspectives. This mode is relatively traditional; although it combines multiple different disciplines, genuine interaction between the disciplines does not occur.

Interdisciplinarity

In contrast, “unlike the multidisciplinary approach which most often reproduces divisions between disciplines by simple addition or juxtaposition” (Darbellay et.al., 2017: xv), interdisciplinary work is a more integrated mode of cross-disciplinary practice. It merges multiple disciplines in a more complex way. “Interdisciplinarity attempts rather to bring together two or more established disciplines so that they interact dynamically with each other.” (Darbellay et.al., 2017: xv). It can include the hybridisation of disciplines or be rooted in one discipline while borrowing or transferring research methods and concepts from others. It may even involve creating new research methods and fields by combining different methods from multiple disciplines. “Interdisciplinarity, which goes beyond the mere juxtaposition of disciplinary points of view, involves the collaboration and integration of specific disciplines in relation to a common object” (Darbellay et.al., 2017: xv).

Transdisciplinarity

Transdisciplinarity, as the most deeply interactive form of research among different disciplines, requires not only a “high level of integration between disciplines”, researchers need to “violate” or “exceed” their own disciplinary norms and adopt working methods from other disciplines (Lawrence & Despres, 2004). It transcends disciplinary boundaries and “reaches beyond interdisciplinarity to transdisciplinarity” (Nowotny et al., 2001:89). Transdisciplinary approaches are often required when

research problems are too complex to be solved by a single discipline's norms and methods.

2. Semantic, Syntactic and Pragmatic Boundary Objects

Semantic boundary objects

Semantic boundary objects are concerned with meaning and interpretation. Semantic boundary objects accompany the process of collaboration and serve as a bridge that facilitates communication and collaboration among the collaborators. Semantic boundary objects make the knowledge gaps between the collaborators 'visible' (Marheineke et al., 2016: 1116), which further helps to translate or interpret meanings across different communities to ensure common understanding and knowledge sharing in collaboration (Bergman et al., 2007). For example, present in visual formats (Nicolini et al., 2012) provides common ground for collaboration that can be negotiated and renegotiated. (Levina & Vaast, 2005; Levina & Vaast, 2006; Marheineke et al., 2016: 1113), 3D models are suitable for mediating complex design decisions (Alin etc. 2012), forming social identities across boundaries (Gal et al., 2008) and facilitating virtual negotiation (Montoya et al., 2011). (Marheineke et al., 2016: 1118)

Syntactic boundary objects

Syntactic boundary objects are concerned with the structure of data and information. They provide standardised ways of communicating so that information can flow and be exchanged between different groups. These objects ensure that team members are able to communicate and understand information under a common language and protocol without misunderstanding due to differences in the structure of the data they use. For example, asynchronous communication methods such as email are seen as an effective means of facilitating knowledge sharing. Research by Berry (2011) highlights that standardised and efficient data storage and retrieval systems can provide communities with a collaborative infrastructure to enable smoother communication and collaboration between team members. In design collaborations, working with the same design software, such as 3D modelling through Rhino, or

adopting similar design techniques, such as 3d modelling, CAD drawing, sketching, etc., was also seen as an effective means of sharing design knowledge.

Pragmatic boundary objects

Pragmatic boundary objects relate to practice and use. Pragmatic boundary objects help to reconcile and integrate differences in ways of working and practising between collaborators, enabling groups to work together more effectively. They are not only tools, methods or processes that help to reconcile practical actions and procedures between different collaborators, but also provide the basis for knowledge brokering. (Kimble et al., 2010) In this process, collaborators with field-specific knowledge communicate with each other through boundary objects, thus enabling the transformation of knowledge sharing across pragmatic boundaries. (Rosenkranz et al., 2014) For example, the use of tools such as PowerPoint, video and audio meetings can be effective in crossing complex knowledge boundaries, leading to in-depth discussions and knowledge translation. And when it comes to design-related knowledge translation, collaborative tools such as Skype and email have proven to be particularly effective. Pragmatic boundary objects are suitable for human-centred tasks, where they not only support the creation of new ideas, but also build social connections and identities among team members. (Majchrzak et al., 2012; Benn et al., 2013; Iorio & Taylor, 2014; Marheineke et al., 2016: 1117)

3. Emerging Boundary Objects and Boundary Zone

Emerging Boundary Objects

Emerging Boundary Objects is “a boundary object whose structure and meaning are not yet stable.” (Dalsgaard et al. 2014: 748) Dalsgaard et al. The study of emergent boundary objects is primarily directed towards 'design concepts' - i.e. “more or less well-developed ideas and concepts about what the product of a design process may become.” (Dalsgaard et al. 2014: 748) - as boundary objects. In the process of collaborative design, design concepts are often in a constantly forming and evolving unstable state due to communication and negotiation between collaborators, rather than entering the collaboration in a complete form ready for direct implementation. In

this context, the concept of emerging boundary objects introduces a procedural perspective for observing the dynamic changes of boundary objects in collaboration, providing an explanation for the emergence, development, and transformation of design concepts during collaboration.

During the majority of the design process (if not its entirety), design concepts are often in a state of "ongoing formation." It is only when they achieve success that they gradually become solidified, garnering a shared understanding and execution by collaborators. As the project progresses, these concepts evolve alongside the design, mirroring the negotiation and decision-making activities within the design. Hence, these newly formed boundary objects represent the continuously explored and refined ideas and notions within the design process. The design concepts need to become increasingly stable throughout the process. The integration process not only requires making them more tangible but also harmonising among various parties to ensure a mutual understanding. Emerging boundary objects offer a new perspective to observe this dynamic.

Boundary zone

The term 'boundary zone' refers to a defined conceptual space (the term "conceptual space" is used by Dalsgaard et al. to denote an analytical structure), not a physical space. Within this space, the collaborators' interests overlap, and shared agendas can be negotiated and acted upon. (Dalsgaard et al., 2014:748) Multiple boundary zones can coexist within the collaboration process. The emergence of these boundary zones often comes with some form of adjustment and coordination, aimed at verifying, managing, and harmonising the interests and goals of the parties involved. This can be achieved through means such as meetings, workshops, and email communications. Furthermore, the shared artefacts involved (like project plans) and actual venues (e.g., design labs) also provide a framework for joint exploration and action. (Dalsgaard et al., 2014:748)

Chapter 1 - Introduction

1.1 Research context and reflective research motivation

This is a practice-based doctoral research that investigates cross-disciplinary jewellery. The initial interest in this research topic originated from 10 years of my studio practice as a jeweller. When I began preparing my PhD application, I was guided by my own studio practice, which focuses on engaging with engineering principles to create kinetic jewellery works that interact with audiences. This mode of practice accustomed me to the cross-disciplinary use of engineering knowledge (often presented as diverse mechanical structures and further expressed as diverse functional mechanics) in the field of jewellery, shaping its creative expression as kinetic jewellery.

I initially wondered whether knowledge from other professional disciplinary fields could also be transferred into jewellery practice to produce innovative expressions. This curiosity about how innovative expressions could shape jewellery works spurred my initial interest in cross-disciplinary jewellery as a research topic. Subsequently, I began to explore cases involving the application of cross-disciplinary knowledge in jewellery practice. I discovered that although many jewellers had already engaged in cross-disciplinary work or collaborative practices, there was still no clear definition or framework for cross-disciplinary jewellery. On the other hand, I also began to review my own way of working - the cross-disciplinary application of knowledge seemed natural to me during my practice, and the process of looking across disciplines and drawing from different areas was part of this. I noticed this was also common among other jewellery practitioners, with very few discussing what lies behind this creative process in artist statements or projects.

It seems that the use of knowledge and skills from other disciplines to create innovative expressions in jewellery already constitutes a recognisable phenomenon within contemporary jewellery practice. While this category of cross-disciplinary jewellery exists in practice, it remains theoretically underdefined. This research therefore seeks to provide a heuristic definition of this category of practice by focusing on the creative process involved in cross-disciplinary jewellery creation, the flow of knowledge within

this process, and how knowledge from other professional fields is innovatively expressed in the context of jewellery.

1.2 Reflection on changes to the research focus

The research questions and focus of this research have evolved throughout the timeline of the process. In the initial stages of the research project, the interest in 'how collaborations between jewellery and other different domains could create various types of cross-disciplinary jewellery' led me to plan to set up multiple collaborative projects with different disciplines (working with a range of professionals from different areas). The aim was to explore how knowledge from different fields changes when transferred into jewellery. To this end, a pilot project was established to test the possibilities and potential processes of creating cross-disciplinary jewellery through collaboration with professionals from other areas. However, the results were not quite positive, with both the mode of collaboration and time management proving to be challenging. Moreover, since professionals from different disciplines each have specific working styles, a significant amount of time was needed to adjust and familiarise ourselves with each other's methods so that effective collaboration could take place. Thus, considering the constraints of research time, there was not enough time to establish and polish collaborative projects with professionals from multiple different areas. Consequently, the focus of the research shifted from the outcomes of collaborative practices (a series of different cross-disciplinary jewellery works) to the process of collaboration itself.

The research focus finally shifted further towards exploring the processes of cross-disciplinary knowledge flow and co-construction, as well as the relationship between these processes and the creation of cross-disciplinary jewellery.

1.3 Contextual Background

To position this research within a broader theoretical context, this section provides a brief introduction to key foundational concepts that shape this study, setting the scene for the discussions in the literature review in Chapter 3.

First, cross-disciplinarity serves as the fundamental theoretical framework for understanding the exchange of knowledge between jewellery and other fields in this research. Cross-disciplinarity involves interactions of knowledge across disciplinary boundaries (Steiner, 1996; Darbellay et al., 2017) and takes various forms, from borrowing concepts to deeper integration of methodologies (Barry et al., 2008; Szostak, 2017). In contemporary jewellery, cross-disciplinarity extends beyond material experimentation to encompass the exchange of concepts and methods with disciplines such as design and craft. These cross-disciplinary interactions provide the theoretical basis for investigating the cross-disciplinary knowledge flow related to jewellery (see section 3.1).

Collaboration between different disciplines often presents challenges, as each discipline has its own theoretical framework, terminology, and knowledge structures (Carlile, 2002; Nicolini et al., 2012). For instance, in the fields of craft and design, tacit knowledge—knowledge accumulated through experience and embedded in bodily practices—plays a crucial role (Polanyi, 1966; Dormer, 1997). Yet collaboration is more than the negotiation of disciplinary differences; it is also a dynamic process that enables co-creation, shared learning, and the emergence of new knowledge. As highlighted by Suib et al. (2020), collaboration provides a space where tacit knowledge can be shared and even transformed through interaction. It allows practitioners to collectively navigate uncertainty, develop mutual understanding, and engage in reflective dialogue. In this research, collaboration is not only a practical method but also drives knowledge flow and integration across fields. It establishes a shared platform that supports both knowledge exchange and innovation within cross-disciplinary practice.

To analyse how the cross-disciplinary collaborations function within jewellery practice, this research introduces the concept of boundary objects during the analysis stage (Star & Griesemer, 1989). Boundary objects refer to artefacts or concepts that facilitate communication and collaboration across disciplines, allowing different fields to interact without requiring complete consensus (Bechky, 2003; Carlile, 2002). These objects act as intermediaries in collaborative processes, enabling participants to engage in discussions around shared reference points while maintaining their distinct disciplinary perspectives. In this study, the concept of boundary objects is used to examine

knowledge exchange and negotiation between disciplines in collaborative processes. Furthermore, Nicolini et al. (2012) highlight that the role of boundary objects is not fixed but evolves over the course of collaboration, a perspective that also informs this study's analysis of cross-disciplinary jewellery practice.

By introducing these key concepts, this section sets the theoretical context for the later literature review. Chapter 3 will further explore theories related to cross-disciplinarity, collaboration, and boundary objects. These theoretical perspectives not only shape the research methodology (Chapter 4) but also provide an analytical framework for examining knowledge transfer in collaborative processes (Chapter 5).

1.4 Research aims, questions and objectives

The aims of this research are as follows:

1. To establish a definition for cross-disciplinary jewellery.
2. Standing in the jewellery field, to identify the flow and construction of knowledge during the collaborative processes between jewellery and other disciplines, as well as the creation of cross-disciplinary jewellery based on the knowledge flow process in a collaborative environment.

This research is driven and directed by the following questions:

1. What is cross-disciplinary jewellery? What are its definition and features?
2. What are the modes of production of cross-disciplinary jewellery?
3. How is cross-disciplinary jewellery created through cross-disciplinary collaboration?

To achieve the aims and answer the research questions, the objectives of this research are as follows:

1. To establish a provisional definition of cross-disciplinary jewellery through reviewing a series of existing and emerging cross-disciplinary jewellery practices.

2. To use cross-disciplinary methods and research approaches to collaborate with other professionals, creating new works based on collaborative practices.
3. To test and expand the provisional definition of cross-disciplinary jewellery through practice.
4. To analyse the processes of cross-disciplinary collaboration, by identifying and discussing the knowledge flow processes during the collaboration between jewellery and other disciplinary fields, and to discuss how these processes contribute to the creation of cross-disciplinary jewellery.

1.5 Overview of Methodology

To be able to answer the research questions and achieve these research aims and objectives, this research follows a craft-thinking methodology, which functions not only as a method of practice but also as an epistemological framework that structures the entire research process. This research also engages the method of conceptual analysis, which follows a three-step process to construct a heuristic definition for cross-disciplinary jewellery.

The first phase involves a review of the historical development of contemporary jewellery and examining cases of current practitioners engaged in cross-disciplinary work within the contemporary jewellery field. This is to establish a provisional definition for cross-disciplinary jewellery (these address research questions 1 and 2, corresponding to aim 1 and objective 1.)

The second part is based on two collaborative projects (as heuristic case studies), to explore the process and features of creating cross-disciplinary jewellery based on the collaborative process. This is to further explore the creation process of cross-disciplinary jewellery based on a collaborative environment to identify other potential features, as well as the knowledge flow processes involved in the creation of cross-disciplinary jewellery through collaboration. This part addresses research questions 3 and corresponds to aim 2 and objectives 3 and 4.

The research then enters a third and final phase: synthesising insights from both theoretical and practical work to construct a more informed definition. This stage forms

the completion of the conceptual analysis process, enabling the formation of a heuristic definition. Rather than propose a final or universal explanation of cross-disciplinary jewellery, this is presented as a starting point for future identification, understanding, and critical discussion of this category of practice and creative outcome.

The craft-thinking methodology in this research is characterised by encouraging interactive exploration dynamically - both the practice and research processes are generative, and are dynamically evolving with the research, and emphasise the process of thinking through collaboration and reflection (see chapter 4).

This research set up two distributed cross-disciplinary collaborations. Due to the distributed nature of these, an online meeting-based approach to data collection was used, allowing for data collection without disrupting the practice process. This method is qualitative, participatory, and collaborative. The data types collected included recordings of conversations between collaborators, as well as all involved drawings, sketches, prototypes, digital files, and audio/visual recordings of meetings and their transcriptions. Additionally, the physical and digital items created during the practice process, including a series of physical models, digital models, and images, were incorporated into the analysis as forms of knowledge (or new knowledge), and the collaborative practice process itself was analysed as a form of knowledge production.

For the data collected from the practice research phase, multiple rounds of data review were conducted using Reflexive Thematic Analysis (Braun and Clarke, 2006; 2016; 2018; 2019), establishing an integrated analytical framework (section 4.6) based on boundary objects and their derivative concepts drawing on key theorists including Star and Griesemer (1989), Carlile (2002, 2004), Halpern et al. (2013), Nicolini et al. (2012), and Dalsgaard et al. (2014) among others. This analytical framework serves to addresses research questions 3 and corresponds to aim 2 and objectives 3 and 4.

1.6 Structure of the thesis

To report on this dynamic research process, the thesis comprises 6 chapters and 20 appendices. The thesis takes the following structure:

Chapter 1 provides an overview of the research background, the evolution of research motivations and focus, as well as an outline of the research aims, objectives, and methodology.

Chapter 2 focuses on identifying the candidate criteria and creation methods of cross-disciplinary jewellery through existing literature and practice, exploring the history of contemporary jewellery and selected cases of cross-disciplinary work in contemporary jewellery to propose a provisional understanding of cross-disciplinary jewellery.

Chapter 3 offers a literature review of cross-disciplinary studies and knowledge transfer, knowledge in craft and design, and boundary objects and their derivative concepts in design research, related to unpacking the collaborative practice process.

Chapter 4 discusses the craft-thinking methodology. It involves the craft-thinking methodology framework and its application from both practical and research perspectives. This chapter also discusses the methods of data collection, the 8 rounds of data review (the reflexive TA), and the establishment and application of the integrated analytical framework (section 4.6) created based on boundary objects and their derivative concepts.

Chapter 5 reports on the data collected from the practice process of the *'Data-Music-Jewellery'* project, and discusses the knowledge flow, deconstruction, transformation, and reconstruction involved in the collaboration process through the integrated analytical framework based on boundary objects established in Chapter 4. It specifically discusses the roles of the 8 categories of boundary objects identified in the 'Data-Music-Jewellery' project, focusing on their impact on communication between collaborators and the cross-disciplinary flow and construction of knowledge, and their contribution to the creation of cross-disciplinary jewellery outcomes.

Chapter 6 serves as the conclusion of this thesis while also reflecting on the research process. Here, a heuristic definition of cross-disciplinary jewellery is provided - building on the provisional identification on features and creation methods of cross-disciplinary jewellery proposed in Chapter 2, here combined with additional features and creation methods identified from the analysis of the collaborative creation process in Chapter

5, creating a more informed definition for cross-disciplinary jewellery， which adding to the contemporary jewellery research literature.

As a further contribution of this research, this chapter presents the 8 categories of boundary objects and their features identified in this research. Through the set of specific interactions between the jewellers and visual artists in the collaborative practice, this chapter also discusses the dynamic interaction among the boundary objects, the distributed collaborative environment, the process of knowledge flow, and the creation of cross-disciplinary jewellery.

Additionally, while the focus of this thesis is on the theoretical discussion developed from data collected during the collaborative processes of the practical projects, the practical outcomes of this research are also considered as contributions to this doctoral study. These include a large sculpture that emerged from a musical piece (from the *'Data-Music-Jewellery'* project) and various collaborative (co-authored) in-progress creative outputs (from both the *'Data-Music-Jewellery'* and *'Viral Making' projects*).[1] Discussions regarding the contributions of the practical work will be addressed in Chapter 6.

Finally, this chapter provides a critical reflection on methodology and findings of this study, and discusses potential future directions for the research.

Note 1:
These two projects are documented on the following websites:
Viral Making: https://daviddongdingjewellery.squarespace.com/viral-making
Data-Music-Jewellery: https://daviddongdingjewellery.squarespace.com/arabesque-no-1

Chapter 2 Provisional Definition of Cross-disciplinary Jewellery

This research adopts the method of conceptual analysis to construct the definition of cross-disciplinary jewellery. Conceptual analysis is “a method for clarification and development of concepts previously under-defined or unclear, in order to develop practice and build theory on theoretical and conceptual levels” (Väänänen & Pöllänen, 2020:267; Bonis, 2013; Nuopponen, 2010b; Polit & Beck, 2006; Walker and Avant, 1995; Baldwin & Rose, 2009). “Concept analysis may work as an auxiliary tool to create conceptual clarity at various stages of the research work” (Nuopponen, 2010b:7). This aligns with the aim of this research, which is to provide a definition for cross-disciplinary jewellery - a category that seems to be widely practised but has yet to be clearly defined in theoretical discourse.

Conceptual analysis is widely used across various fields of research. However, it does not have a standardised procedure. As Nuopponen (2010a:8) notes, “it is not possible to describe an exact step-by-step procedure for concept analysis.” Wilson (1963:33) describes conceptual analysis as “an imaginative process,” during which “concepts are defined as evolving” (Hupcey & Penrod, 2005:202; Walker and Avant, 1995:37). The outcomes of such analysis are considered provisional and may be revised or adjusted as new evidence and understanding emerge (Hupcey & Penrod, 2005:203; Chinn & Kramer, 1995, 1987). Therefore, conceptual analysis is a “repetitive, iterative, and ‘distilling’ process” (Bonis, 2013:86) that “increases understanding through iterative cycles of analysis” (Väänänen & Pöllänen, 2020:267).

In this research, the definition building process for cross-disciplinary jewellery is a form of “constructive analysis” (Nuopponen, 2010b:13). Nuopponen points out that the purpose of constructive analysis is to develop concepts and systems within a research field, with the goal of creating new concepts - an approach that perfectly aligns with this research’s aim of offering a definition for cross-disciplinary jewellery.

The process of definition construction in this research is divided into three phases:

1. A provisional definition proposed through literature review and analysis of selected cases in practice (see Chapter 2).

2. Further verification and extension of the provisional definition through analysis of heuristic collaborative creative practice projects (see Chapter 5).

3. The integration and synthesis of findings from all stages to arrive at the proposed definition of cross-disciplinary jewellery (see Chapter 6).

The use of this 3-phase method aligns with the craft-thinking methodology followed in this research (see Section 4.1.1 for a detailed discussion of craft-thinking methodology). This approach was exploratory and responsive, in line with the craft-thinking methodology. Further engagement with relevant literature led me to recognise that this 3-phase approach matches the methodological structure of conceptual analysis suggested by Schwartz-Barcott and Kim (1986, 1993, 2000). Effectively, I put practice before theory, and this approach is further discussed in Section 4.1.2, Point 3. Reflection on the use of this method in this research is provided in Section 6.7. Hupcey and Penrod (2005:204) also summarised the approach as consisting of three stages: 1) theoretical work (literature-based conceptual analysis); 2) fieldwork (empirical investigation); and 3) analytical work (integration of findings). The 3-phase method that emerged in this research through the craft-thinking methodology matches with this model.

This approach enables the concept to continuously adapt to new understandings and application contexts through practice, validation, and reflection. A provisional definition was established through a review of existing cross-disciplinary works, while the collaborative projects offered a first-person heuristic perspective. Insights from these phases were then synthesised to arrive at a more informed definition.

In addition, conceptual analysis is often viewed as a method naturally compatible with qualitative research, as it supports theory construction by identifying conceptual attributes through the analysis of empirical data (Baldwin & Rose, 2009:782; LoBiondo-Wood and Haber, 2006; Rodgers, 1993). Meanwhile, thematic analysis is also recognised as an effective analytical tool that supports conceptual analysis, particularly in handling and interpreting empirical data during concept development

(Baldwin & Rose, 2009:782; Bonis, 2013:86). This research uses thematic analysis during the second phase of definition development (see Chapter 5) to identify and refine the key attributes of cross-disciplinary jewellery from the data generated during the collaborative projects. These attributes are then integrated into the evolving definition in the third phase.

The definition of cross-disciplinary jewellery constructed in this research is intended as a heuristic definition. The term heuristic here refers to the "heuristic value" (Carroll, 1999:10) of both the definition itself and the process undertaken to construct it. Heuristic value means "the method of definition, even when it fails, can assist us in making discoveries" (Carroll, 1999:10). From the perspective of process, the construction of this definition through the three phases has provided a systematic way of identifying candidate criteria in defining cross-disciplinary jewellery, While the methods used in the research give me confidence in proposing this heuristic definition, I fully expect it to continue evolving through others' research in the future.

This chapter does the first stage of this conceptual analysis. Through a review of relevant literature and practitioner case studies, this chapter aims to identify candidate criteria and establish a provisional understanding of cross-disciplinary jewellery, serving as a foundation for the subsequent stages of definition-building.

2.1 Through Literature

2.1.1 Contemporary Jewellery

Jewellery, as a widely recognised form of body adornment, has always been a part of human developmental history. From early human adornments made from shells, stones, flowers, and animal bones and teeth to the beautiful artistic creations made from metals and gemstones, evidence in many museum collections and archaeological finds of beads trace the history of jewellery back to 100,000 years ago (Cunningham, 2008:5; Game, 2005: xiii; Turner, 1973:1). "Pieces of jewellery … are probably as old as mankind" (Unger, 2010:11).

Jewellery, as a universal phenomenon embedded in society and culture, spans history and geography. People around the world wear jewellery for various reasons across different statuses and classes, with diverse forms and materials. Thus, it is only natural to ask, as Unger (2010:20) did, "whether a sensible subdivision into categories can be made." Cunningham (2008:14) addressed this, stating that while subjective to a degree, jewellery may be categorised through various terms of reference, such as: materials, form, image, kinetics, subversion, architectonic, abstraction, figuration and kinaesthetic." This is based on the evolution within the field of jewellery, particularly the emergence of what is known as 'contemporary jewellery' (to be described in the following section). Various categories of contemporary jewellery have already been defined by practitioners and researchers, such as 'Architectonic Jewellery' (defined by Vanessa Ward, 2005), 'Narrative Jewellery' (defined by Jack Cunningham, 2008), and 'Transformational Jewellery' (defined by Min Sun Kim, 2015). 'Cross-disciplinary jewellery', which this research aims to define, will also be one of those categories.

After World War II, a new way of thinking based on cultural and social attitudes began to influence the design approach of jewellers. The focus on the intrinsic value of materials and existing manufacturing patterns was gradually abandoned, and the personal "signatures" (Dormer & Turner, 1985:8) of individual artists began to emerge. Influenced by technological and industrial developments, a re-evaluation of the use of precious materials took place, leading to a pivotal moment in the field of jewellery: the late 20th-century contemporary jewellery movement, sometimes also referred to as the "New Jewellery" movement (Cohn, 2009:4; Turner, 1976; Dormer and Turner, 1985; Metcalf, 1989; Turner, 1996; Gaspar, 2007). The 1960s studio movement, with its creative freedom and the emergence of modernist studio jewellery, witnessed a series of creative outputs in the contemporary jewellery field.

Dormer and Turner (1985:178) claim jewellery to be "a shrewd monitor, reflecting the ups and downs not only of money and fashion, but also of political, social and cultural change." This interpretation of jewellery indicates a structural shift, namely "from the ornamental interests of the jeweller to the exploratory concerns of the contemporary maker, and a desire to challenge and extend preconceptions of the notion of jewellery […] the creative development of contemporary jewellery has been shaped by this

interrogation of the validity of jewellery as an art form, and the role in this of art school training.

Jewellers started to challenge elitist expressions, defining a new focus that merges inexpensive, mass-produced materials with conceptual ideologies. This pursuit of materials and meanings fundamentally diverged from the traditional decorative and monetary signifying role of jewellery, thus distinguishing contemporary jewellery from the mainstream jewellery field (Cohn, 2009:4). The cultural and artistic value of contemporary jewellery sets it apart from historical jewellery (Ward, 2005:4), establishing it as a distinct discipline separate from traditional jewellery.

2.1.2 Cross-disciplinary Jewellery

Jewellery, as part of the field of craftsmanship, was once positioned in opposition to the fields of art and design. Adamson (2007:2), in 'Thinking through Craft', discusses the notion that art and craft reside in opposing fields. However, Legg (2012:19) argues that "jewellery lies in a space between these constraining definitions. It belongs to both the optical and the material realms; it has the capacity to tread on the terrain of the fine arts while its roots stem from the crafts […] and often both fine art and craft theories can be applied to it". She suggested that:

> *"If we are to allow for a constructive critical discourse to thrive within the discipline of contemporary jewellery, we should embrace the active space between fields that the subject has the ability to inhabit." (Legg, 2012: 20)*

As the field of jewellery evolves, it begins to move into the spaces between disciplines (Rendell, 2006) - this transition allows jewellery practitioners and theorists to adopt terminology from the fields of fine arts, crafts, and design. With further development in the jewellery field, the integration extends beyond the spheres of art, craft, and design, as increasingly, knowledge and skills from various other disciplines are being utilised by jewellers, enabling a broader, more cross-disciplinary approach to jewellery making.

Another significant characteristic of contemporary jewellery is its unrestricted approach to thinking. Turner (1976:19) observed that "the rebellion against

commercialisation leads the jewellery into a realm that is not known before. The endless possibilities are now open and not explored, providing intriguing new freedom." In the words of Cohn, contemporary jewellery has embraced an "anything-goes" (Cohn, 2009:4-39) philosophy. Contemporary jewellery designers are free to explore anything that captures their interest, from concepts, structure, scale, and form. It is possible to create jewellery with any idea, in any form, using any materials and any techniques.

The 'anything-goes' philosophy embodied in contemporary jewellery has become the foundation for the development of cross-disciplinary jewellery. Unrestricted design thinking allows designers to step outside the traditional frameworks of jewellery, with every idea finding expression within contemporary jewellery. This breaking of boundaries leads them to explore and adopt more suitable materials (beyond precious metals and gemstones) and techniques to better express their design thoughts. The use of new materials naturally drives them to seek new tools, methods, and techniques. In this context, designers begin to seek assistance from other professional fields, facilitating the integration of jewellery design with various disciplines.

Various new materials and technologies are taking root in the field of jewellery. The use of fabrics connects jewellery with fashion and textile fields, while collaborations with the biological sciences have made plant and animal specimens part of jewellery materials. Even in the medical field, innovative technologies have been developed to transform the deceased's remains into diamonds.

Moreover, the integration of digital craftsmanship and new technologies - moving towards digital fabrication - has ushered in the existence of digital jewellery and wearable devices. Methods like 3D printing enable designers to express their creative talents outside their original disciplines, thus fostering a trend towards cross-disciplinary practitioners. For the industry, this is an exciting era, as there are no longer the clear boundaries and definitions that once existed. The definition of a designer has become blurred, ushering in an era of creative freedom.

On the other hand, with the development of the contemporary jewellery field, it is not only the freedom in material usage and design thinking that is significant. The shift in

concepts and values associated with contemporary jewellery also provides fertile ground for its cross-disciplinary development. By citing an excerpt from the Cross Currents exhibition catalogue, Ward (2005: 4) points out:

> *"A hybrid 'jewellery' – a verb – emerged out of the necessity to speak about the world of experience as it is; not how it was, or even how it should be. Its formal, technical, material and functional aspects are no longer derived solely from other or earlier jewellery. Its strategies are often borne out of other disciplines and areas of knowledge." (Arthur, 1984: 6-7)*

This discussion reflects that the cross-disciplinary development in contemporary jewellery has gradually started to be recognised, and the related terms such as "multidisciplinary" or "interdisciplinary" have also appeared in some studies and critiques (such as Jessop, 2013). The final chapter, 'Jewellery Without Boundaries' of Ralph Turner's Contemporary Jewellery: A Critical Assessment 1945–75 (Turner 1976) concludes with a selection of images that communicate a loosely-defined notion of jewellery design, presenting face painting and ballet dancers alongside Bakker's *Shadow Jewellery*. Jessop's (2013:22) doctoral research refers to these as "These multidisciplinary examples..." Jessop also mentioned the website for the *Gray Area* symposium at the Biblioteca de Mexico in Mexico City in 2010 introduced the concept of "grey" areas," The grey association here signifies a subject without a clear structure and with an ambiguous identity and is symbolic of jewellery's interdisciplinary involvement with a diverse range of subjects, techniques and materials" (Jessop, 2013:23).

Although Jessop's use of terms like 'multidisciplinary' and 'interdisciplinary' may be unintentional (Jessop also does not define or differentiate between these terms), it also implies that the cross-disciplinary elements in jewellery have started to be acknowledged by some practitioners and researchers. However, to date, research on cross-disciplinary elements in the field of jewellery, as well as the concept of "cross-disciplinary jewellery" itself, remains poorly defined. This serves as one of the driving forces and key contributions of this research.

In the following section, an attempt is made to establish a provisional definition and framework of cross-disciplinary jewellery based on selected existing cases of cross-disciplinary practices in the contemporary jewellery field, and some potential features and creation modes of cross-disciplinary jewellery will also be identified.

2.2 Through Makers: Cross-disciplinarity practice within the contemporary jewellery field

This section shifts the focus from literature to practice, aiming to investigate the features and modes of creation associated with cross-disciplinary jewellery. To do so, this section examines selected examples of contemporary jewellers engaging in cross-disciplinary works to identify candidate criteria toward a provisional definition of cross-disciplinary jewellery.

These examples were selected through an iterative and reflective process grounded in the researcher's early understanding of cross-disciplinarity in jewellery. Rather than aiming for representativeness or completeness, the selection was guided by resonance — that is, cases that appeared to align with or challenge an emerging concept of cross-disciplinary jewellery. As the research progressed, further examples were included to expand the range of practices considered and to test the relevance of developing insights. This process continued until recurring features and approaches began to emerge across different cases, suggesting a point of thematic saturation (Fusch & Ness, 2015).

Accordingly, this section does not seek to offer a fixed or comprehensive definition of cross-disciplinary jewellery. Instead, its purpose is to identify a set of candidate criteria toward a provisional definition, forming the first phase of the conceptual analysis method adopted in this study. These criteria are further explored and refined through heuristic, practice-based investigation in the subsequent stages (see Chapters 5 and 6).

In the writing of this section, the reviewed practices have been organised into three modes of cross-disciplinary creation:

Cross-disciplinarity within individual practice: Some jewellers integrate expertise from other fields into their own practice. To better understand this integration, the concepts of T-shaped and π-shaped professionals are introduced, helping to frame how individual jewellers combine depth in jewellery with breadth in other domains. Five practitioners are analysed in this part. In some other cases, there is no clear evidence that the practitioners have formal cross-disciplinary backgrounds; however, their work demonstrates integration of knowledge and skills from fields such as fashion, industrial design, and emerging technologies.

Cross-disciplinarity through collaboration: Other jewellers engage in explicit partnerships with professionals from different disciplines — such as performing arts, digital technology, or photography. These collaborative processes often lead to outcomes that extend or transcend jewellery boundaries.

Conceptual cross-disciplinarity: Finally, there are cases where jewellers consider or interpret specific characteristics or principles of certain fields (rather than engaging directly with the application of knowledge and skills from those fields), such as examples in Vanessa Ward's (2005) definition of "architectural jewellery", which are discussed towards the end of this section.

This exploratory approach is rooted in the craft-thinking methodology (see Chapter 4), in which knowledge emerges through a dynamic process of reflection, making, and analysis. The examples analysed here reflect that process and serve as reference points for identifying possible characteristics of cross-disciplinary jewellery. These characteristics will be revisited and further developed in later chapters, and synthesised into a more informed definition in Chapter 6.

2.2.1 Cross-disciplinary jewellery practice by individuals

2.2.1.1 The 'T-Shaped' and 'Pi-shaped (π-shaped)' professionals

The concept of 'T-Shaped' skills and 'T-shaped' professionals was introduced by David Guest (1989) and popularised and expanded upon by Tim Brown (2009). 'T-Shaped' is a metaphor used to describe a person's skill set and how they contribute to their

organisation or field. This concept is particularly valued in cross-disciplinary environments where individuals possess a deep understanding and expertise in a particular area (represented by the vertical bar of the "T") while also having a broad range of knowledge across another discipline (represented by the horizontal bar of the "T"). This combination allows for specialisation in a field as well as the ability to collaborate and innovate across different areas.

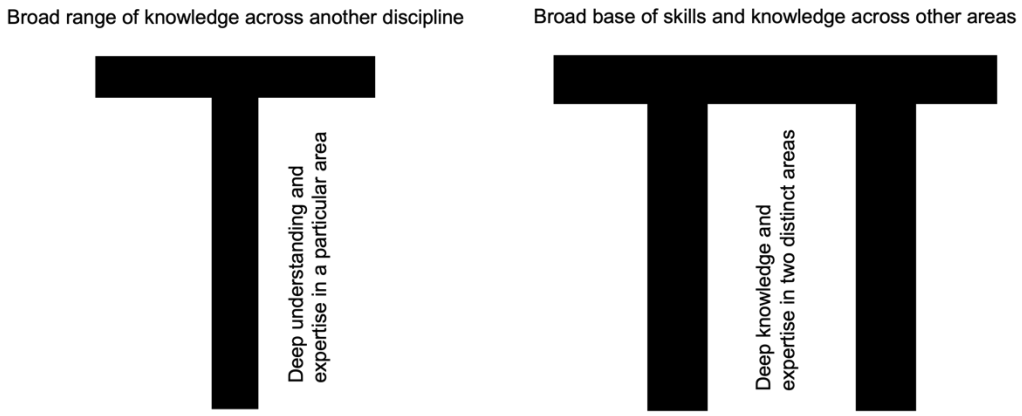


Figure 2-0: “T-shaped” and “π-shaped” professionals

Pi-shaped (π-shaped) professionals extend the T-shaped metaphor by adding a second leg of deep expertise. The concept describes individuals who have deep knowledge and expertise in two distinct areas (the two vertical legs of the π) along with a broad base of skills and knowledge across other areas (the horizontal line connecting the two legs). In this research, the concept of π-shaped professionals is borrowed to describe jewellery artists who possess expertise from different distinct fields.

2.2.1.2 Cross-disciplinary jewellery practice through π-shaped jewellers

Friedrich Becker started the incorporation of engineering knowledge into jewellery in the early 1960s. With a background in both engineering and jewellery, Becker's experiences as a mechanical engineering apprentice and his studies in aeronautical technology supported his work as a π-shaped jeweller. His understanding of mechanical structures enabled him to skilfully apply engineering principles to his

jewellery creation, successfully introducing movement as a fourth dimension into his jewellery.

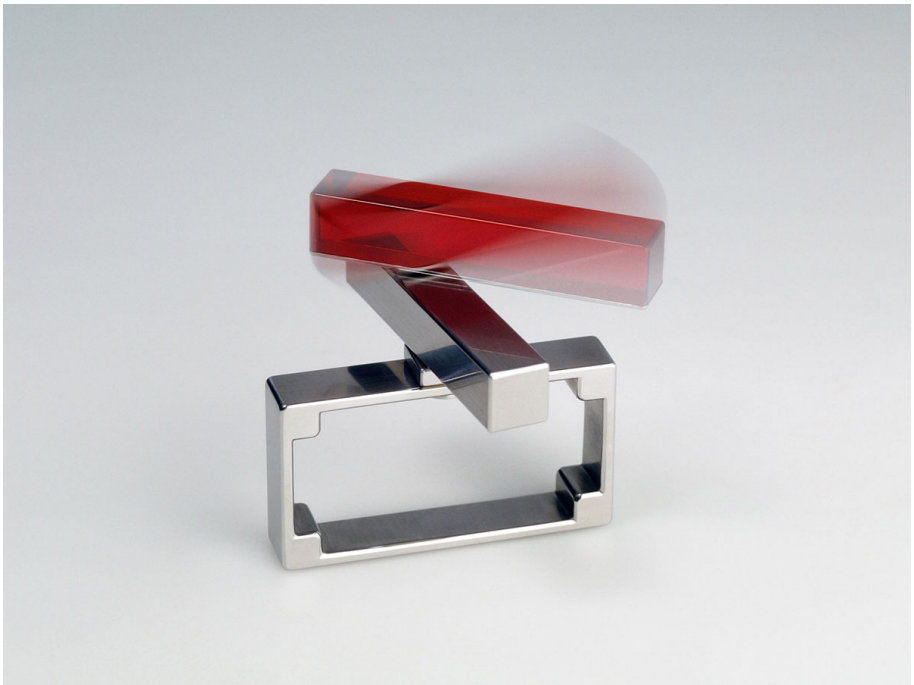


Figure 2-1: Kinetic Ring by Friedrich Becker, 1958

As shown in Figure 2-1, the ring is one of Becker's most well-known kinetic jewellery pieces.

> *Drawing on his knowledge from aircraft engineering, Becker succeeded in keeping the jewellery in motion using hidden ball bearings. This created entirely new, tangible dimensions of space, surface and change, even stretching to optical illusions. […] The interaction between technical perfection, with the inclusion of physical principles, and artistic visions characterize the objects with the fourth dimension in jewellery and sculpture, created by Becker: movement. (Henselder, 2018)*

Michael Berger, following in the footsteps of Friedrich Becker (Berger worked as an assistant to Becker in the 1990s), also dedicated his work to kinetics. Similar to Becker, Berger, who was formerly a mechanical engineer, also possesses extensive knowledge and relevant skills in the fields of physics and engineering. This background enabled him to work as a π-shaped jeweller, integrating engineering and physics knowledge into his creative process.

As shown in Figure 2-2, it is one of Michael Berger's widely recognised kinetic rings. In his latest *"Flower Power series"* (Figure 2-3), elements related to physical optics have been introduced into his work in further exploration of kinetics:

> *This group of works starting 2018 is a further development of my kinetic jewellery, in which I experiment with dichroic glasses. The momentum, provided by the wearer through his own movements impulses the rotation of the glass panels, which effectively sets the scene for light refraction, reflection, and the colour change effect. A double interplay arises: between the lattice structure and the reflective glass surfaces on the one hand and the piece and the viewer on the other. (Klimt02.net)*

In the cross-disciplinary explorations of Becker and Berger, the transformative expression of knowledge from the fields of physics and engineering within the jewellery field is clearly demonstrated. In the engineering field, this knowledge is often expressed as functional mechanics, but in the jewellery field, it becomes a bridge for interaction with the wearer and the audience. Based on dynamic interaction with the wearer's body movements, these kinetic structures created through cross-disciplinary expressions of engineering knowledge become powerful means for the artists to convey their concepts. This not only connects the jewellery makers, wearers, and viewers but also expands the forms of expression and the boundaries of the jewellery field.



Figure 2-2: Kinetic Ring by Michael Berger



Figure 2-3: *“Flower Power series”* by Michael Berger, 2023



Figure 2-4: ‘Sparrow Mouse Brooch’ by Julia deVille

Julia deVille is a jeweller and taxidermist:

> *I work predominately in traditional gold and silversmithing, combined with materials that were once living such as jet, a petrified wood historically used in Victorian Mourning jewellery, human hair and taxidermy. I use these materials as a Memento Mori, or reminder of our mortality. (DisceMori.com)*

Since 2002, after beginning to learn the skills of taxidermy, she has started incorporating taxidermy into her jewellery creations. This innovative cross-disciplinary use of taxidermy techniques and the integration of taxidermy as a medium for conceptual expression stem from her familiarity and expertise in both fields:

> *I bought my first piece of taxidermy (an eight-pointer stag mount) when I was 16. This inspired me to learn taxidermy. It took me another three years to find a mentor. It happened that I began studying jewellery at the same time, so it was natural for me to combine the two crafts together. (Fowler and deVille, 2021)*

This background enables her to work as a π-shaped jeweller to creatively combine taxidermy techniques with leather and metalworking skills. Her works often explore concepts related to death, with taxidermy, as a death-related artefact, becoming a key carrier for her conceptual expression. She believes that taxidermy can better communicate the 'preciousness' of life:

> *By combining precious stones like diamonds with a taxidermy mouse I find it really confronts people. I am asking the question, what is precious? Diamonds are considered precious to most people, but I can buy any diamond I want from my diamond merchant. I never know when I will find my next mouse so, to me that is more precious, not to mention the life the mouse once lived. Far more precious than a diamond. (Habitusliving.com)*

She believes that “taxidermy is a way to celebrate love […] to fully appreciate life, we must first accept or even celebrate death… one can’t exist without the other.” (Joy and deVille, 2019) Through this creative use of taxidermy in the field of jewellery, she aims to invite the audience to seriously contemplate life and death and what these mean to them in a positive way. (Habitusliving.com)

The intersection of jewellery and the performance arts also produces captivating results, exemplified by the work of Lodie Kardouss, who is simultaneously a dancer,

opera stage director, and jeweller (see: https://lodiekardouss.com). Kardouss completed her studies at Anne Teresa de Keersmaeker's Performing Arts Research and Training Studios in Brussels since 2006 and obtained a diploma in contemporary jewellery in 2017 at the RHOK Academy of Arts. In addition to her work as a dancer, she has also been a movement director and artistic collaborator for opera and stage directors:

> *As a visual artist, my creations, which range from jewellery to sculpture, installation and performance, draw on my multi-disciplinary training and professional experience in the applied and performing arts. My work integrates creative processes from various artistic fields. I try to create a context that enhances the bonds that unite us all, through a combination of mediums that are rarely expected to work together: performing arts – what I initially studied – and jewellery – my secondary training, but of equal interest to me. (Kardouss, see: https://lodiekardouss.com/work-aJewelryPiece.html)*

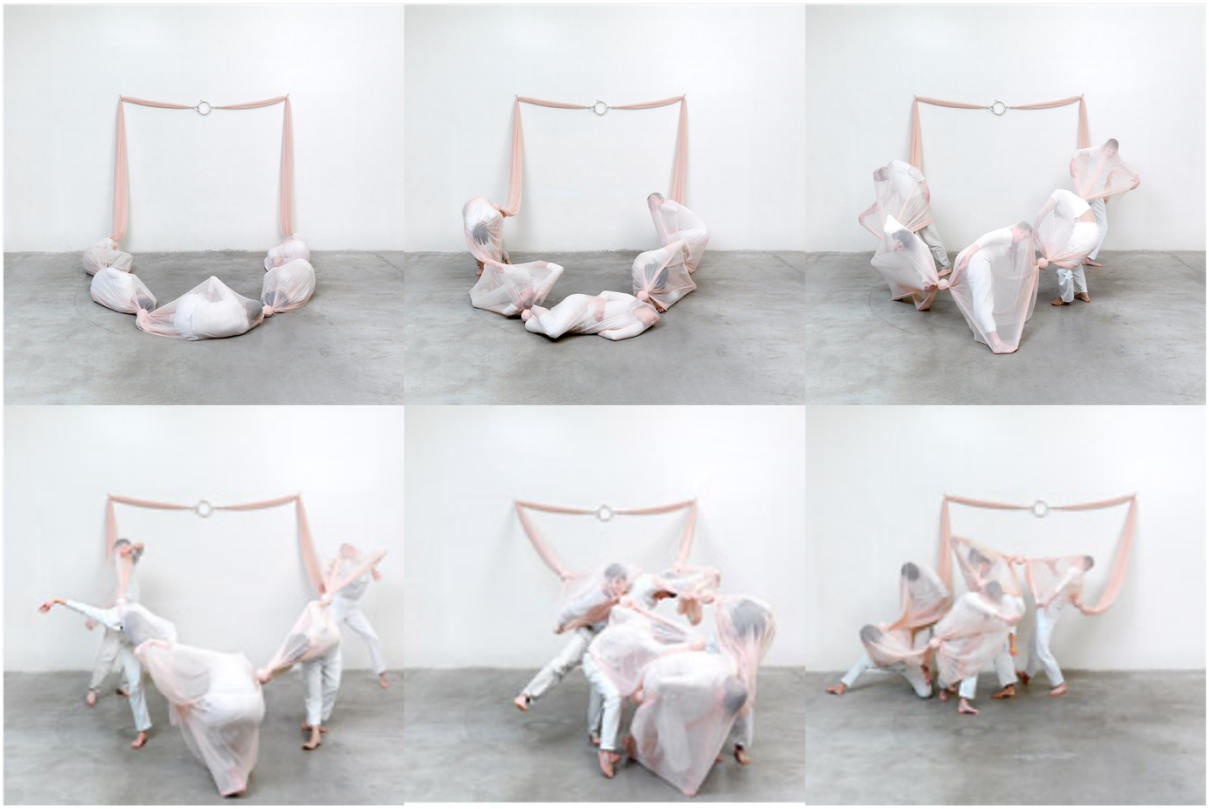


Figure 2-5: Cuts from “A Jewellery Piece” video by Lodie Kardouss, 2019 (Video available at: https://lodiekardouss.com/work-aJewelryPiece.html)

As shown in Figure 2-5, Kardouss's work titled ‘A Jewellery Piece’ is a performance jewellery work - a necklace composed of several performing dance artists and a net, which is also a constantly changing performance. Regarding this piece, she states:

A jewel, from the hands of its maker to the person wearing it, is a rather solitary journey. Creating an XXL necklace to be embodied and activated together, whose nature changes from an ornamental piece to a live composition offers a collective experience and turns the wearer into an actor. （Kardouss, 2019）

"A Jewellery Piece" combines the jeweller's craftsmanship with the choreographer's expertise through a large-scale handmade silver clip. It is shaped and moulded by dancers performing within the net cocoon of the necklace. Its form is ever-changing, perpetually renewing. It becomes alive through the combination of people who activate it. By bringing elements and techniques from dance and performance into the jewellery field, Kardouss has developed new possibilities for jewellery. Unlike Friedrich Becker's kinetic jewellery, which creates interaction between the jewellery and the wearer, this piece creates a collective interaction through the form of performance. This unique method of integrating performance into the jewellery field opens up new possibilities for jewellery expression and audience interaction.

Jewellery artist Rita Soto's approach of combining traditional craftsmanship as a technique with jewellery as a form of expression successfully incorporates cross-disciplinary elements into the field of jewellery. Soto learned the craft of jewellery making from her father and then implemented the micro-basketry technique (an indigenous form of craft particular to the area) that she learned from two artisans from the town of Rari in Chile, where the process originated. The main works produced by the artisans in Rari are colourful figurative pieces such as miniature portraits, animals, and insects. However, after mastering this technique, Soto began to challenge herself by exploring the limits of basket forms. She combined her expertise in industrial design with Chile's ancient traditions, applying them to her jewellery creations.

Over the years I had the opportunity to connect over my work as a designer with various artisans who worked with natural fiber. This gave me the opportunity to exchange knowledge and experiences between design and crafts, a very relevant process in the subsequent construction of my work. From these techniques and materials, I was able to shape forms that inspired me, but that metal did not allow me to build. It overturned an entire imaginary, with emotions and reflections on the fabric and the filaments. (Art Jewellery Forum, 2023)



Figure 2-6: (Left) ‘Quiltra II Brazalete’ by Rita Soto, 2018
Figure 2-7: (Right) ‘Parasite No. 8 Brooch’ by Rita Soto, 2018

Soto, working as a 'π-shaped' jeweller, creatively incorporates ancient craft skills into her creative process, blending traditional crafts as a unique form of knowledge into contemporary jewellery creation. Although ancient craft skills and jewellery-making skills may have many similarities (jewellery, as a form of craft, also nurtures various craft skills), even similar techniques (such as weaving with fine metal wires in jewellery) can differ due to their interaction with different materials and forms or their use for different purposes. Bringing different craft skills into the jewellery field, as Soto does, or thinking along the lines of 'What would happen if this technique were used to make jewellery?' and experimenting with different craft skills in jewellery creation is undoubtedly an effective and creative approach. The result is often highly inventive cross-disciplinary jewellery.

The five cases above suggest a mode of cross-disciplinary jewellery creation characterised by π-shaped jewellers. These individuals uniquely integrate knowledge and skills from distinct fields without engaging in collaboration with others. Instead, their independent design process relies on their own knowledge reservoir, enabling them to bridge the expertise of these familiar fields to create jewellery.

2.2.1.3 Other cross-disciplinary jewellery practice by individuals

Of course, cross-disciplinary jewellery pieces created by individuals are not necessarily all produced by π-shaped jewellers. Many cross-disciplinary jewellery projects created by individuals do not come with detailed information about the creators' backgrounds. Although the creators' backgrounds may be unverifiable and their sources of cross-disciplinary knowledge and familiarity with such knowledge may be undefined, their created cross-disciplinary works can still be considered examples to support the discussion of cross-disciplinary jewellery.

Since the 1980s, jewellery makers have begun to push the boundaries of traditional jewellery concepts. They started drawing inspiration from fashion, textiles, and performance art to challenge conventional jewellery design ideas and expand its framework (Jessop, 2013:20). Caroline Broadhead's creations, such as *'22 in 1 (Armpiece)'* and *'18 Cushions (Armpiece)'* from 1984, represent the fusion of jewellery and fashion. As shown in figures 2-8 and 2-9, the bracelet is made of cotton and nylon, extending along the entire arm.



Figure 2-8: 22 in 1 (Armpiece) by Caroline Broadhead,1984



Figure 2-9: 18 Cushions (Armpiece) by Caroline Broadhead,1984

Broadhead's approach of wrapping the body blurs the boundaries between the body's starting and ending points, while also embodying the cultural and metaphorical meanings of clothing and fashion.

> *I was blown away by the way these works complemented and extended the body. And I realised that jewellery can be about the whole body and not just the finger, the ear, or (heaven forbid) the lapel! (Davern, 2012).*

Through this fusion of jewellery and clothing, *"22 in 1 (Armpiece)"* explores the human body:

> *This phase of work represents the transition from jewellery to clothing. This is one of a series of armpieces - 'Sleeves'. From these pieces, my garments developed. The ideas I was working on were how to make a piece of jewellery as large as possible, whilst still making it wearable. Also, the change of character of a piece from being worn to an abstract piece. The 'transparency' of the piece when on the arm is important. (Caroline Broadhead, 1984; Crafts Council Collections Online)*

Pamela Johnson (1999: 22) believes that: 'These body-scale works are not bounded, discrete objects, rather they dissolve the boundary between jewellery, garment, skin, subject/object'. From Broadhead's statement, she attempts to explore the concept of

wearing jewellery, leading her to investigate this human body-related concept from another body-wearing-related field - fashion. By introducing certain characteristics (here referring to the relationship between wearable objects and the body and their morphological features) and materials from the fashion field into the jewellery field, an innovative form of cross-disciplinary fusion between jewellery and fashion is created, demonstrating the influence of fashion on the jewellery field.

Similarly, involving the fields of engineering and industry, unlike Friedrich Becker, who introduced dynamics into jewellery through mechanical design knowledge, self-taught jeweller Wendy Ramshaw brings industrial processing skills into the jewellery field, extending the conceptual and craft parameters of jewellery by turning her work on an electric lathe. As shown in Figure 2-10, one piece from her *"Picasso's Ladies Series"* (1990-1991) is created using lathe-turning and jewellery techniques. This iconic stacking ring series showcases the new possibilities of industrial production techniques in jewellery making. Using the lathe, Ramshaw constructed segmented rings combined with display stands, allowing the jewellery to be presented as sculptures when not worn.



Figure 2-10: *Rings for Woman Leaning on her Elbow (12 part), Picasso's Ladies Series* by Wendy Ramshaw, 1990-1991

As Ramshaw put it: “Most of my jewellery is made in parts or sections, so that the owner can share in the way the piece is worn” (Drutt, 2019). “This choice of form was an individualistic expression that combined tradition with innovation and took a stance against handmade craft practice” (Jessop, 2013:20). In this way, Ramshaw not only innovatively introduced industrial production techniques into the jewellery creation process, but also expanded the forms of her work beyond the boundaries of jewellery, sculpture, installation, and design.



Figure 2-11: *“Film: A Sensual Shiver”* by Naomi Filmer, 2000

By focusing on the relationships between the body, objects, and the immaterial, designer-maker Naomi Filmer often challenged the boundaries of jewellery definitions through cross-disciplinary approaches. Her works are known for their sculptural forms and experimental use of materials such as ice, chocolate, glass, and rubber. Although there is no specific information indicating that Naomi Filmer has a professional background beyond her degree in Metalwork and Jewellery from the Royal College of Art, she frequently works across disciplinary boundaries. “In Filmer’s practice she is both hands-on and hands-off: sketching and casting metal, and also working like a producer by collaborating closely with sound designers, glassblowers and cameramen”

(Highlike.org). In one of her interviews, her description of her identity also highlights the cross-disciplinary nature of her work:

> *I am a designer-maker, who creates pieces about the body rather than pieces to be worn on the body. I work and flirt with the world of jewellery and in doing so, I cross borders between design, craftsmanship, jewellery, contemporary accessories, and fashion. (Yasser and Filmer, 2018)*

Given this background, Naomi Filmer not only combines jewellery with the fashion industry through collaborative catwalk shows with designers such as Alexander McQueen, Hussein Chalayan, and Anne Valerie Hash, but her research also explores the application of film and photography in the jewellery field. As shown in Figure 2-11, her work titled *"Film: A Sensual Shiver"* exemplifies this approach. As the archive of Crafts Council Collections Online, in this piece:

> *Ice was frozen in styrene moulds, then placed on model. The film was shot on a digital video camera (DV tape). The DV tape was translated onto Beta tape, this was then edited on Beta, then copied onto VHS and DVD." (Naomi Filmer, 2000; Crafts Council Collections Online)*

> *This film was made to support the ice jewellery displayed in the Crafts Council gallery. The ice is displayed on a mannequin hand with a drip bowl. A strong image, but one loses the sense/sensation of ice against flesh...These two short pieces of film illustrate the very temporary experience of ice pieces worn on flesh. (Naomi Filmer, 2000; Crafts Council Collections Online)*

This creative process introduces the time-sensitive material of 'ice' into her creations and uses techniques from the film and photography fields to document these pieces as they change over time, which results in uniquely shaped jewellery pieces. Not only does this demonstrate the potential for applying photographic techniques to the jewellery field, but it also expands the formal boundaries of jewellery, incorporating elements related to photography. This showcases the possibilities of cross-disciplinary jewellery based on the integration of jewellery with the film and photography fields.

Stefania Lucchetta's exploration of integrating cross-disciplinary elements into jewellery creation originated from her desire to break free from the constraints of traditional jewellery through the exploration of new materials and technologies. Born into a family of goldsmiths, Lucchetta continued the family tradition but sought to

transcend the limitations of traditional materials and production techniques by applying additive technologies to stellite (a type of cobalt-chromium alloy) and titanium, creating innovative jewellery pieces:

> *My jewels are the result of long and deep research on shapes, materials, and new techniques. Since I started working in jewellery in 1999, my goal was to overcome the boundaries imposed by traditional manufacturing. I wanted to move beyond what was already achievable, pushing the modern technologies to their limits and exploring their full potential, to find new possibilities of expression. Combined with the experience I had accumulated in making traditional jewellery by hand, 3D design and additives technologies have been a precious tool in my work, allowing me to give substance to an ambitious idea: creating a new and unconventional language for jewellery. (Klimt02.net)*



Figure 2-12: (Left) Ring "*Digital 1"*", Titanium, by Stefania Lucchetta, 2010
Figure 2-13: (Right) Ring *"Digital 65"*, Stellite, diamond, by Stefania Lucchetta, 2008

Her work often involves the innovative use of materials such as biocompatible resin, polyamide, titanium, or stellite to create "synergy between form, structure, and material" (Lucchetta, 2022). As shown in Figures 2-12 and 2-13, the ring is formed through 3D printing of metal materials. The 3D printing technology, which originated in the industrial field, provides an ideal solution for creating uniquely structured jewellery. This cross-disciplinary approach of introducing 3D printing technology into the jewellery field expands the expressive possibilities for jewellery artists.

Given the diverse and varied materials that can be used in 3D printing and their powerful advantages in expressing special shapes, more and more jewellery artists are starting to incorporate 3D technology into their creations. Discussions about digital crafting techniques such as 3D printing have become one of the significant issues in many craft fields, including jewellery.

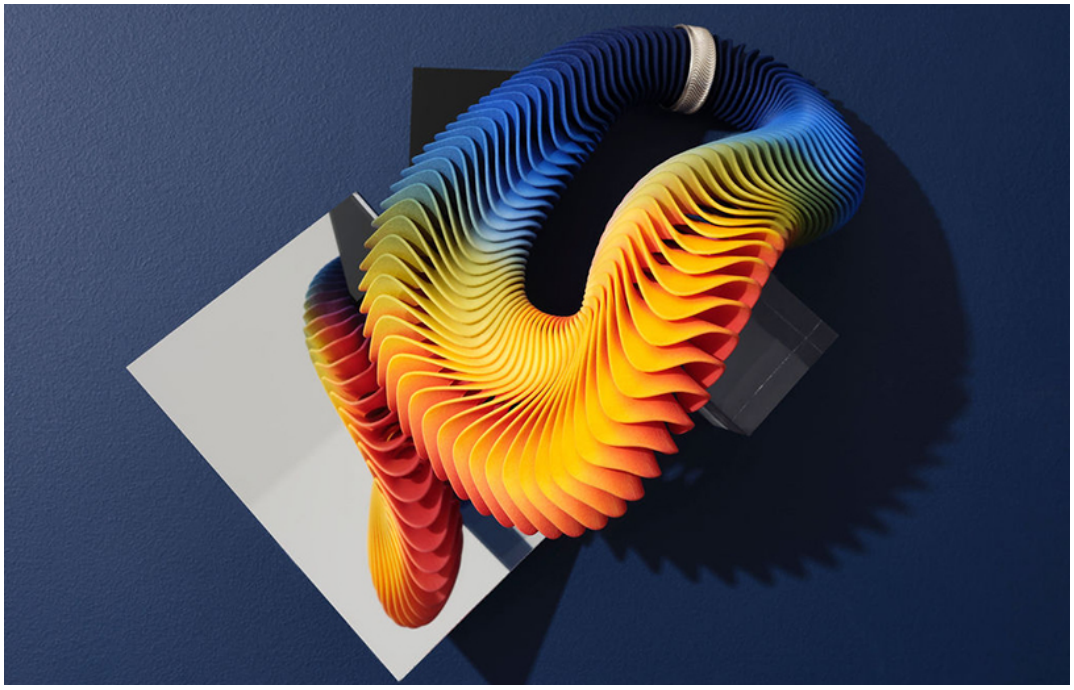


Figure 2-14: Neckpiece by Lynne MacLachlan

As shown in Figure 2-14, Lynne MacLachlan’s jewellery is created using digital technology and 3D printing. As a previous aerospace engineer, MacLachlan excels in using digital tools experimentally, exploring and pushing their capabilities. She uses custom software and 3D printing technology to achieve the resulting complex forms. Her jewellery designs skilfully utilise “light, space, and colour, providing visual pleasure to both wearers and viewers. The brightly coloured sculptural forms create fleeting, shimmering optical effects through the interplay of layered three-dimensional patterns” (Museum of Art and Design, 2018).

Khajornsak Nakpan's approach to cross-disciplinary work in the jewellery field involves extending his exploration of the scientific field into his jewellery creation process. As a jewellery artist and researcher from Thailand, Nakpan describes himself as an

“Innovative Body Adornment Jeweller” who specialises in generating knowledge of creative design, theory of colours, and computer graphics. He demonstrates different aesthetic dimensions through the lens of adaptive science. (Klimt02.net)



Figure 2-15: “Adorn Din No.1” by Khajornsak Nakpan, 2021

Nakpan is widely known for his work *"Amplituhedro"*, which involves synthesising bio-melanin fibres from soil bacteria to design innovative, zero-waste body adornments. This work is part of his research called *“Using Soil as an Innovative Biomaterial”*, which aims to introduce a material to replace commonly used resources in jewellery. In this research, soil is studied and synthesised into a new type of jewellery. The series shown in figure 2-15 is also created using the special material developed from this research:

> *The research investigated the use of soil to create a biomaterial in Thailand. Bio-fibre was synthesised from soil bacteria […] The final material contained melanin pigments similar to human skin tones. (Klimt02.net)*

> *The process of creating materials based on the concept of melanin in human skin begins by synthesising quality bacteria from soil and natural sources. Grams of soil are dissolved in hot water and sweetener is added. After that, a bacteria enhancer is introduced in culture dishes for another hundred days. The result is cellulose sheets. These sheets are rinsed with water and sun-dried, leaving a strong material that can be used to produce jewellery pieces. (Romanian Jewellery Week, 2021)*

This approach of using biotechnology to create new materials and applying them in jewellery demonstrates the potential for cross-disciplinary collaboration between the field of science (here, biological sciences) and jewellery. By applying material creation methods from the scientific field to the jewellery field, new possibilities are opened - not only for the use of new materials but also for the process of material creation. This provides new perspectives for jewellery creation and offers new possibilities for the development of cross-disciplinary jewellery.

2.2.2 Cross-disciplinary jewellery practice through collaborative environment

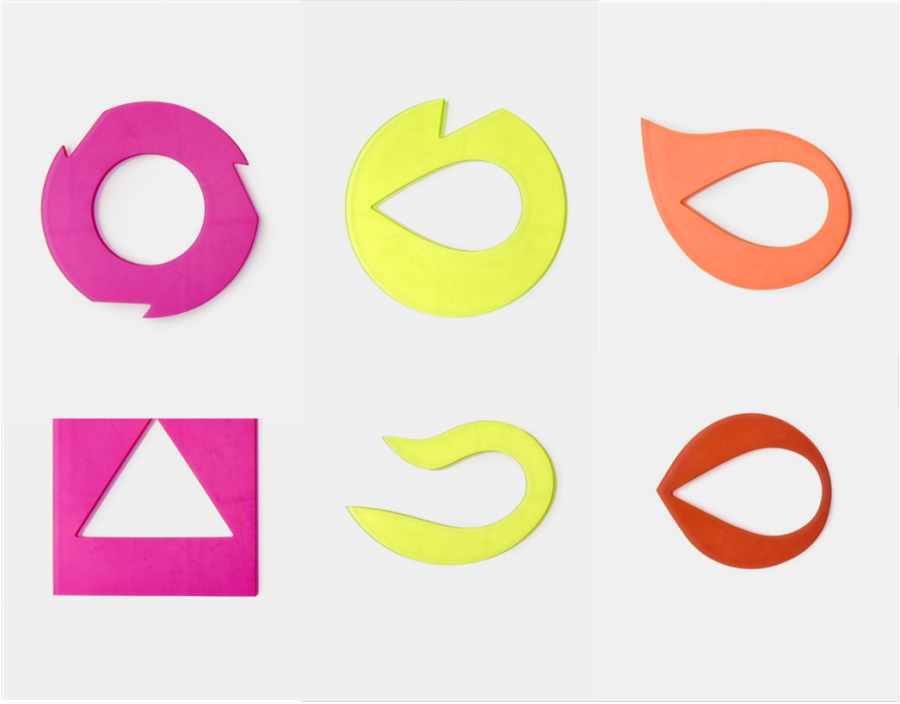


Figure 2-16: *"Twelve Perspex Multiple"* by Susanna Heron, 1976

In her 1976 series *"Twelve Perspex Multiple"*, Susanna Heron pioneered the use of industrial materials and sought the assistance of industrial techniques. As shown in Figure 2-16, the series of bangles was cut from templates by Town and Country Signs Ltd. This choice of materials and the corresponding technical requirements stemmed from her design concept:

> *I wanted to make some jewellery that was cheap, good, simple, and that could be used in many of the ways that a painter uses a print. I mean to continue with this idea. (Crafts Council Collections Online)*

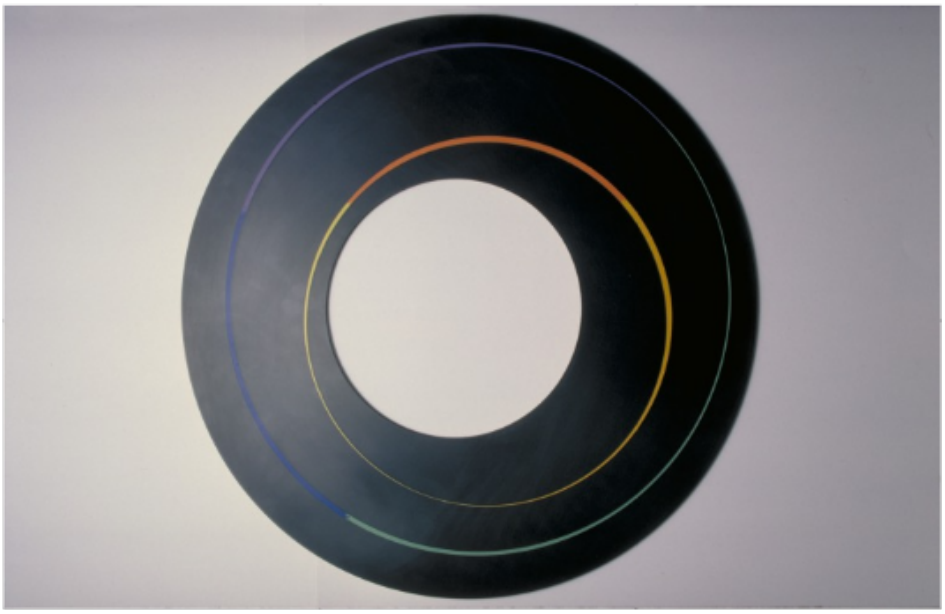


Figure 2-17: *“Jubilee Neckpieces”* by Susanna Heron, 1977

Susanna Heron’s 1977 creation, *"Jubilee Neckpieces"*, marked the beginning of her focus on the body as the subject of her work. The production process of this series similarly sought help from the industrial sector. As described in the technical record of this series by the Crafts Council Collections Online:

> *The disc and concentric rings of the piece were cut by the Perspex supplier from the maker's drawing. Heron offset the rings and joined them with cold curve embedding resin. She made a working drawing in advance to decide the exact colours and position of the meeting points between colours. (*Susanna Heron, 1977; *Crafts Council Collections Online)*

The works in these two collections by Susanna Heron demonstrate the application and exploration of industrial materials and techniques in the early stages of contemporary jewellery development. This method of collaboration with material manufacturers to industrially process materials highlights a mode of collaboration where jewellers seek assistance from non-jewellery sectors to express their concepts. It also suggests the early emergence of cross-disciplinary jewellery creation based on such collaboration (here primarily illustrating the need for industrial techniques for material processing).



Figure 2-18: *"Light projection"* by Susanna Heron, 1979

Susanna Heron's early explorations in contemporary jewellery also involved deeper collaborations with experts from other fields. Unlike the shallow collaboration with material suppliers mentioned before, which focused on material processing, collaborations with artists from other artistic disciplines resulted in richer cross-disciplinary outcomes in terms of both form and concept. The *"Light projection"* series (Figure 2-18) is a result of Susanna Heron's collaboration with photographer David Ward. Heron fixed hard ring lenses on various parts of the body, segmenting and enlivening it. In the *"Light projection"* series, a series of abstract shapes were projected onto the body's surface and photographed, highlighting the role of the body in jewellery and the concept of adornment.

> *A group of photographs made with David Ward in New York. "We projected slides. Susanna had a big mirror and composed the light on herself while I composed the photographs. I don't think either of us could have anticipated the resulting images [when the negatives were developed] – they could almost be stills from a performance" David Ward. (Heron & Ward, 1979)*

Sarah Osborn (1980:4) describes the performance between the two that is: '...strangely inhuman yet so obviously flesh and muscle grabbing twisting harsh light'. Such commentary showcases the interaction between light and the body in the *"Light*

projection" series, “both of which react, activate and highlight to capture the preciousness of the projected shapes and the body in motion.” (Jessop, 2013: 21)

Heron and Ward's collaboration ingeniously introduced 'light' as a material into the concept of jewellery creation. Through collaboration with a photographer (utilising photographic techniques), they successfully applied concepts, materials, and techniques related to photography to the jewellery field, creating a unique form of jewellery art. This cross-disciplinary attempt expanded the possibilities of contemporary jewellery at the time and was a notable experiment in the development of contemporary jewellery.

Zoe Robertson, as a jeweller, enjoys working collaboratively – working with dance artists, film makers and sound artists to move beyond Jewellery and into fields such as performance, sound, and dance.



Figure 2-19: “flockOmania” exhibition by Zoe Robertson, 2017
(Video available at: https://klimt02.net/jewellers/zoe-robertson)

Robertson exploring Jewellery within a performative context, experiments on the edges of the Jewellery field and into the fields of performance, sound, and dance. Her work *“flockOmania”* (figure 2-19) is an exhibition of Robertson for her series of

theatrical sculpture jewellery works that involves not only installation and performance, but also elements of a laboratory and workshop. (Aouf and Robertson, 2016)

In this work, Robertson worked with dance artists Dr Natalie Garrett Brown and Amy Voris to create the oversized wearable objects through a mix of traditional crafts and industrial processes, which explore the interaction between jewellery, the body and performance. In her exhibition, dancers moved among these objects, improvising their interactions with them:

> *The installation space is seen as a laboratory of making in which the dance artists improvise movement, and the audience is invited to interact with the work on show. (Aouf and Robertson, 2016)*

The cross-disciplinary and collaborative nature of *"flockOmania"* moves beyond jewellery and into the fields of performance, sound, film, dance and photography. This not only explored greater possibilities in the scale and relationship of jewellery with the wearer but also, based on dance and performance methods, Robertson explored the possibility of how jewellery, once created, can transcend its original form to create new works through interaction with people based on methods from other discipline (in this case is sound, dance and performance). This interaction was then documented and transformed into new art pieces through photography and film. This profound, cross-disciplinary collaboration opened up new possibilities for cross-disciplinary jewellery.

Silvia Weidenbach is a jeweller who blends traditional and contemporary techniques, expanding the creation of cross-disciplinary jewellery into collaborations between jewellery and visual arts, indulging in new production possibilities known as digital craft. She explores the potential of new technologies in jewellery through collaborations with various fields, integrating traditional and modern techniques to create compelling jewellery pieces.



Figure 2-20: *"Visual Feast: Moving Image"* by Silvia Weidenbach and Jon Emmony, 2018

(Video available at: https://www.silviaweidenbach.com/visualfeast-va)

As shown in figure 2-20, is Weidenbach's work collaborated with digital artist Jon Emmony called "*Visual Feast: Moving Image"*:

> *This visualises Silvia's creative process, exploring the collisions of contemporary and historic, physical and digital that inspires her work. 3d scans and images of objects are merged with data that when printed and hand finished becomes one of Silvia's pieces. through these ruptured and shifting forms, Jon creates a portrait of the maker and her process. (Weidenbach, 2018)*

This work, through collaboration with a visual artist, transforms jewellery as a physical form into digital elements as a visual form, expanding the expressive potential of jewellery. This cross-disciplinary collaboration transformed the jewellery-making process and expressing it as visual elements, which are then re-converted and expressed in the jewellery field. This method of treating the jewellery-making process as material and re-creating it into jewellery forms based on evolving visual elements explores new possibilities between jewellery and the visual arts.

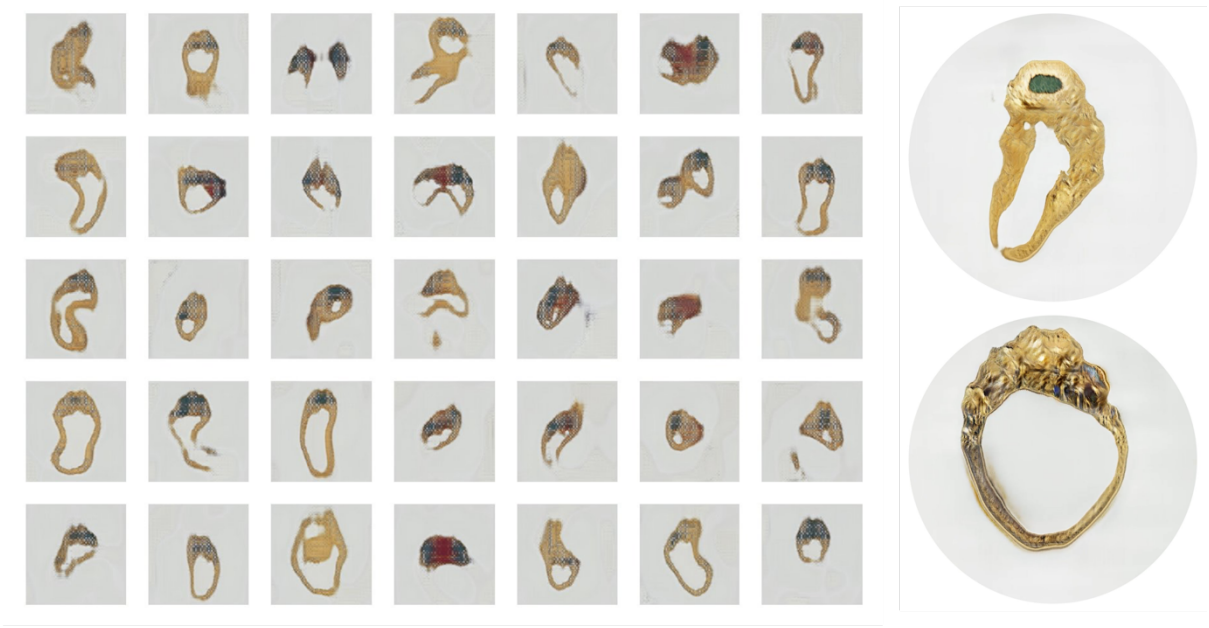


Figure 2-21: *"Infinite Loop"* by Silvia Weidenbach and Jon Emmony, 2022

As shown in Figure 2-21, another collaboration between Weidenbach and Emmony, *"Infinite Loop"*, involves the latest technology in the digital world - artificial intelligence:

> *Our project, infinite loop - feeding an artificial intelligence with historical rings, spanning over 3000 years of human creation (including pieces from the Antikensammlungen Munich, the Germanisches National Museum Nuremberg and the Alice and Louis Koch Collection in the Swiss National Museum, Zurich); each embedded with the desires, dreams and realities of the makers of the time. the ai learns from these pieces of jewellery — examining in its own way the meaning of materiality, form and features. once it has learnt, it begins its own journey of creation - showing us infinite new rings that feel familiar yet somehow distant. (Weidenbach, 2022)*

This work explores the newest digital technologies - through collaboration with artificial intelligence tools. Weidenbach and Emmony extend the collaboration between jewellery and the visual arts into new areas. Artificial intelligence, a new perspective from the field of computer science, is introduced into the creative process of transforming jewellery and visual elements, providing new possibilities for cross-disciplinary work based on the jewellery field.

2.2.3 Cross-disciplinary Jewellery through Incorporation and Interpretation of Elements from Other Fields

In the previous sections, we discussed cross-disciplinary jewellery through the use of materials and technologies. However, in reviewing cross-disciplinary practices within the contemporary jewellery field, it becomes evident that not all cross-disciplinary practices are tied to the use of materials and technologies from other fields. In some cases, the creation of cross-disciplinary jewellery involves interpreting or considering the characteristics or principles of a specific field based on the context of the jewellery field. Vanessa Ward's (2005) definition of *"Architectonic Jewellery"* in her doctoral research showcasing the unique features of this type of cross-disciplinary jewellery.

In the definition of *Architectonic jewellery,* Ward (2005) categorises *Architectonic jewellery* into three strands by the expression forms of architecture: abstract, interpretive and figurative.



Figure 2-22: “Collana” by Giampaolo Babetto

Abstract *Architectonic jewellery* “deal with architectural principles and qualities on a conceptual level” (Ward, 2005:16). Giampaolo Babetto’s work explored the classical numerical and proportional systems – by employs the Fibonacci sequence or the golden ratio in the proportions and design theories of his creations, attaching to classical principles: clarity of form, measurement, and a sense of proportion that dates back to Renaissance architecture:

I almost always rely on numbers […] for example, starting with a 3 x 3 triangle, to find the measurements of the other elements I multiply or divide by three. A mathematical relationship is thus established between the different components. (Chilleri, 2018)

This rational approach and strict adherence to classical numerical systems creatively introduce principles used in the field of architecture into the jewellery design process, forming a unique artistic language and cross-disciplinary jewellery.

Interpretive *Architectonic jewellery* “responds to a specific architectural site.” (Ward, 2005:16) Through evoking specific architectural sites, interpretive Architectonic Jewellery connects people on an intimate scale. Michael Becker’s work "from studying proportions to exploring architectural elements, to researching inception, transition, and connection. On this basis, he began studying architectural blueprints and abstracting these diagrams into jewellery pieces" (Ward, 2005:26).

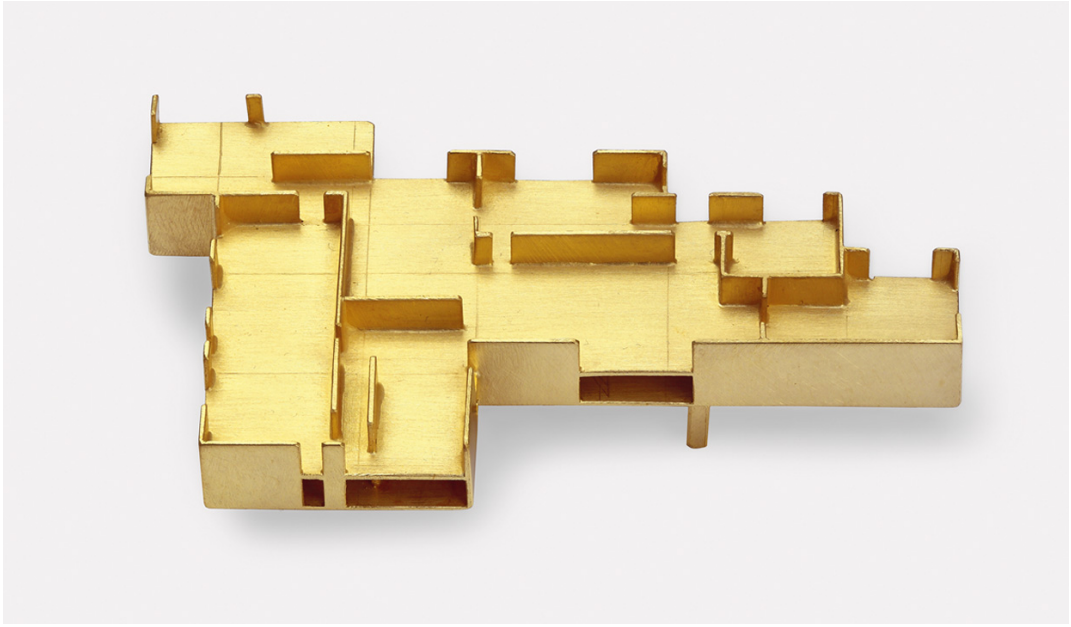


Figure 2-23: Brooch by Michael Becker

Figure 2-23 shows a series of works created by Becker in the 1990s, echoing the aerial view of Marrakech. He drew inspiration from satellite photos and similar digital imaging of architecture. As Becker explains:

The analyses of particular buildings were my point of departure for designing groups of related objects. I developed spatial, three-dimensional brooches based on two-dimensional forms, rhythmical units and principles of arrangement. (Dormer and Drutt, 1995: 69)

Figurative *Architectonic jewellery* “use the image of architecture symbolically” (Ward, 2005:16). These works communicate through architectural symbols, expressing statements, narratives, or identities. Otto Kunzli's work involves the symbolic use of architecture.

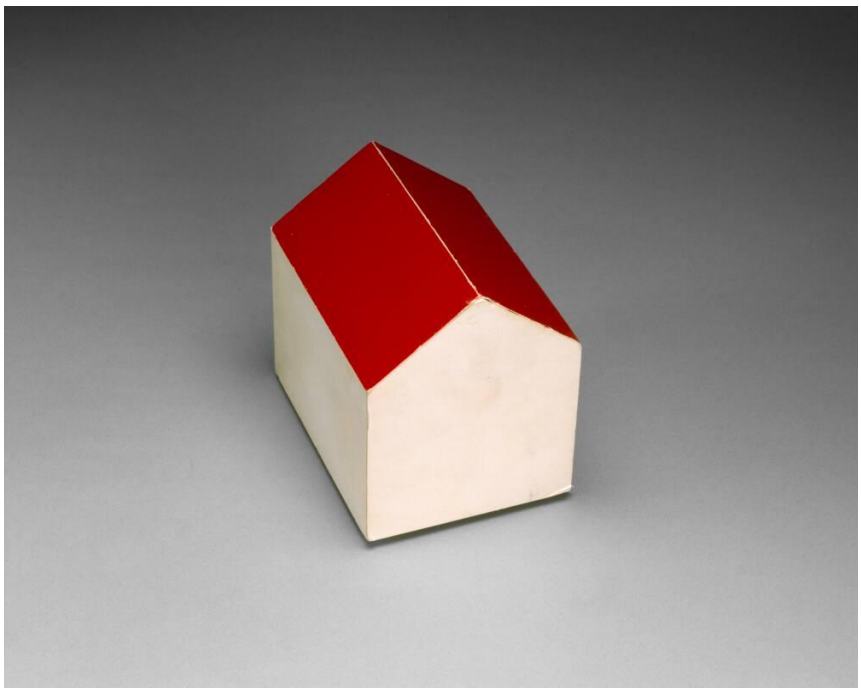


Figure 2-24: “House” by Otto Kunzli, 1983

In his ‘House’ brooch, he shaped the brooch like a house, and when worn, the wearer’s body becomes the landscape. Through this context created by the brooch and the wearer’s body, Kunzli playfully engages with the archetype of "fixed abode" (Ward, 2005:27).



Figure 2-25: “xyz” by Otto Kunzli, 1991

Kunzli’s engagement with architecture is not limited to playing with its symbolic meanings. For example, the piece "xyz" (figure 2-25), installed in 1991 in the stairwell of the Museum of Modern Art in Antwerp, demonstrates this:

> *Three vertical strips, their length (175cm) corresponding to that of Kunzli’s body… On each of the strips is a point where two walls meet. This gives rise to a system of coordinates in a part of the building that people usually pass through quickly. (Kunzli, 1991:68; Ward, 2005: 27)*

Through these creative forms, Kunzli “transformed architecture on to the body, its graphic qualities exemplified with irony” Ward (2005: 27) commends. The boundaries of jewellery are expanded by integrating principles and elements from the architectural field, illustrating the potential for cross-disciplinary jewellery that transcends traditional concepts and practices.

2.3 Cross-disciplinary Jewellery – A provisional definition

This chapter has reviewed literature related to the development of contemporary jewellery, and has discussed examples of cross-disciplinary practice within the contemporary jewellery field. It has identified candidate criteria for cross-disciplinary jewellery to propose the following provisional definition:

Cross-disciplinary jewellery, builds on the fundamental definition of contemporary jewellery (a wearable human adornment that, while possessing value and decorative appeal, also carries meanings imparted by people, including designers, makers, or wearers), cross-disciplinary jewellery integrates knowledge and skills from various professional fields, or considers and interprets the characteristics or principles of specific fields during its creation. This results in a type of jewellery that is far richer in form, material, and expressiveness compared to traditional jewellery.

The review of existing cross-disciplinary practices within the contemporary jewellery field also suggests three methods of creating cross-disciplinary jewellery, divided into two categories - individual practice environments and collaborative practice environments:

- Creation of cross-disciplinary jewellery by individuals requires jewellers to have deep knowledge and expertise in two or more distinct areas and the ability to apply this knowledge across disciplines.
- Creation of cross-disciplinary jewellery in collaborative practice environments can be further divided into two different situations:
    - One is when a jeweller seeks to use specific materials or techniques to better express their concept but lacks the necessary knowledge and skills, thereby seeking the collaboration of professionals from other fields to utilise these specific materials or techniques.
    - The other is when the goal is to create cross-disciplinary jewellery through collaboration with professionals from other fields.

Chapter 3 Theoretical contextual review

The previous chapter 2 established a provisional definition of cross-disciplinary jewellery from the perspective of the jewellery field, based on a review of historical literature and existing cross-disciplinary practices within contemporary jewellery. This chapter will adopt the perspective of cross-disciplinary research to discuss the knowledge flow processes that may be involved in cross-disciplinary research based on the jewellery field, laying the theoretical foundation for the practice-based research and analysis of cross-disciplinary jewellery presented in chapter 5.

This chapter begins with a discussion of the broad definitions of cross-disciplinarity and cross-disciplinary research, aiming to position the study of cross-disciplinary jewellery within the wider context of cross-disciplinary research. By discussing the definitions and development of cross-disciplinary work, this chapter provides a foundation for the development of cross-disciplinary research in the jewellery field.

Following this, the discussion narrows to the fields of design and craft. Although the literature on cross-disciplinary research in the craft field is relatively limited, we can discuss the potential foundation for cross-disciplinary research in jewellery through the perspective of cross-disciplinary research in the craft and design field. This part of the discussion will help us understand the interaction between design and craft fields in cross-disciplinary research.

The chapter then focuses on the transfer of knowledge between individuals from different fields in collaborative cross-disciplinary contexts. This involves a discussion of the similarities and differences between knowledge in craft and design. While the boundaries between these fields are often fluid in complex real-world practice, this research recognises that a clear understanding of their distinct characteristics is useful for analysing the process of knowledge transfer and transformation. As discussed later in Section 3.3.2, craft is typically characterised by tacit, situated knowledge, direct engagement with materials, and a holistic, iterative process often described as the "workmanship of risk" (Pye, 1968; Risatti, 2007). Design, in contrast, tends to involve a more structured process that often separates ideation from execution, relying on externalised models, drawings, and simulations. These distinctions influence how

practitioners in each field approach problem-solving, prototyping, and collaboration. Therefore, rather than avoiding these differences, this chapter draws on them to contextualise the nature of knowledge exchange in collaborative practice. Although the emphasis is not on rigidly defining disciplinary boundaries, understanding how craft and design relate to and inform each other provides a critical theoretical foundation for exploring the collaborative practices between jewellery and other design fields presented in this research. This discussion also supports the analysis of knowledge flow and transformation in collaborative practices in Chapter 5.

The discussion of the characteristics of craft thinking and craft knowledge in this chapter offers theoretical support for the establishment of the methodology that follows craft thinking of this research, which will be discussed in Chapter 4.

The final section of this chapter introduces *boundary objects* and its related concepts, which were introduced during the data review process of this research. This concept is used to provide an analytical framework and perspective for the knowledge flow process in collaborative practices of this research. The discussion of this literature will provide theoretical support for the analysis of knowledge transformation processes in collaborative practices presented in chapter 5.

3.1 Cross-disciplinarity

This section first explores the concept of cross-disciplinarity, then the classification and distinction between multidisciplinary, interdisciplinary, and transdisciplinary modes of work are discussed. By focusing on the intersection of craft and design fields, the potential for cross-disciplinary research within these areas is examined, providing a theoretical basis for the subsequent discussion on knowledge transfer processes in cross-disciplinary jewellery research. Finally, the focus shifts to cross-disciplinary research within the broader design fields related to jewellery. By reviewing the application of cross-disciplinary methods in design research, the role of design thinking as a bridge in cross-disciplinary collaboration is highlighted. These discussions provide theoretical support for cross-disciplinary collaboration between the jewellery and design fields in this research.

3.1.1 Cross-disciplinary Research

From the definition, cross-disciplinarity refers to the introduction of ideas from one field, discipline, or functional area into another, to address new problems or propose new solutions. Cross-disciplinary dialogue, as Steiner (1996:129) points out, “has frequently meant the adoption of one idea, technique, method, or theory as part of another”.

In the book *"Creativity, Design Thinking and Interdisciplinarity"*, Darbellay et al. (2017: xv) point out that the exchange between disciplinary fields often relies on researchers from different disciplines opening their minds to other fields based on their analytical skills and tools. The introduction of new knowledge is complex and novel; it cannot be simply summarised as a straightforward combination of knowledge from different disciplines, but rather as new knowledge that cannot be reduced to a single discipline.

Muratovski, et al. (2017: pp. 11-12) discuss cross-disciplinary interactions and suggest that cross-disciplinary work should be understood as the integration of two or more disciplines and distinguish 3 ways of working - multidisciplinary, interdisciplinary, and transdisciplinary (Barry et al., 2008:22; Szostak, 2017:20).

Barry et al. (2008:27) argue that when differentiating these three types of cross-disciplinary work, it is generally considered that multidisciplinary refers to the collaboration of multiple disciplines while maintaining their standard disciplinary frameworks. Interdisciplinary attempts to synthesise and integrate perspectives from multiple disciplines, while transdisciplinary breaks or transcends existing disciplinary norms to achieve disciplinary integration or solve complex problems (Lawrence & Després, 2004: 398-400). (See glossary 1 for further definitions of these different cross-disciplinary interactions).

In this research, these ideas (cross-disciplinarity, multidisciplinarity, interdisciplinarity, and transdisciplinarity) refer to Muratovski et al. (2017)’s use of cross-disciplinarity as an umbrella term that encompasses multidisciplinarity, interdisciplinarity, and transdisciplinarity as distinct ways of working across disciplines (as shown in Figure

3-1). This framework informs the definition of cross-disciplinary jewellery by helping to conceptualise how knowledge flows between fields and is applied in jewellery practice.

The distinction of definitions of different cross-disciplinary modes here is to establish key characteristics of cross-disciplinary jewellery, rather than aiming to categorise jewellery practices strictly according to specific cross-disciplinary modes. While different approaches to creating cross-disciplinary jewellery may align with these distinct modes of cross-disciplinary work, this distinction serves primarily as a theoretical tool rather than the central focus of the research. Instead, this study focuses on defining cross-disciplinary jewellery and identifying its key characteristics, drawing on the broader framework of cross-disciplinarity to situate these characteristics within different knowledge transfer processes.

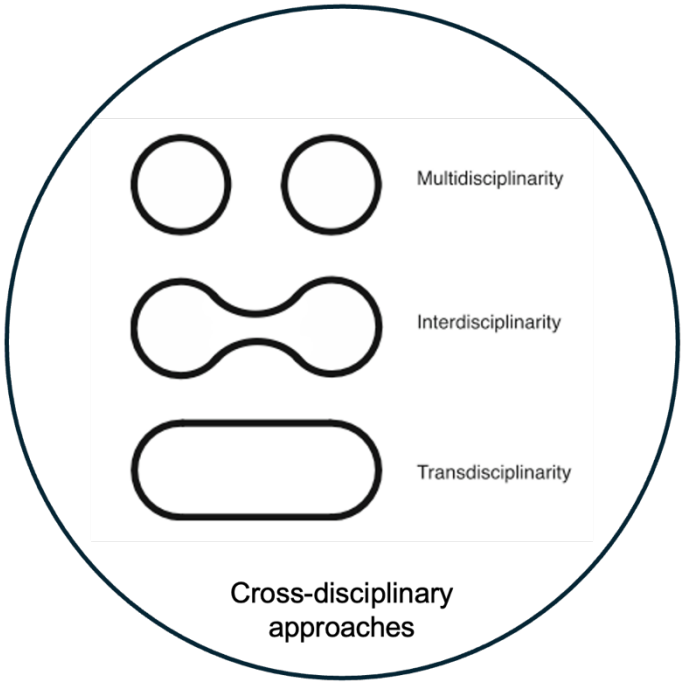


Figure 3-1: Cross-disciplinary approaches according to Muratovski, et.al. (2017:12)

Thus, this chapter will reference definitions of cross-disciplinary work modes to provide a theoretical basis for later discussions. A more detailed classification of cross-disciplinary jewellery according to these specific modes is beyond the scope of this research, but could be explored in future studies.

In addition, the use of the term 'cross-disciplinary jewellery' in this research is also considered with reference to Muratovski et al.'s (2017) model of cross-disciplinarity. At the beginning of the research, the term 'interdisciplinary' was considered to describe the type of jewellery this research aims to define. However, based on the review of the literature and existing cross-disciplinary practices in the jewellery field, as illustrated by examples in section 2.2, it suggests that not all cross-disciplinary jewellery involves deep collaboration between different fields. For instance, Susanna Heron's *"Twelve Perspex Multiple"* series (see chapter 2, in section 2.2) does not involve an 'interdisciplinary' level approach but rather a juxtaposed collaboration with the industrial field. Therefore, when attempting to describe the type of jewellery defined in this research, the term 'cross-disciplinary' was chosen for its broader inclusivity, considering cross-disciplinary jewellery practice encompasses various levels of cross-disciplinary methods.

3.1.2 Cross-disciplinary research in design

In section 2.1, the literature on the development of contemporary jewellery mentioned that contemporary jewellery has gradually moved into an intermediate realm between craft and design (Legg, 2012; Rendell, 2006). Although discussions on cross-disciplinary research in the craft field are very limited, cross-disciplinary research in the design field has already made progress. While these discussions focus on the broader scope of the design field, they can still be borrowed to discuss the potential foundation for cross-disciplinary research in the jewellery field.

In Darbellay et al.'s (2017) discussion, they argue that new, hybrid research and action models emerge during the process of cross-disciplinary research, building bridges between various fields and practices. "The resolution of cross-disciplinary problems is reinvigorated as a creative art of invention, accentuating discovery and learning" (Darbellay et.al., 2017: xviii). Design thinking, as a tool and method, can bring creative ideas even beyond the design field. Therefore, the creativity of design thinking allows it to move freely among various fields and disciplines, providing a service to other disciplines. In this process, the significance of design thinking transcends disciplinary boundaries, "it transcends disciplines and allows the development of interdisciplinary and collaborative work" (Darbellay et.al., 2017: xviii).

Szostak (2017:8-10) believes that cross-disciplinary research is similar to the process of creative design. For some designers, design practice itself is a research process; design methods at times are research methods (Downton, 2003:1-12; Friedman, 2003: 519). Others believe that researching the design process equates to conducting design research (Dorst, 2008:6). The process of cross-disciplinary research is considered a combination of conscious and subconscious thinking (Muratovski, 2017: 10). Sill (1996: 125) reminds us that in cross-disciplinary research, the most crucial aspect might not be the final product but the entire integrated thinking and research process itself. The focus of this research on the collaborative practice process aligns with Still's viewpoint and will be further discussed in chapter 4.

3.2 Cross-disciplinary Knowledge

This section explores the nature of knowledge in a cross-disciplinary context, distinguishing between explicit knowledge and tacit knowledge and examining their interdependence. By understanding these different types of knowledge, the complexity of knowledge transfer between fields is better understood. These concepts support the discussion of knowledge sharing and integration between the craft and design fields in the next section.

3.2.1 Two Types of Knowledge - Explicit and Tacit Knowledge

Knowledge, as summarised by Mathrani and Edwards (2020:5), is “the understanding of a subject gained through study, experience, or access to information, which has the potential for influencing future action” (Alavi & Leidner, 2001). Sarvary (1999) explains its general use from another perspective as “information plus the causal links that help to make sense of this information.”

There are two main types of knowledge: explicit knowledge and tacit knowledge. Explicit knowledge is codifiable and easy to articulate. This type of knowledge, once codified and formulated, can be formally and systematically communicated (Lam, 2000; Nonaka, 1994; Suib et al., 2020). Tacit knowledge, a concept defined by Polanyi, stands in contrast to explicit knowledge. It is considered uncodified, and unspoken, and cannot be easily expressed in words (LSE; Polanyi, 1961). “We can know more

than we can tell" (Polanyi, 1967:64). Which points to a special, non-verbal mode of communication that can be expressed through actions, images, and other forms.

Explicit knowledge and tacit knowledge are not separate entities. Their inseparable nature is evident: "all knowledge is either tacit or rooted in tacit knowledge" (Polanyi, 1969a:195). This means that "explicit knowledge, remaining tacit in nature, is only the surface of a deeper pool of tacit knowledge" (Nonaka, 1994; Suib et al., 2020:113). They are interdependent and mutually complementary (Alavi & Leidner, 2001).

Craft writer and critic Peter Dormer (1997) describes how tacit knowledge is often considered deeply embedded in individuals, residing deeply within their bodies and minds (Dormer, 1997). It is closely linked to personal knowledge and skills, making it difficult to share and organise (Diehl, 2010; Jasimuddin et al., 2005; Suib et al., 2020).

3.3 Cross-disciplinary knowledge transfer

Cross-disciplinary knowledge transfer is a complex process influenced by inherent differences between fields. This section first explores the characteristics of craft knowledge, focusing on how this tacit knowledge is deeply embedded in personal experience and practice within the craft field.

Next, this section explores the distinct characteristics of the craft and design fields through a comparative discussion and examines their impact on cross-disciplinary collaboration. This provides an important foundation for the subsequent discussion on knowledge transfer between craft and design based on collaboration and supports the investigation of knowledge flow and transformation in collaborative practices process within this research.

3.3.1 Craft Knowledge

Barad (2007) argues in her book *Meeting the Universe halfway* that knowing "is a performance in many worlds," and knowledge is dynamic and performative, occurring in different worlds where the specific forms of knowledge expression vary (de Stael, J. 2020: 30). Trevor Marchand (2017) in *"Craftwork as Problem Solving"* contends that

the knowledge contained in craftsmanship (which he refers to as "skilled handwork") is integral to the practice.

> *As a kind of secret knowledge; as being inextricably entangled with mastery of materials, tools, techniques; as a residual of art; as social resistance against modernity and its processes of alienation; as an exemplar for, and vehicle toward, good and ethical conduct; as process, and in motion; as directly related to the functional objects that it yields; and... as problem solving. (Marchand, 2017:8)*

Tacit knowledge, though not exclusively, is primarily used to describe knowledge within the craft field. It highlights the “invisible” aspects of craft knowledge (Jones, 1970: 18; Cooley, 1988; Dormer, 1988: 14; Cross, 1990; Dumas, 1994; Shreeve, 1998: 42; Press & Cusworth, 1997: 30; Yair, 2001: 61; Groth et al., 2013; Suib et al., 2020: 114). The British psychoanalyst Christopher Bollas (1987：282) uses the phrase “unthought known” to describe something we know but cannot think about or articulate, accurately capturing this type of knowledge in the craft field that can be perceived at a bodily level but is difficult to express in words. Within the field of jewellery, demonstration for example within a workshop setting is key to the acquisition of craft skill sets.

Since the Renaissance, as people attempted to rationalise this practical, tacit knowledge, the experiential and practical knowledge in the craft field, which is difficult to codify into universal theories, was denigrated as “mindless making” (Johnson, 1998:13) and trivial skills (Cooley, 1988; Johnson, 1998: 13; Yair, 2001:33-39). The “inarticulacy of craftsmen was misinterpreted as a lack of intelligence rather than as intelligence expressing itself in a non-verbal form” (Mitchell, 1998: 329). However, this situation has improved with the development of craft studies. The craft field is no longer valued solely for its products; the knowledge it develops and the cognitive processes it involves are also recognised (Fry, 1995: 203). The craft field has gradually established its own identity, being viewed as a third category distinct from art and design (Greenhalgh, 1997: 40; Yair, 2001: 39; Niedderer, 2005: 45; Risatti, 2007; Niedderer & Townsend, 2010: 626). Yair (2001: 65) believes that craft embodies “a pluralistic intelligence capable of producing knowledge on both tacit and explicit levels.”

Craft knowledge is described by Greenhalgh as “an unstable compound” (Greenhalgh, 1997: 21), encompassing “formal knowledge, tacit knowledge, physical and mental skill, contextual awareness, innovation, and personal creative autonomy” (Press and Cusworth, 1997: 16). A significant portion of this composite knowledge is tacit. Adamson (2010) defines craft knowledge as material and skill-based small-scale production knowledge, often acquired through extensive practice and experience (Dormer, 1997).

Apart from the tacit characteristics of craft knowledge, the creativity involved in craft activities also complicates the traits of craft knowledge. Risatti argues that craftsmanship should be understood as a creative act, in which the actual material form is merged with ideas/concepts. It entails risks at the craft level through manual techniques (as Pye, 1968, introduced the concept of 'the risk in workmanship'), but also includes abstract conceptualisation similar to design. It is not merely about executing complex manual skills (whether risky or not) but also involves the creative imagination applied in guiding and using complex manual skills - this underscores the creative aspect of craft, the quality of thought involved in making a craft piece (Risatti, 2007:167). “The craftsman, following the traditional practice of craftsmanship, both conceives and executes" (Risatti, 2007:169).

This integration means that in craft activities, the conceptualisation and execution are no longer separate phases but are merged into one continuous process. This process also points to an intuitive, ongoing adjustment that occurs during the action. Knowledge in the craft field is believed to be generated through prolonged, active participation and sensory engagement in practical activities (Janik, 1988:49; Yair, 2001:61). One characteristic of craft knowledge is that it is composed of experience and sensory judgment (Seiler et al., 2021). “In the beginning there is always an intuition” (Bernabei, 2011:77), and the decisions made during the making process are also intuitively, relying on “judgement and contextual awareness” (Pye, 1968:47). Intuition is described by Blakeslee as:

> *(Intuition) catch all word for thinking processes that we can't verbally explain […] Intuitive judgements are not arrived at step-by-step, but in an instant. They typically take into consideration a large mass of data in parallel, without separately considering each factor. Finally, they cannot be explained verbally. (Blakeslee, 1980:24)*

In Legg's (2012:69) doctoral research, it was found out that "… references to intuitive working practices were recurrent (fifteen out of the sixteen makers cited 'intuition' as important to their creative approach)." This intuition is built on extensive experience with materials and craftwork, forming the "sense of material" that craftsmen rely on. It enables craftsmen to gain knowledge and skills based on experience (Berliner, 1994:110; Dreyfus and Dreyfus, 1988:16ff; Niedderer and Roworth-Stokes, 2007; Niedderer & Townsend, 2010:633), which McCullough (1996:96) describes as the "assimilation of explicit and tacit knowledge."

3.3.2 The two different fields - Craft and Design

The practical projects in this research are two sets of cross-disciplinary interactions between the fields of craft and design. From its inception, design has been closely intertwined with traditional craftsmanship (Drumeva, K. et al., 2024: 251). Although craft and design advanced hand in hand in Britain during the 1880s, they gradually diverged (Shiner, 2012: 237). The distinction between the field of craft and design can initially be seen in Pye's (1968) distinction between craftsmen and designers (Von Busch, 2013:142).

Pye (1968:17) initially distinguished between design and workmanship: "Design is what, for practical purposes, can be conveyed in words and by drawing; workmanship is what, for practical purposes, cannot" (Risatti, 2007:162). Craftsmanship, however, differs from both design and workmanship. Yet even Pye himself seems to struggle to define this contentious term. He regards craftsmanship as an "honourable mention" of workmanship and describes it as "the workmanship of risk", contrasting it with regular workmanship, which he calls "the workmanship of certainty" – Pye (1968:20) argues that the "workmanship of risk" (what Risatti calls Craftsmanship) is, "where the quality of the result is not predetermined, but depends on the judgment, dexterity, and care which the maker exercises as he works" (Risatti, 2007:164). Risatti argues that such

distinctions and definitions are imprecise but affirms Pye's distinction regarding risk because it "captures some of the tension and drama in genuinely challenging handwork" (Risatti, 2007:165). This way of thinking, which involves continuously modifying actions based on intuitive judgments during the action, is a crucial characteristic rooted in craft thinking and a significant aspect of the methodology followed in this research (see detailed discussion on this in Chapter 4, Section 4.3).

The craft field is often regarded as possessing inherent complexity and an elusive concept (Greenhalgh 2002: 4; Niedderer & Townsend 2010; Niedderer et al., 2011:5). Craft, as an independent discipline rather than a sub-discipline of art or design (Dormer, 1997; Jönsson, 2005; Risatti, 2007; Nimkulrat, 2012), is not only understood as a way of making objects by hand but also as a way of thinking through the manual manipulation of materials (Nimkulrat, 2010). Craft is described as “a means for logically thinking through senses” (Nimkulrat, 2010: 75), “a way of thinking through practices of all kinds” (Adamson, 2007: 7), and “a dynamic process of learning and understanding through material experience” (Gray & Burnett, 2009: 51). Its process can be identified as “one way of thinking intellectually” (Sennett, 2008: 149-153).

Similarly, design knowledge exists in designing activities, in which designers, their creation processes, and resulting artefacts are involved—it is considered a “designerly way of knowing” (Cross, 1982, 1999; Nimkulrat, 2012:2).

This suggests a similarity between craft and design as creative practices, where thinking and cognition in both disciplines are inseparable from making. Their knowledge is embedded within practice and can be acquired through practice. However, the processes of craft and design also differ significantly.

Craft is considered a holistic process of activity and thinking (Sennett, 2008; Crawford, 2009; Niedderer et al., 2011:5). This holistic approach of craftsmen is related to the tacit knowledge they possess. Høgseth (2012) believes this ability encompasses two aspects - knowing what and knowing how：

> *Knowing what is related to the craftsman's technical skill and physical acting through making. Knowing how contains knowledge and experience related*

to material selection, using tools, creating a form and choosing the proper making method. (Temeltas, 2017:16)

“All this knowing and making decisions causes a holistic approach for craftsman” (Temeltas, 2017:16).

On the other hand, "Craft’s historical partner–design" (Shiner, 2012: 237) is regarded as a process and activity. The understanding of design has undergone significant changes with the development of various design studies. The perception of its process has evolved from a linear, orderly, systematic, and highly structured approach (Archer, 1965; Jones, 1970; Niedderer et al., 2011: 2) to a more complex and intuitive process (Niedderer et al., 2011: 4).

Rawsthorn (2013:9) believes that “Design is a complex, often elusive phenomenon that has changed dramatically over time by adopting different guises, meanings and objectives in different contexts” (Giuliano, L. et al.，2019：246).

Design, as a reflective dialogue, aligns with Schön's (1983) idea of "reflection-in-action." Design often follows a process of testing, reflecting, and altering to be refined and developed (Cross, 1995; Yair, 2001:56). As Schön (1983:79) argues, "In answer to the situation’s back-talk, the designer reflects-in-action on the construction of the problem, the strategies of action, or the model of the phenomena, which have been implicit in his moves." The craft process seems to follow the same rules – a repetitive cycle of action, reflection, and change. However, there is a significant difference between them. According to Yair's (2001:56-57) research, the complexity and scale of problems faced in the design process, along with the uncontrollability of materials and techniques, stopped designers from direct contact with the actual product and environment (Lawson, 1990:18). This means the reflective process in design is a symbolic process based on simulation and imagination. Designers mainly work with drawings, models, and digital simulations (Jones, 1970:264; Cross, 1990; Lawson, 1990:170). In the craftsman's workspace, this interaction occurs between the conceptual realm and the actual materials, models, and finished products (Pye, 1968).

The characteristics of craft thinking are grounded in situational engagement rather than established principles and procedures. This trait not only resonates with Pye's (1968) concept of the 'workmanship of risk' - "the quality of the result is continually at risk during the process of making" (Temeltas， 2017:15). This indicates that craft is "based on an individual creative effort and working which cares about the process of making and creating the ultimate artefact by the judgments" (Temeltas, 2017:15).

Craft thinking also aligns with Schön's (1983:40) notion of "reflection-in-action". Which involves understanding "the nature of the unique problem, accepting its uncertainties and contradictions, rather than attempting to label and resolve the problem according to precedent." In the craft process, craftsmen are described as being "cautious" and "search for the ideal forms" (Dormer, 1997).

Although designers are also "happy to work with uncertainties where solution and problem evolve in response to each other, where the end product is not clearly defined from the beginning, and where different options are kept open as long as possible before making final decisions" (Cross, 2011:11-12; Niedderer et al., 2011:2). But differ from craftsmen, designers do not always create finished products. The design process often concludes with sketches, prototypes, or concepts, as designers tend to understand the product better through creating prototypes. For craftsmen, however, the 'prototype' is the product itself (Sennett, 2008; Temeltas, 2017:15). Craftsmen rarely make complete changes to a single or series of work, but instead, explore and develop limited forms through continuous adjustments, gradually perfecting them. As Lewis (1999) describes his own work, it is "a balance between experimentation and ongoing 'fine-tuning'".

This demonstrates the locality of craft thinking. It is based on responses to specific environments, situations, materials, and processes, where any change in these elements can influence the craft process and outcomes. Craftsmen possess the ability to discover and solve problems based on material and experiential knowledge (Jakob, 2013; Temeltas & Kaya, 2021:871). The craft process engages the craftsman's experiential knowledge, meaning "customised adaptation of skill to circumstance," and is an "improvised interpretation of the task by the craftsperson" (Rowley, 1997:6). This process also echoes the previously mentioned holistic nature of the craft process -

where the craftsman takes full control of the entire process and assumes sole responsibility for creativity, determining the final outcome of a unique product through a holistic approach (Yair et al., 2001; Temeltas, 2017: 15).

Other differences between the fields of craft and design can also be referred to in the table summarised by Risatti (2007).

Although there are differences between the craft and design fields, collaboration and knowledge exchange between the two have become increasingly frequent and common in recent years. As suggested by Izidio et al. (2018: 9), the two should not replace one another but instead foster alliances between craftsmen and designers.

	Craftsman	Designer
Product	Singular, Handmade, Unique Object	Identical Objects, Mass Production
Material	Engages with material in the process of giving form	Understands the properties of materials and material-production method realtion
	Extensive Knowledge of the related materials	
Process	Dialogical/dialectical process (This process includes both idea-concepts and form-concepts in the hand through making activity)	Conceptualization of form is separated between designing stage and making stage
Prototype	Prototype is the artefact	“Prototype” may be made to test design and production possibilities

Table: Difference between Craftsmen and Designer (Risatti, 2007)

In the differences highlighted in the table regarding craftsmen and designers, their respective approaches to problem-solving in collaborative environments, as well as the previously mentioned inherent characteristics of tacit knowledge in these fields and their distinctions in knowledge sharing, we can see that these differences pose barriers to knowledge flow between the two fields. However, even though craft and design are categorized as two distinct fields, they overlap in many areas. For example, both designers and craftsmen engage in innovative and creative practices (Drumeva,

K. et al., 2024: 7). The overlaps provides a foundation for collaboration between the fields of craft and design.

Firstly, both craft and design are considered fields that exist at the boundaries of disciplines and are accustomed to cross-disciplinary collaboration and knowledge sharing.

The design field, due to the complex problems it addresses and the solutions it often requires, inherently involves materials, techniques, and expertise from various domains. Its processes draw on and incorporate knowledge, procedures, and ideas from different disciplines (Niedderer et al., 2011: 2-4).

Craftsmen, on the other hand, are described by Giuliano et al. (2019: 247-248) as “a figure with a strong social role, capable of both intellectual and manual work, an agent of change who lends form and meaning to the physical world and more” (Sennett, 2008). Brulotte et al. (2019: 15) state that “Craft is a word that is both devoted to the old and invested with meaning through its tension with the new.” Yair et al. (1999: 509) highlight “the dual nature of crafts knowledge as a discipline dependent on both practical skill and reflection.” These descriptions of the craftsman or the craft field’s ability to oscillate between the old and the new, between practice and reflection, suggest the multidisciplinary nature of the craft field.

In recent years, various studies have explored craft from different perspectives (McCullough, 1997; Sennett, 2008; Risatti, 2007; Adamson, 2007; Niedderer & Townsend, 2014), enabling craft to integrate more effectively into many cross-disciplinary studies (Temeltas, 2017: 13). Therefore, the multidisciplinary characteristics of the craft and design fields create opportunities for collaboration and knowledge sharing between the two.

As previously mentioned, prototyping is considered one of the key connection points between craft and design (Drumeva et al., 2024: 7). Although the two fields utilize prototypes differently - designers view prototyping as a tool for problem-solving and project communication, using it to explore new ideas, create forms or structures, and facilitate discussions (Valentine, 2013), while craftsmen regard the prototype itself as

the final product (Risatti, 2007). Prototyping remains a familiar method and tool in both fields. Particularly in cross-disciplinary collaborations where participants work together through three-dimensional models, prototypes enhance communication among participants, making idea-sharing easier and ensuring concepts are more comprehensible (Temeltas, 2017: 17). Niedderer (2009) identifies several key roles of craft-making:

- Testing or improving the use of specific methods or techniques
- Experimenting with new materials and exploring their potential applications.
- Using craft-making as part of a creative exploration to develop new understandings of objects or concepts.
- Analysing and comprehending complex concepts through craft-making.

This suggests that prototyping can serve as an effective tool for communication and knowledge exchange between the fields of craft and design, providing a foundation for collaboration. This understanding also offers a theoretical basis for prototypes (specifically physical models, digital models, and process images in this study) functioning as boundary objects. The idea of boundary objects will be explored in detail in Section 3.4.

Earlier, we also discussed how both craft and design are capable of adapting to uncertainty and risk, sharing the characteristic of "reflection-in-action" (Schön, 1983). This action-oriented process, which inherently involves creativity (Risatti, 2007), further reinforces the foundation for collaboration and knowledge flow between the two fields.

Niedderer et al. (2011) highlight the exploratory potential of craft (Niedderer, 2009), suggesting that craftsmanship can act as a tool for knowledge integration in interdisciplinary collaboration and practice. While their research focuses on design-related management processes within team-based collaboration is a different context from the one-to-one, individual collaborations examined in this study, but their discussion of craft as a cross-disciplinary knowledge integration tool offers valuable insights into knowledge flow within craft and design collaborations.

In the one-to-one collaboration context of this study, designers and craftsmen do not face the complex team management issues that often arise in group settings, such as the conflict between designers' willingness to work within risk and management teams' tendency to mitigate risk (Niedderer et al., 2011). Instead, in individual collaborations, both designers and craftsmen operate within an exploratory working mode, embracing risk and adjusting solutions and outcomes based on real-time conditions. Rather than serving as a tool to mediate conflicts, the idea of craft in this context becomes a shared foundation for collaboration and knowledge flow between individuals in both fields.

Craft, as "a discipline with its origins in both design and production" (Yair, K. et al., 1999: 509), is characterized in studio crafts by the notion that "the idea of hand work implies that the maker is also the designer […] the design and craft processes become almost indistinguishably interwoven" (Shiner, 2012: 234-237).

Shiner (2012: 236) further argues that "the craft process at its best involves continuous feedback between initial ideas and their embodiment, especially when the maker is also the designer. In this way, the craftsperson's tacit knowledge becomes the basis of spontaneous expression since one whose mastery of technique has become second nature can more freely modify means in the service of creation."

This perspective also aligns with Pye's concept of the workmanship of risk and Schön's (1983) "reflection-in-action," as previously discussed. Such characteristics of craft establish a foundation for cross-disciplinary knowledge transfer related to craft practice. A more detailed discussion on interdisciplinary collaboration and knowledge flow will be presented in Section 3.3.2.

3.3.3 Collaboration and knowledge transfer

"Knowledge sharing is an activity," says Shaarawy (2017:2). It "allows knowledge like information, skills, or expertise to be exchanged among people, friends, families, digital communities, or organisations" (Bukowitz et al., 1999; Chin et al., 2015). The innovation process is closely related to knowledge sharing and transfer (Penide et al., 2013; Temeltas and Kaya, 2021:868).

From the perspectives of the design and craft fields, Suib et al. (2020:115) believe that knowledge exchange between these two fields is challenging. The primary reason is that practitioners in the design and craft fields often rely on specific field knowledge (Halpern et al., 2013; Nicolini et al., 2012), which is often considered “localised and embedded” (Carlile, 2002). This implies that sharing and capturing such knowledge during collaboration can be highly challenging (Carlile, 2002).

Although the knowledge involved in the craft and design fields “is implicit, and unique to the individual and the working environment, it is also transferable to other situations” (Yair, 2001:63). Collaboration is considered as the fundamental method and necessary condition for initiating knowledge exchange between the two fields (Sanders & Stappers, 2008; Suib et al., 2020). It is also considered the most effective means of sharing craft knowledge (Yair, 2001:70). Collaboration can establish a platform that allows knowledge to flow freely. Based on this platform, collaborators can influence the process and outcome of the collaboration through experience sharing and knowledge flow (Tung, 2012; Santos et al., 2013; Suib et al., 2020). Suib et al. (2020:115) argue that collaboration initiates the shared knowledge space required to convert tacit knowledge into explicit forms (Alavi & Leidner, 2001; Grant, 1996) and fosters a common perspective among the participants (Nonaka and Takeuchi, 1995).

The inherent attributes of the craft field provide a foundation for its participation in collaboration. As Veiteberg (1988:74) suggests, the craft field lies on the "borderline" between design and art. “Where the porosity of boundaries between disciplines becomes a creative stimulus rather than a source of frustration” (Rees, 1997:118). Yair (2001:66, 68, 71) believes that collaboration is an inherent dimension of craft cognition: “that certain characteristics of crafts knowledge and practice instil a need to work with others which becomes a preference, whilst providing the skills which facilitate it. For many practitioners, collaboration is integral to practice from their first encounter with a medium. Collaboration and creativity are inseparable for them” (Yair, 2001:66, 68, 71). Therefore, the craft field and its practices, due to their disciplinary boundaries, characteristics, and diversity, become fertile ground for cross-disciplinary development.

The characteristics of the craft field and craft knowledge provide a basis for updating themselves by incorporating knowledge and skills from other fields. As Shreeve (1998) explains, “the making process allows emerging, context-specific knowledge to be compared with - and contribute to - existing, general knowledge” (Yair, 2001:62).

The interaction between mentors and students in the craft field is characterised by “observation and action” (McCullough, 1996:252) and “comparison and reflection” (Dormer, 1988:1948) and is considered a dynamic and bidirectional learning process (Yair, 2001:62). This implies that while disseminating knowledge, craft practitioners can also learn from others' actions, updating their own experiential knowledge. Practitioners in the craft field are accustomed to acquiring knowledge through interaction with others. This establishes a foundation for craft practitioners to update their knowledge through collaboration with other fields. Temeltas and Kaya (2021:869) suggest that industries using craft knowledge can share and process this tacit knowledge within their organisations through collaboration, significantly enhancing their competitive advantage (Yair et al., 2001).

“Since the fourteenth century, practitioners have travelled in order to learn new skills through collaboration with others,” as Press (1997:5) also notes. In studios, craftsmen are also accustomed to seeking advice from peers through collaboration, which is considered “an important creative stimulus and support network for practitioners” (Ball & Price, 1999:28; Yair, 2001:69). This “collaborative habit” of craftsmen provides them with opportunities to innovate through collaboration with experts from other fields. Craft-related activities frequently occur in collaboration with practitioners from other industries, shaping collaborative capabilities (Von Busch, 2013).

In the previous chapter, we discussed how Niedderer et al. (2011) suggest that the idea of craft can serve as a tool for knowledge integration in cross-disciplinary collaboration and practice. This capability of craft is attributed to its ability to foster complex thinking by combining cognitive and experiential knowledge (Crawford, 2009: 23ff; Niedderer et al., 2011: 5).

By engaging both the hands and the mind, craft activities possess a unique openness, participatory nature, and depth of understanding, which are believed to involve three

key abilities: concrete realization of the current task or issue; reflection and critical questioning of its characteristics, and expansion of its meaning (Sennett, 2008: 26, 126-7, 144-6, 237-8; Crawford, 2009: 23ff; Niedderer et al., 2011: 5).

The concept of complex thinking is closely related to Polanyi's (1961, 1969) idea of tacit knowledge, as discussed in earlier sections. Polanyi argues that "an expert can describe the particulars of a skill (explicit knowledge) and 'integrate' those particulars to make a general understanding of the particular entities through a process of 'tacit knowing.' Thus, experts have the ability to analyse and integrate, which are complementary endeavours" (Polanyi, 1961: 260-262, 460; Niedderer et al., 2011: 6).

Collins (2004: 125-127) further extends this idea, suggesting that the process of knowledge integration in practice is based on "experts learning from experience within their own domain (contributory expertise) and through communication (interactional expertise) with other experts from different domains." This suggests that in collaborations between craft and design, knowledge can flow and integrate through the interaction between experts, leading to the generation of new knowledge.

Temeltas (2017: 13-14) identifies "there are three major ways in which the crafts contribution to innovation is realized: the knowledge of the craftsman was transferred, the craftsman-designer led a process together, or craftsman becomes the person who provides the inspiration for the innovation through crafts knowledge." Craft knowledge is "learned throughout experience" (Ray, 2009) and "transferred through action" (Polanyi, 1967; Schön, 1983). To facilitate such knowledge transfer, Brown and Duguid (1998) propose three methods for integrating knowledge across different expert communities: "Translation (carried out by people with knowledge of different domains), knowledge brokering (carried out by those who participate in the practices of several communities), and boundary objects (objects of common interest, e.g., contacts, blueprints, techniques, technologies, etc.)" (Duguid, 1998: 103-104). The use of boundary objects can be seen as a foundation for both knowledge translation and knowledge brokering (Niedderer et al., 2011: 7-8). Boundary objects provide a crucial perspective for this study, which will be explored in detail in section 3.4.

3.4 Boundary Objects

One of the concepts that has been used to study collaboration between different fields is the use of boundary object in collaborative projects, which was originally proposed by Star and Griesemer (1989), is “an object that lives in multiple social worlds and which has different identities in each”, also a “practical artefact” that can represent both the knowledge of the respective field and the knowledge shared between fields (Sapsed & Salter, 2004; Star & Griesemer, 1989; Suib et al., 2020:116). It is considered to have an important role in the study of collaboration between different fields (Lee, 2007; Nicolini et al., 2012).

This concept was introduced during the data review process of this research to provide an analytical framework for examining the knowledge flow in the collaborative practices process. This section introduces the concept of boundary objects and explores their various forms and functions. By discussing how these objects operate in collaborative environments, acting as bridges to facilitate communication and knowledge transfer between different fields, their importance in cross-disciplinary research is explained.

Building on the definition of boundary objects, this section further explores their specific roles in facilitating collaboration. By examining how boundary objects translate tacit knowledge, enhance mutual understanding, and support the co-creation of new knowledge, it demonstrates how boundary objects, through their intermediary role, help translate and integrate cross-disciplinary knowledge.

Finally, the discussion extends to the expanded concepts of boundary objects, including Carlile’s (2002; 2004) concepts of semantic, syntactic, and pragmatic boundary objects; Halpern’s (2012) definitions of existing, established, and appropriated boundary objects; Nicolini et al.'s (2012) exploration of the dynamic concept of boundary objects; and Dalsgaard et al.'s (2014) discussion of boundary zones and emerging boundary objects. The introduction of these key concepts will provide the theoretical foundation for the integrative analytical framework created in Chapter 4 based on these concepts and support the analysis of knowledge flow in collaborative practice processes discussed in Chapter 5.

3.4.1 The use of Boundary Objects in collaboration

In the context of collaborative projects, boundary objects are used primarily as a translation medium for the transfer of knowledge. Its main role is to carry information and narrative context to enable the conversion, translation and transfer of knowledge between different groups (Phelps and Reddy, 2009:125; Ackerman, 2000).

There is a wide variety of objects that can serve as boundary objects, ranging from databases or standardised formats such as tables and workflows (Carlile, 2002; Star & Griesemer, 1989), to physical and information technology objects such as prototypes and sketches (Bechky, 2003; Carlile, 2002; Pawlowski & Robey, 2004), as well as more abstract objects such as metaphors (Koskinen, 2005), narratives (Bartel & Garud, 2003; Boland & Tenkasi, 1995) or processes and methods (Swan et al., 2007). (Bowker & Star, 2000; Nicolini, D. et al., 2012:13) “Fundamentally, boundary objects are things that generate action towards and with other entities” (Star, 2010; Scoles, 2018: 274).

Boundary objects, as a 'powerful concept' (Scoles, 2008: 274) for explaining the role of objects in interdisciplinary collaboration, since their introduction by Star and Griesemer (1989), have been developed and utilised by researchers in a wide range of fields over the past 30 years. As a concept originating from the field of science studies (Nicolini et al., 2012: 7), it emphasises the ability of certain types of artefacts that can support collaboration between different professional groups by acting as 'boundary objects' (Carlile, 2002, 2004; Carlile & Rebentisch, 2003; Star, 2010; Levina & Vaast, 2005; Star & Griesemer, 1989). The concept of ‘Boundary objects’ have been used to explain the process of collaboration and how it has aided the flow of knowledge in the process of collaboration.

3.4.2 Role of Boundary Objects in Collaboration

Dormer (1997:151) argues that “Objects communicate to some people as powerfully as written texts or musical scores or mathematical equations do for others.” In practices related to fields such as craft and design, which are closely related to objects, it is clear that objects help to carry and represent a great deal of tacit knowledge for

practitioners, who can more easily communicate and generate understanding through the observation and description of objects than through verbal communication. Visualisations such as models and sketches are widely used as tools to facilitate communication with peers and even with the self. “The process of ‘making’ aids participants in expressing tacit knowledge and surface assumptions that are often difficult to identify by other means” (Dhaundiyal & Sharma, 2022).

Boundary objects, in such cases, helps to provides the basis for the negotiated transfer of knowledge between fields, through which knowledge across fields boundaries is represented, learned and translated, thus further stimulating the flow of knowledge across different fields (Nicolini et al., 2012; Sapsed & Salter, 2004; Carlile, 2002; Star, 1989; Suib, 2020:116).

Bechky (2003) argue that knowledge is transformed when a person from one field realises "how knowledge from another field fits into the context of his own, enriching and altering what he knows". The term ‘transformation’ here is a process of creating new knowledge based on existing knowledge (Bechky, 2003; Dalsgaard et al., 2014:747; Carlile, 1997). Boundary objects provide an important aid in this process. Bechky‘s research points out that by introducing new knowledge through boundary objects, the collaborating parties are able to access this knowledge from their own practice perspective and see their practice in a new light, thus enhancing their understanding of their own practice.

Marheineke et al. (2016) argue there are three essential characteristics of a boundary object: (1) an artefact, (2) crossing a boundary, and (3) conveying meaning (Iorio & Taylor, 2014; Rosenkranz et al., 2014). Suib's (2020:116) description further extends the characterisation of boundary objects: First, is the capability to represent different knowledge domains. Second, are its aids in learning similarities and differences among domains (e.g., terminology), as well as their dependencies and contradictions, and third, it allows current knowledge to be transformed into something new (or different) through a collective effort (Carlile, 2002; Suib, 2020:116).

The characteristics of the boundary object indicate the 'bridging' role it plays in the collaborative process. This is due to their dual identity in the original field and the

collaborative environment - because of their roots in the original field, based on their meaning in the original field, they are able to shape communication as representatives of the original field's knowledge in the collaborative environment. The flexibility of their interpretation and their malleability with themselves, as well as the fact that the collaborative context does not require 'a deep sharing', allows boundary objects to facilitate the flow of knowledge from different fields in the collaborative context (Nicolini et al., 2012).

As defined by Star and Griesemer (1989: 393), boundary objects often "inhabit several intersecting social worlds and satisfy the information requirements of each of them". “Collaborative action is maintained around the pursuit of a partially shared, partially fragmented, and partially disputed object” (Miettinen & Virkkunen, 2005; Nicolini, D. et al., 2012: 8). For a more effective collaboration, information must cross ideological boundaries (Tushman, 1977). And the translation, delivery, and recording of information between different collaborators (groups) relies on elements that are able to cross boundaries. These elements often take the form of boundary objects (Phelps and Reddy, 2009). Boundary objects are flexible enough to represent different meanings in different fields and contexts. Some parts of their structure are common and recognisable to all people in the collaborative environment, which can therefore be used as a means of translation to communicate with all people in the collaboration project. “It can work as translation operator” (Star and Griesemer, 1989).

Nicolini et al. (2012:614) argues that the concept of a boundary object is considered most suitable to use in the context of the ability to “shed light on how, through an object that resides amid different social worlds, groups cooperate without consensus, tacking ‘back-and-forth between both forms of the object’” (Star, 2010: 605). Boundary objects come with details that are understood by both fields, so that collaborators can use the knowledge without fully understanding them and the context behind them. Boundary objects regulate the limits of using knowledge, limit the need for collaborators to learn across boundaries and allow the researcher to work with partial ignorance (Nicolini et al., 2012:617). Its role, as Star and Griesemer suggest, is to allow people who do not know enough to understand the full context of knowledge and skills to use that knowledge to solve problems.

3.4.3 Dynamics of boundary objects in collaboration processes

The choice of boundary objects in collaboration processes is not always static. Kimble et al.'s (2010) study focuses on the selection of boundary objects for collaboration and suggests that “The selection of boundary objects is more or less technical in nature: a matter of choosing the right boundary object for a particular set of circumstances. Changes in boundary objects occur when the former boundary object is no longer able to sustain the innovation process because of its inability to support a discussion that includes a wider range of competences” (Dalsgaard et al.2014:747).

Whereas Nicolini et al.’s (2012) research has traced the dynamics and transition states of objects during the collaboration process and argues that the role of an object in the collaborative process is not only a property it carries in itself but is given by its interaction and relationship with other objects or people in the process of collaboration. This means that the ‘boundary role’ played by an object, or even the object that plays boundary functions, is not static. In more specific terms, the function and role of a particular object may change during the collaboration process - the same object may recede from the foreground in one phase and then return to a central position in another. “Our findings suggest that same object may change role and status over time, moving across the cells in the table” (Nicolini et al., 2012: 37). “We can propose that collaboration objects follow a trajectory or have a career (Engeström & Blackler 2005); not unlike actors on a stage, they perform certain functions (as epistemic or boundary objects, for example) and then disappear behind the scenes until the plot requires them to resume center stage. Such a trajectory can unfold either at the local project level or on a grander scale” (Nicolini et al., 2012: 37-38).

However, this is relative to the perspectives of different participants - the same role, in the eyes of one participant, can undergo changes at different moments, and the same item can simultaneously play different roles in the eyes of different participants. Its position in the collaboration and the issues it deals with determine its function; the boundary object itself and the role it plays are dynamic as the collaboration process develops (Nicolini et al., 2012). As Levina and Vaast (2005) argue, “whether objects perform boundary (or other) functions cannot always be anticipated as objects become scaffolds for cross-disciplinary collaboration within a specific context of use.” “The

‘career’ of objects may not look like an orderly trajectory as much as a messy, iterative journey” (Nicolini et al., 2012: 41). Diverse perspectives are fundamental to understanding the role and function of boundary objects in collaboration, 'the explanatory power of a theory is weakened when all objects become boundary objects.' (Nicolini et al., 2012: 4).

3.4.4 Derivative concepts of boundary objects

Semantic, Syntactic and Pragmatic Boundary Objects

With the increasing development of the internet, and especially under the influence of COVID-19 during the past few years, collaborative environments are no longer limited to face-to-face communication; collaborations based on long-distance environments are starting to become more interesting to researchers.

The long-distance collaborative environment on which the collaborative practice in this research is based is referred to as distributed collaboration by Candy (2020). Distributed collaboration is considered a method of remote collaboration that allows partners to engage within a common field while being in different locations and potentially having different goals (John-Steiner, 2006; Simon, 1996; Candy, 2020). Marheineke et al. (2016) expanded this concept and referred to a specific type of distributed collaboration as “virtual collaboration”, which they describe as a kind of virtual community (VCs), a way of interacting with each other by connecting individuals who voluntarily collaborate with each other through electronic means. This is consistent with the collaborative environment on which the two collaborative projects in this program of research are based.

Further discussion on distributed collaboration and virtual collaboration will be provided in section 4.2.1. Here, the focus is on several derivative concepts of boundary objects involved in Marheineke et al.'s (2016) discussion of virtual collaboration called: Semantic, Syntactic, and Pragmatic Boundary Objects.

Marheineke et al.'s (2016) study involves the extended concept of boundary objects by Carlile (2002, 2004). He categorised boundaries according to increasing complexity

of boundary information, incorporating semantic, syntactic and pragmatic boundary objects into the concept of boundary objects. (See glossary 2 for further definitions of Semantic, Syntactic and Pragmatic Boundary Objects.)

Existing, Built and Appropriated Boundary Objects

In a collaborative project, different types of boundary objects often work together. In Halpern's (2012) study, by observing the collaboration process, he identified three types of boundary objects: existing, constructed, and appropriated. Halpern's study notes that existing boundary objects are artefacts or abstract items that participants bring into the collaborative environment. These can be part of their existing work and are introduced into the project to express concepts and ideas. Constructed objects are temporarily created during the collaborative process between the two participants to inform each other. Appropriated objects are created based on fragments of existing objects, which have specific meanings in their own contexts but are given new meanings in the collaborative environment (Halpern, 2012).

Boundary Zones and Emergent Boundary Objects

Dalsgaard et al. (2014) continued the study by Nicolini et al. (2012) on the dynamics of boundary objects in collaboration, focusing on the dynamic changes of boundary objects in the 'research through design' (Zimmerman et al., 2007) process. Their study covered derivative concepts related to boundary objects, including 'Boundary Zones' and 'Emerging Boundary Objects' (See glossary 3 for further definitions of Boundary Zones and Emergent Boundary Objects). “Our intent is furthermore to shift attention from how the use of objects organises activities towards a reciprocal understanding of how design activities shape and form objects and are in return affected by these objects” (Dalsgaard et al., 2014：746).

These concepts focus on the design collaboration that revolves around 'unstable design concepts' (Dalsgaard et al. 2014: 748). They are concerned with situations where 'boundary objects' themselves do not undergo substantial changes during the design process, but are interpreted, translated, or further evolved into new boundary objects by different practice groups. These concepts emphasise the 'dynamic

characteristics' of working objects (such as design concepts), rather than ‘the tools that mediate work on this object.' (Dalsgaard et al. 2014: 748; Kimble et al., 2010; Lee, 2007).

In this research, the concept of *boundary zones* is used to describe the spaces (collaborative environment) where knowledge flow occurs during collaborative practice, while the concept of *emerging boundary objects* provides a perspective for tracking the development of concepts related to cross-disciplinary jewellery creation. Both concepts will be utilised in Chapter 5 for the analysis of the collaborative practice process.

Chapter 4 Methodology

4.1 Introduction and features of this research

4.1.1 Introduction

This research is grounded in practice and structured around a collaborative practice project. As McNiff (2012:29) highlights, contrary to the common trend in the humanities of fitting questions into predetermined research methods, art-based researchers embrace the fluidity of working with questions and devising tailored methods for distinct scenarios. An analysis and discussion on the creation and theoretical underpinnings of this creative methodology are conducted in this chapter.

The aim of this research is to establish a definition for a to date poorly defined category of jewellery called ‘Cross-disciplinary Jewellery’ within the broad framework of contemporary jewellery studio outcomes. To support this aim, this research follows a craft-thinking methodology, which functions not only as a method of practice but also as an epistemological framework that structures the entire research process. Rather than being limited to the research-through-making phase of the research, the craft thinking methodology includes bracketed moments of theoretical development and analytical work.

This research engages with conceptual analysis as a method to construct a heuristic definition for cross-disciplinary jewellery. Conceptual analysis offers a structured approach for clarifying underdeveloped concepts in order to advance both theory and practice (Väänänen & Pöllänen, 2020; Bonis, 2013; Nuopponen, 2010b; Walker & Avant, 1995).

In this research, the method follows a three-step process: the first stage involves generation of candidate criteria through a series of case studies, the second is a practice-based investigation through collaborative projects, and the third is a synthesis that integrates insights from both theoretical and practical work. These three stages are fully embedded within the broader logic of the craft-thinking methodology, and a more detailed discussion of how conceptual analysis engages in this context is provided in Chapter 2.

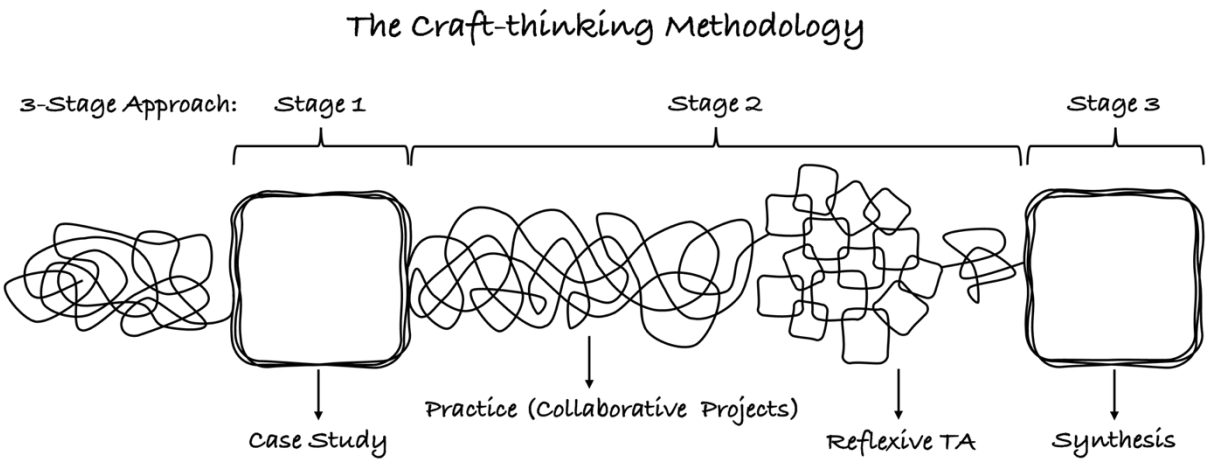


Figure 4-1: Visualisation of the Craft-thinking Methodology

Figure 4-1 offers a visual summary of this methodological structure. It presents the research as a non-linear and entangled process, characterised by a reflective, iterative and generative dynamic. The tangled line represents the lived experience of the research - marked by uncertainty, openness, and constant feedback.

Within this entangled trajectory, moments of clarity and structure emerge. The case study is the first of these structured moments, corresponding to the first stage of conceptual analysis. This is followed by a more exploratory and dynamic practice phase, and then a stage of reflexive thematic analysis, visualised through tangled geometric forms that suggest the gradual formation of analytical structure from within complexity. Finally, the synthesis phase appears as a clear and structured form, representing the third stage of conceptual analysis.

This diagram provides a point of entry into the logic of the craft-thinking methodology and highlights the interplay between craft-thinking and conceptual analysis in this research. The following sections will discuss the theoretical foundations and practical applications of the craft-thinking methodology.

To view the 3-phase approach in more detail: the first part focuses on identifying and analysing existing examples and cases in order to identify potential features of cross-disciplinary jewellery (Chapter 2). This corresponds to the first stage of the conceptual analysis: a theoretical exploration based on literature and case review.

The second phase is centred around two collaborative practice projects, which serve as the foundation for exploring how cross-disciplinary jewellery is produced in collaborative environments. This practice-based investigation enables the testing, refinement, and expansion of the initial definition and forms the second stage of conceptual analysis. It also supports the identification of new features and contributes to understanding the knowledge flow involved in collaborative process (see Chapter 5).

Following these two stages, the research proceeds to a third phase, which integrates insights gained from both theoretical and practice work to construct a more informed definition of cross-disciplinary jewellery (see Chapter 6), which constitutes the final stage of the conceptual analysis process.

4.1.2 Features of this research

1. A process-focused framework

The ultimate design outcomes of the collaborative practice projects hold less significance compared to the process for this thesis. The examination of the project's creative processes and the knowledge exchanged through mutual feedback are central to shaping the heuristic definition of cross-disciplinary jewellery. Therefore, for this thesis, the focus on data generated from the practice process outweighs the attention given to the final outcomes of the practice.

2. Craft Thinking in Collaborative Development

The development of the collaborative projects follows the working pattern of craft practitioners – the approach is generative and naturally extends, develops and emerges alongside the project's progression and the intersection of ideas between the collaborators.

The 'Data-Music-Jewellery' project, which is the primary focus of this thesis, was initiated without setting very explicit goals. The project is exploratory and focuses on the collaborative process. It is intended to observe whether and in what form cross-disciplinary jewellery might be created through a naturally evolving collaborative process. The openness to all possibilities of the process is to hope that the goal

emerges naturally through exploring the collaborative process. The inclusiveness of outcomes inevitably means that goals evolve dynamically as the process develops. This signifies a process-led approach rather than one driven by problems or results.

The collaboration process diverges from a rigid and formulaic process, embodying a distinctive quality that emphasises the process of thinking through collaboration and reflection. This craft thinking mode also extended to the whole methodology of this research and will be discussed in section 4.3.

3. Practice before theory

In the establishment of this research, the collaborative projects were developed prior to the overall research methodology. This means that the research perspective was not considered in the initial establishment of the collaborative projects. There was no theoretical intervention at the time the projects were set up. Literature reading related to the methodological theory development took place alongside the development of practice process, implying an intrinsic relationship where the development of theory was grounded in the practice process and the development of theory and practice proceeded in parallel. The establishment of the methodology related to data analysis began after the practice had been almost completed (The nature of this approach is rooted in craft thinking and will be discussed in more detail in Section 4.3.2).

4. Interweaving of Practice and Analysis

In this research, the practice (which also serves as the data collection phase) and data analysis are sequentially arranged in the overall scheme, but also interwoven at certain points (this is also demonstrated in the discussion of the practice project workflow in the next chapter, section 5.2, and in figure 5.2-3.). As the two practice projects at the heart of this research were collaborative, conducting research through collaboration provides the primary framework for research. Additionally, conducting research through reflection (both in and on action) is also a vital part of the methodological approach in the practice component of this research - the two collaborators provided feedback on each other's actions, which was documented in various ways (this includes online meeting records and its transcripts, process and reflection journals creates during the practice process, among others). Thus, the process and outcomes of reflection not only serve as creative force of the projects

(reflection-in-action) but also comprise a crucial component of the research data. They provide a basis for the next steps of both collaborators during the project and contribute to the data analysis after the project finishes (reflection-on-action).

5. Insider and outsider - Dynamic roles shifting

The research can also be understood through the lens of design anthropology, encompassing both the practice analysis phases. The researcher experiences a tension in the roles throughout the research process during this research. Acker (2001) suggests that pinpointing our position as researchers is becoming more complex, which questions our capacity to discern whether we are insiders, outsiders, or at a midpoint between the two. The researcher's transitional role might even be viewed as another identity that presents a challenge to self-awareness (Kanuha, 2000). Such tension between different identities has also been experienced in this research - I played multiple roles in the project, constantly navigating between insider (practical) and outsider (research) perspectives. During the practice phase, I participated as a collaborator, striving to bracket the research perspective to allow creative freedom as much as possible. The aim of immersing myself as a practitioner was to let the practice flow in an organic and natural state, unrestricted by any theoretical or research-driven perspectives. Subsequently, a retrospective analysis of the collaborative process and data from a research standpoint allowed themes to emerge, providing a foundation for the analytical outcomes. This approach of openness to experience ensured the primacy of the collaborative process, free from preconceived notions. It also facilitated the flow of knowledge across disciplines, ensuring the authenticity of the observed collaborative processes and knowledge transfer.

6. Narrative Perspective in writing - Shifts between first-person and third-person perspectives

In the research framework conducted for this research, the overall approach is reflexive while the post-practice data analysis phase is reflective. The openness of the research framework, as well as the tension in the researcher's role, influenced the linguistic pattern adopted in this thesis. The first-person and third-person perspectives are blended to demonstrate the dynamic shifts between the insider and outsider viewpoints that the researcher navigates. Even when analysing the data, the

researcher is immersed (as when a craftsperson is immersed with a material), meaning that sometimes the practitioner's perspective is adopted to retrospectively understand how action unfolded. Therefore, throughout the data review, the perspectives of the practitioner and the researcher alternately appear and evolve dynamically. Consequently, the first-person perspective is employed when describing the actual collaboration process. This approach helps to showcase the dynamic shifts between the research and practice perspectives throughout the analysis process, bringing the argument more ‘alive’.

7. Datasets selection

Although this research was designed and conducted through two collaborative projects – 'Data-Music-Jewellery' and 'Viral Making', data collection was carried out for both. However, in the actual data analysis phase, this thesis focuses on analysing the dataset collected from the “Data-Music-Jewellery” project. While the Viral Making project was not included as a formal dataset for analysis, journals from Viral Making were referenced in the analysis to illustrate the development of data collection methods and the exchange of design insights, but the dataset itself was not systematically analysed. The specific reasons for this decision are explained fully in Section 5.1.

4.2 Research through collaboration

Since this research is based on collaborative practice, the 'Research through collaboration' approach is an essential component. Additionally, influenced by geographical distances and the pandemic, both collaborative practices in this research were conducted remotely, with regular online meetings to maintain communication and advance the projects. This points to a specific mode of collaboration called distributed collaboration.

4.2.1 A distributed collaboration

According to Candy (2020), distributed collaboration is a method of remote collaboration that allows collaborators to connect within a shared field, although they are from different locations and may have different objectives (John-Steiner, 2006;

Simon, 1996; Candy, 2020). The advantage of this method is that it increases the opportunity for participants to share, while allowing them to maintain their unique contributions, regardless of their physical location. Distributed collaboration enables participants to access diverse ways of thinking and enhances their understanding of their own research.

Marheineke et.al. (2016) introduced a specific concept of distributed collaboration called 'virtual collaboration' - described as a virtual community representing an interactive approach where individuals willing to collaborate are connected electronically. Their study focuses on boundary objects in remote collaboration based on online methods. They argue that virtual collaboration occurs among individuals or communities that are virtually connected but geographically dispersed (Hardy et al., 2005; Gibson & Gibbs, 2006), and it necessitates the purposeful use of boundary objects (Leimeister et al., 2004; Marheineke et al., 2016:1108). Their research aligns with the collaborative environment upon which this study is based, and the theoretical framework used in subsequent analyses.

Both collaborative projects involved in this research were developed within a distributed collaborative environment. My collaborators and I maintained communication through online meetings while working long distances apart, kept independent creative processes in some steps, and shared our respective outcomes online, providing mutual feedback and advancing the project through this method. Distributed collaboration, as the foundation upon which the projects was established, permeates the entire collaborative projects.

The *'Data-Music-Jewellery'* project (https://daviddongdingjewellery.squarespace.com/arabesque-no-1) was developed and established through a distributed collaborative environment. Rebecca, a professor and visual artist based at Syracuse University in the United States, and I met during the 2020 Tongji University summer program 'Shanghai Space Installation and Material Exploration International Exhibition 2020', where Rebecca presented a lecture titled *'Experiments and Practice: from Information Design to Data Arts'*. Due to her extensive involvement in collaborative projects, I contacted her to have a one-to-one discussion after her lecture. During our conversation, we explored data visualisation and our

respective design fields. This discussion sparked the idea of visualising the same design element in different forms through jewellery and digital design, thereby establishing our collaborative project. This aligns with Candy's (2020) description of distributed collaboration, often beginning with temporary collaboration, possibly initiated by simple idea sharing or technical exchanges among like-minded individuals at formal or informal gatherings, which may gradually evolve into long-term stable collaborations.

The first part of the *'Data-Music-Jewellery'* project was conducted in a typical distributed collaboration manner, aligning with Candy's (2020) characterisation of distributed collaboration where participants can independently create their research and connect online to share content. Rebecca and I independently developed our respective design processes, each using the same musical piece as a design element, transforming it into different forms of artwork. During the first phase of practice, the independent design process involved us communicating our progress and providing mutual feedback through regular online meetings via the Zoom platform. The process of mutual feedback not only advanced the development of each individual design process during the first phase but also accumulated potential concepts for the second (co-creation) phase of the project. The second phase of the project continued within a distributed collaboration environment, where we selected concepts created during the first phase and took them further. This process was still carried out within the distributed collaboration environment through online meetings. Detailed descriptions of the process can be found in section 5.3.

In the other collaborative project *'Viral Making'* (see: https://daviddongdingjewellery.squarespace.com/viral-making), a similar distributed collaboration model was also employed. The collaborator, Jo, is a PhD candidate in the Architecture Department at the University of Queensland, Australia. The first part of the model exchange cycle was conducted using a distributed collaboration approach, where Jo and I exchanged models, each developing them further based on our distinct professional knowledge and then sharing feedback through the internet. The second part continued in a distributed collaboration environment, not only utilising online meetings but also employing a virtual reality platform called Fologram (see: https://fologram.com/), which allows for remote interaction. Together, we developed

the same model to create a new one. During this process, the detailed focus of jewellery design and the structural form focus of architectural design dynamically interacted within the distributed collaboration environment, facilitating the creation of new models and the construction of new knowledge.

As I chose to use only the dataset from the *'Data-Music-Jewellery'* project for discussion (see section 5.1), the development process and outcome of the *'Viral Making'* project are not discussed in detail here, but can be found in appendices 4, 5, 6 and 7.

The process of collaboration also includes the steps of 'contemplate, appraise, evaluate, reassess and revise' (Candy, 2020:128), similar to those found in individual creative work. This process highlights a reflective characteristic rooted in craft thinking. Creative research conducted collaboratively provides researchers with additional opportunities for reflection through dialogues originating from different collaborators. Thus, conducting research through reflection is an essential part of research conducted through collaboration, as well as a significant component of this research methodology, which will be discussed in detail in the next section 4.3.

4.3 A craft thinking methodology

As a mature artist, I have always worked in the capacity of a practitioner before stepping into the PhD journey, which has kept the researcher’s comprehension of 'research' anchored within studio work and personal practice. Upon transitioning to a PhD researcher role, due to unfamiliarity with research paradigms outside of those related to ‘studio practice-related' and involving a completely different mode of thinking, it was challenging to apply the conventional research methods and models typically utilised in research. From the beginning of the study, an effort was made to construct the research framework rooted in the 'craft thinking' familiar to the researcher. In the process of developing the research methodology, it was discovered that craft methodology, centred around craft thinking, while not widely used in research, is not an anomaly. Contemporary practice has begun to pay attention to craftsmanship as a result of new reflections within the field and understandings obtained from discussions outside the field (de Waal, 2006). Scholars such as Kettley (2007) and Zamora

Barroso (2019) in their PhD research have adopted and discussed methodologies built on craft thinking. Craft has increasingly been recognised as a serious discipline with the potential to inform new practices (Kettley 2005a, 2005b; Luscombe, 2017), “going beyond the common conceptions of craft as a thing well done, and even beyond its relationship with material to open up craft as a process with particular underlying philosophies” (Kettley, 2007:81).

In this research, the most significant characteristic of the methodology that follows craft thinking is its encouragement of interactive exploration, akin to how craft practice involves exploring the properties and applications of materials through interaction with them. Craft thinking, as both research philosophy and methodology, is comfortable with emergence through interaction, through attunement with a specific situation at hand. Such methodology in this research follows a non-linear approach to explore the research methods and topics at any point in the research process. The theoretical foundation and specific applications of this approach will be detailed in this section.

4.3.1 Craft thinking

Schön argues that reflection in action enables practitioners to become researchers, who can then develop new theories from unique cases. This points to the potential for methodologies following craft thinking to extend from the realm of practice to the realm of research. When the identity of craft practitioner transitions to craft researcher, the uniqueness of craft thinking may incorporate into the research perspective, which allows the practice-based research to conduct a “non-linear” knowledge production pattern that generates 'data' through prolonged practice rather than posing questions first and then seeking answers through experimental data.

Compared to results-oriented research methodologies, craft thinking places greater emphasis on the research process itself. Craft is "exploratory, and creates meaning through action" (Kettley, 2007:81). Therefore, the craft-thinking methodology values practice, exploration, and learning throughout the process, rather than focusing on a single, predetermined outcome. The creative process related to craft is never a solitary activity; it is a composite process surrounded by activities such as engagement with bodies of literature, experimentation with materials and techniques, and interaction

with peers and publics. Reflective practice methods provide a unique 'insider view' for unpacking the creative process, and materials that document the changes in an artist's thinking, such as reflective journals and recorded dialogues between artists, can offer a way to gain insight into this reflective process.

When Muller (2011) described the impact of reflective process on his research, he said: "Reflective practice allowed me to integrate the results of these experiments into a holistic cycle of reflection, theoretical development, and practical innovation [...] The result is a series of new discoveries." This indicates how reflective practice can explain how practitioners generate new knowledge in their daily work (Candy, 2020:242; Muller, 2011).

The reflective mode in practice provides opportunities to record intuition and responses, turning one into a researcher within the practice context. In a practice-based research process, research and practice are interconnected, and the cycle of creation, reflection, investigation, and evaluation is periodic and often tightly iterative. This includes all practice processes, along with associated documentation and reflection. Observation, recording, and practice are used as parts of the methodology to achieve a deeper understanding of the entire research process. Reflection within the practice research process can provide practitioners with rich material about practice research; when research in practice and practice in research are combined, this lays a foundation for individual and collaborative exploration and experimentation.

In this research, each online meeting during the practice process is a part of the self-reflective process. Through exchanges and reporting on the previous phase of work with collaborators, this process of communication provides an opportunity for self-reflection on the work completed. Whether it is the preparation of materials for reporting or the mutual feedback process during the meeting on the work completed so far, both are reflective of the completed work. The preparation of materials involves self-reflection on the completed work, which could trigger new thoughts about the work. The mutual feedback process based on online meetings is an opportunity for self-reflection on completed work using the perspectives of collaborators. Based on this immediate reflection and feedback, it often influences the subsequent practice process.

Candy (2020:241) considers the process journals written in real-time to be rich first-person materials. The process journals and diaries mentioned here refer to the creative processes and thoughts that artists record in real-time during their creative work. Such materials not only capture the process and details of practical activities but also provide a sense of immediacy. Although often fragmented and partial, possibly consisting only of brief phrases, sentences, bullet points, or simple sketches, they offer irreplaceable rich material for retrospectively reviewing the practice process from a research perspective.

This also responds to the approach adopted in the 'Viral Making' project and the early stages of the 'Data-Music-Jewellery' project, where process journals and reflection journals were used as methods for documenting the creative process. Although in the 'Data-Music-Jewellery' project this method was later replaced by online meetings, these meetings still included these fragmented process recordings, which can be seen as another form of 'process journal'. Compared to traditional process journals, this method introduces dynamic interactions with collaborators (another perspective), enriching the reflective process and perspectives, which also corresponds to Candy's (2020:3) understanding that 'external factors can trigger reflection', suggesting that external influences often become opportunities for reflection that change the form and progress of the work. This aligns with the development of concepts in the 'Data-Music-Jewellery' project based on mutual feedback processes (in which comments on completed work by collaborators and discussions between collaborators on potential concepts and future directions can be considered as 'external factors'). The iterative development of concepts and the construction of potential new knowledge guided by feedback from collaborators (external factors) are the results of 'reflection-in-action' based on external influences. Specific methods for data collection and recording will be detailed and analysed in section 4.5.1.

In addition to the immediate recording of the practice process, another form of reflection discussed in the literature involves reflective materials organised at the end of the creative process or during breaks. These reflective materials, due to the time lag and retrospective nature, may deviate from the immediate records but often capture details and tacit knowledge that are otherwise overlooked. Combining

reflective materials with immediate process journals provides researchers of creative practice with signposts into creative thinking.

This post-reflective process also aligns with my analytical perspective in this research and thesis writing - reviewing the practice process with a time lag through meeting recordings to uncover hidden details, thereby identifying potential themes and noteworthy points. This also provides a further explanation for the dynamic shifts between the first-person and third-person perspectives in the writing language of this thesis, as discussed in section 4.1.2.

4.3.2 Craft thinking in research

Craft-related creation often points to an uncertain process characterised by exploratory qualities, where even the artists themselves cannot determine the outcome of the work before it is completed. (Kuh, 1962) “Craft practitioners are used to experiencing stretches of time when goals seem to disappear and are accustomed to operating on trust during these exploratory periods. This often goes unquestioned by the maker, but can unfortunately appear to other disciplines as a dangerously unfocused way of working, resulting in what appears to all intents and purposes an unacceptable level of post-rationalisation" (Kettley, 2007:209).

Risatti (2007) proposes that craftsmanship is an act imbued with profound creativity. (See discussion in Chapter 3, Section 3.3) In actions related to craft, conceptualisation and execution are no longer segmented but merged into one seamless process, where thinking and making, visualising and executing, theory and practice are interwoven and advance together. When ideas lead to the manipulation of materials, and materials in turn constrain ideas, a true dialectical and dialogic process occurs. It is this interplay of constraints and modifications during the making process that forms the core of the creative act in craftsmanship (Risatti, 2007:169). This creative process, involving continuous modifications during action, also responds to Pye’s (1968) discussion of the 'workmanship of risk' (also Luscombe, 2017, as well as the discussion in Chapter 3, Section 3.3) – this method, rooted in uncertainty and continual adjustments during the process, is inherent in craft thinking.

This habit of 'working with risk' among crafts practitioners has also been discussed by Candy (2020:7), who states, "It becomes clear that setting out with well-defined fixed intentions is not the most rewarding or fruitful way to proceed. Instead, being open to the creation of forms that emerge unexpectedly, combined with an ability to select from those forms and go on to make a work, seems to represent the essence of the creative process."

This open attitude towards 'unexpected' outcomes provides opportunities for new thinking patterns stimulated by challenges, unforeseen discoveries and happy accidents, thereby relieving the original (pre-settled) questions and intentions that may limit the practice. This is why, in the practical process of this research, I did not set any specific questions for myself or my collaborator in the early stages of the collaboration projects, or even throughout the process. I chose to give both participants complete creative freedom during the project, allowing us to immerse ourselves in the development and making process, making decisions based on situations “in relation to the matter in hand” (Bourdieu, 1990:90). This mode of “advancing the project based on feelings and intuition” (Winter, 1998) is rooted in craft thinking. In this process, knowledge based on practice is created, fostering a strong 'reflection-in-action-in-the-moment' model (Candy, 2020:244).

This paradigm not only reflects an open attitude towards practice but also implies that the craft research paradigm can be dynamic. Research paradigms and methods are re-evaluated based on reflection in action (Creswell, 1998; McNiff and Whitehead, 2011), but this also brings certain difficulties to the construction of the overall structure of the research and the writing of the thesis. The influence of this epistemological paradigm adopted in this research, which encourages interactive exploration at any stage of the research process, is evident throughout the research process. It is necessary to revisit various theories by continuous reading of literature and request extensive redrafting of the literature review and methodology sections.

4.4 Data analysis method - Reflexive Thematic Analysis

As the practical projects progressed, the exploration of theories became tightly integrated with practice. Various theories and methods were introduced and tried out

through interaction with ongoing practice and the data already collected. This interactive dialogue between theory and practice data peaked after the practical projects were nearly completed. At this point, the researcher was conducting a preliminary review of the collected data (most of which had been gathered), attempting to identify potential themes for analysis.

This interaction between data and theory ultimately evolved into the data analysis process employing reflexive Thematic Analysis (reflexive TA). This data analysis process involved seven rounds of reviewing the raw data, with detailed descriptions of these seven rounds provided in Section 4.5.3. This section will refer to these rounds of data analysis (including brief descriptions of them) and discuss why reflexive TA was chosen as the data analysis method for this research, based on its theoretical foundations.

Thematic Analysis (TA) is a widely used analytical method that has been significantly detailed and popularised by Braun and Clarke (2006). At that time, they described TA as “a poorly demarcated and rarely acknowledged, yet widely used qualitative analytic method” (Braun and Clarke, 2006:77). After more than a decade of development, they observed that TA comprises many different approaches, yet these variations were often obscured by the common name "TA" (Braun and Clarke, 2018:3). Consequently, Braun and Clarke (2016; 2018; 2019) clarified TA again as an approach to analysis. They consider the distinctive features of three “schools” of TA, which they refer to as “coding reliability,” “codebook,” and “reflexive TA” (Braun et al., 2018:3; Braun and Clarke, 2019). In this research, reflexive TA is adopted as the method of analysis. Reflexive TA is characterized by its creativity, reflexivity, and subjectivity, emphasizing the active role of the researcher in the knowledge production process, considering “researcher subjectivity as not just valid but a resource” (Gough and Madill, 2012; Braun and Clarke, 2013; Braun and Clarke, 2018:6). The features of the craft thinking methodology followed in this research align well with the emphasis on researcher subjectivity inherent in reflexive TA.

In reflexive TA, themes are the result of extensive analytic work undertaken by researchers to explore and develop an understanding of the patterns of meaning across the entire dataset. Coding is an organic, open, and iterative process where

“Codes – the product of coding – can evolve throughout the coding process” (Braun and Clarke, 2018:6). Reflexive TA offers researchers substantial flexibility, being active and generative. Braun and Clarke envision the TA method as an exploration rather than a prescription (Willig, 2008). The researcher is a storyteller, aiming to provide coherent and persuasive interpretations based on the data. The role of researchers in knowledge production - emphasising the researcher’s subjectivity, the organic and recursive coding process, and the importance of deep reflection and engagement with the data - is central to reflexive TA.

In this research, the characteristic of the craft thinking methodology emphasises the exploratory and interactive nature of the process, with researchers positioned from a unique perspective (see sections 4.1, points 4 and 5). The researcher, as a practitioner, brings a subjective perspective to the data that not only does not undermine objectivity but provides a deeper interpretation from a unique standpoint. This aligns with the importance of the researcher's subjective interpretation of data emphasized in reflexive TA.

This research underwent seven rounds of review of the raw data, where each subsequent round built upon the previous one, allowing for a more detailed interpretation of the data. This process involved the identification and positioning of more "interesting features” (Braun and Clarke, 2018:10) and potential themes, progressively shaping and refining each theme to develop an interpretation of the data and thereby "create a story from the data” (Braun and Clarke, 2018) - in this research, the story or narrative theme is the perspective of boundary objects, the flow of knowledge during collaborative processes, and the creation of cross-disciplinary jewellery. This process, as Braun and Clarke (2018:10) mention, points to a "reflexive and recursive process, rather than a strictly linear one."

TA also offers flexibility in data collection: diaries, visual methods, participatory approaches, surveys, and a wide range of secondary data sources such as online forums, blogs, websites, magazines, newspaper articles, and police reports, among many other methods, are employed in TA research (Braun and Clarke, 2018:8). This aligns with the rich variety of data forms collected in this research – including communications between collaborators, feedback processes, and discussions on

design decisions, as well as all involved drawings, sketches, prototypes, and digital files, along with audiovisual records of meetings and their transcriptions, and the physical or digital artefacts created during the practice process, including a series of physical models, digital models, and images.

Braun and Clarke (2018) suggest that in reflexive TA, the initial process of becoming familiar with the data includes listening to audio data, watching video data, and/or reading and re-reading textual data, while "noticing" interesting features and documenting both individual data items and the entire dataset. During this process, it is necessary to engage with the data in various ways through "immersion": being both engaged and relaxed; noting spontaneously while being thoughtful and curious about what is read. The goal is to identify interesting aspects of the data and the possibilities, connections (between participants, data, and existing literature), and peculiarities that are noticed. This is the approach followed in this research during the data review process, especially in rounds 1.1, 1.2, and 3.1:

- In round 1.1, the transcription process of meeting records also involves making simple comments to record immediate reactions to the data, with the aim of noting interesting findings during the preliminary review of the data.
- In round 1.2, immediate comments on the data were made, and continually posing new questions and added to the data. The purpose of this was to identify more interesting parts of the data and potential themes that could be used for further analysis.
- Round 3.1 involved identifying potential boundary objects in the practice project based on existing literature on boundary objects, attempting to establish connections between the data and the boundary object theories. This process involved immediate commentary on meeting transcripts (documenting individual data items, as Braun and Clarke, 2018) and later summarising the comments and identified boundary objects in table format (documenting the entire dataset, as Braun and Clarke, 2018).

Additionally, Braun and Clarke (2018:11) propose that coding has two broad orientations: one is an inductive approach, where researchers start the analysis process with data, identifying meanings "from the bottom up" without preconceived

ideas; the other is a deductive approach, where researchers approach the data with various ideas, concepts, and theories, even potential codes based on these ideas, and then explore and mark these ideas, concepts, and theories within the dataset. The method used in this research for reviewing data responds to the deductive coding approach, especially in rounds 3.1, 3.2, and 3.3, where the coding for identifying boundary objects is applied. In these three rounds of data review, researchers oscillate between the literature and data, coding and processing data with evolving concepts and theories, identifying and exploring the data.

Overall, using reflexive TA as the analytical method in this research is not only due to its flexibility in data collection, which suits the rich variety of data types in this research, but also because the core feature of reflexive TA, centring on researcher subjectivity, aligns well with the craft thinking methodology framework followed in this research, as well as the unique researcher's perspective. Utilising reflexive TA as the analytical method effectively extends the craft thinking methodology into the data review and analysis process, and the analysis based on researcher subjectivity significantly enriches the interpretation of the data in this research.

4.5 Data collection and review

4.5.1 Data collection and datasets

As previously discussed, although the practice section of this research involves two collaborative projects, only the datasets collected from the 'Data-Music-Jewellery' Projects will be used for analysis. Therefore, the forthcoming discussion on data collection and analysis will focus solely on content related to the 'Data-Music-Jewellery' Projects. The reason for choosing this specific dataset will be discussed in more detail in the next chapter, in section 5.1.

In the 'Data-Music-Jewellery' Project, most of the practical work was carried out by the two collaborators independently. Alongside the practice process, an online meeting-based method was established through the discussion of the two collaborators to collect data without interfering with the actual practice process. This method is qualitative, participatory, and collaborative. The dataset analysed includes all

communications, feedback processes, and discussions about design decisions, as well as all involved drawings, sketches, prototypes, digital files, audio and visual records of meetings and their transcripts.

The table below displays the types of data included in the 'Data-Music-Jewellery' Projects datasets - specifically, Rebecca shared her design process through online meetings, supplemented by screenshots of her design process, forming the original dataset of the visual field. I shared my practice process through the use of digital models, renderings and physical models, forming the original dataset of the craft field. More detailed descriptions and discussion of the data collection method establishment and the data collection process will be provided in the next chapter, in section 5.3.3.

The primary data collected and utilised from the 'Data-Music-Jewellery' project include the online meeting records and transcripts between my collaborator Rebecca and myself. The data set from the 'Data-Music-Jewellery' project can be broadly categorised into two parts. The first part relates to project development, the collaborative process, and academic research. This dataset is the central focus of this research and is further divided into smaller datasets, which will be elaborated upon in subsequent sections.

Data - Music - Jewellery project	
Online Meeting Records	
Online Meeting Transcripts	
David	**Rebecca**
Process Journal	Process Screenshots
Digital Model	Audio Records
Physical Model	
Design Sketches	
Design Making Journal	

Table 4-1: The types of data included in the 'Data-Music-Jewellery' Projects datasets

The second part comprises the informal conversations from our online meetings. Rebecca and I engaged in discussions that somethings extended beyond project-

related topics; hence, almost all meetings contained some segments of casual conversation that not relevant to the project, research or collaboration process. Initially, it was unclear whether these segments would be relevant for analysis, leading to their transcription alongside more pertinent discussions.

However, during the review process, it became apparent that while these informal exchanges might positively impact the relationship between collaborators and the continuity of project development, they did not sufficiently relate to the core focuses of this research. Consequently, this part was not included in the main analysis.

The communication between collaborators represents the most distinctive and relevant data within the 'Data-Music-Jewellery' project. It contains insights into the collaborators' expertise, the design process, design thinking, collaboration methods, and the evolution throughout the project - all of which align with the research objectives. For processing this data, I have selected the meeting transcripts as the primary resource for further analysis.

4.5.2 Online Meeting Transcript - Language and Translation

As Rebecca and I are both native Chinese speakers, we choose to communicate in Chinese during our online meetings, but also accommodate occasional interspersions of English terms due to our backgrounds in living and studying abroad. This linguistic choice not only facilitated clearer understanding and enhanced communication efficiency. For the transcript of the online meeting record, initially, I attempted to use computer software or online tools for automatic transcription. However, the accuracy of these tools was significantly reduced in our mixed-language environment, necessitating manual proofreading of all transcripts.

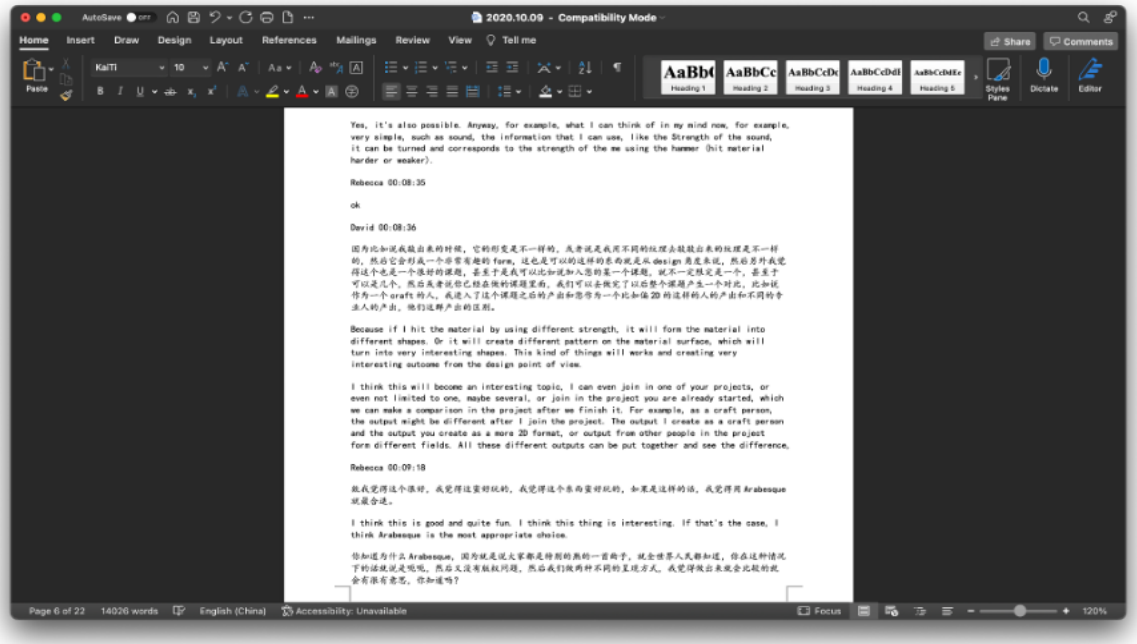


Figure 4.5-1: Example of translated meeting transcription

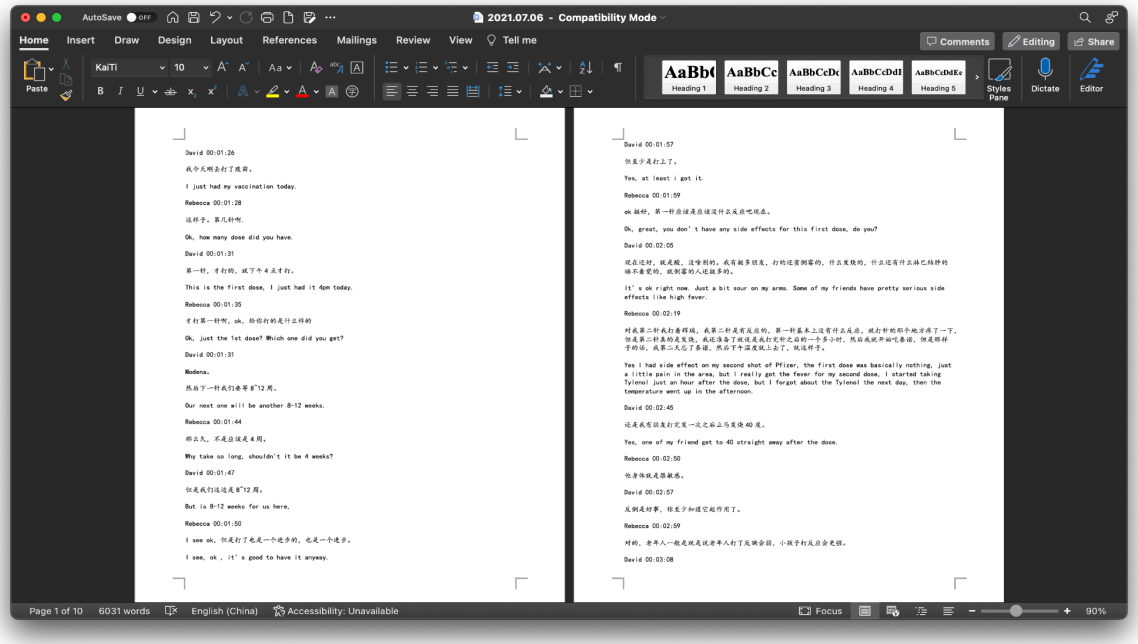


Figure 4.5-2: Example of translate meeting transcription - Chatty parts

In the process of transcribing and translating the online meeting records, the original plan was to translate all the records into English (as shown in figure 4-1 is a partial transcription and translation of the meeting records at the beginning of the first-round data analysis process). However, during the actual transcription and translation

process, it became evident that translating everything word-for-word was impractical. Not only was this approach time-consuming, but it was also unnecessary for several reasons:

1. Content Relevance: A considerable portion of the online meeting records consisted of informal conversation. Although these segments positively influenced the project, they were not the primary focus of the research. The interspersed nature of these casual conversations throughout the meetings meant that academic discussions and informal chats were not easily separable for translation purposes. Moreover, not all content within the project and research discussions was relevant to the research objectives.

2. Linguistic Nuances: The Chinese language features specific words and expressions (e.g., regional idioms, tonal auxiliaries, slang) that do not translate seamlessly into English. Most of these colloquialisms appeared in the informal sections, where we opted for more casual language, rendering word-for-word translation of these parts unnecessary.

3. Purpose of Transcription: The goal of transcribing meeting videos was to transform the content into analysable text and image formats. Reviewing the transcripts to identify points for further analysis meant that only select portions were needed for deeper exploration, obviating the need for full translation.

4. Contextual Understanding: Conducting the original discussions in Chinese and reviewing data in the same language facilitated a clearer understanding of the communication. Translating all data into English at the transcription stage could have led to potential misinterpretations during subsequent analyses:

- ※ Retention of Original Context: Keeping the data in Chinese during the review phases helped preserve the integrity of the original discussions and facilitated a more accurate interpretation.
- ※ Risk of Misinterpretation: Multiple reviews of the material could reveal different understandings, which might be compromised by initial translations

based on a singular interpretation. Retaining the original linguistic context was deemed essential for accurate data utilisation in further analysis.

In conclusion, not all transcripts were translated into English during the data review process. Instead, translation was reserved for when data segments were specifically selected for use for thesis writing to optimizing both the research process.

4.5.3 Data Review and Initial Data Analysis

The theoretical development process of this research employs reflexive thematic analysis through several rounds of reviewing the raw datasets collected from the 'Data-Music-Jewellery' project. This method categorises and processes the data into several smaller datasets. This section describes the process across seven rounds of initial data review (a sample of transcription can be seen in Appendix 12; detailed review materials, such as samples of immediate comments from round 1.1, detailed comments from round 1.2, and thematic coding tables from rounds 2.1 through 3.3, included in Appendices 13-20). Analysis using an integrating boundary object framework based on these seven rounds of data review will be detailed in Chapter 5.

4.5.3.1 Data review round 1.1 - Immediate comments

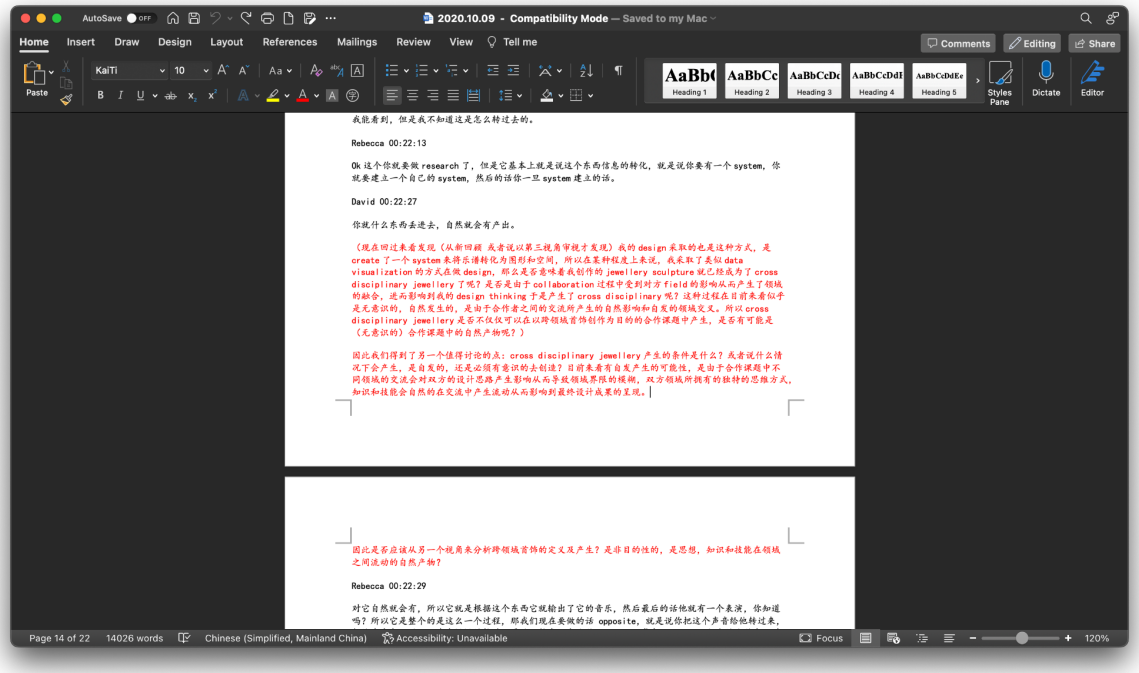


Figure 4.5-3: Example of round 1.1 data review - Immediate comments

The first round of review (round 1.1) occurred concurrently with the transcription process, during which I made simple annotations and comments to capture my immediate reactions to the data. The red sections in Figure 4.5-3 show an example of how the immediate comments are made alongside the data during transcription. This first round of review serves as foundational material for subsequent analysis.

4.5.3.2 Data review round 1.2 - Detailed breakdown and comments of the data

The subsequent review (round 1.2) took place after all meeting recordings were transcribed. This round provided a more detailed breakdown and commentary of the data, partly influenced by the comments and questions raised during round 1.1 data review. The comments from round 1.1 inspired more detailed questions and comments in this round, which led to the identification of additional relevant data during round 1.2 and led to further reflection and discussion. The method used in this round of data review was carried out by using the review function of the Microsoft Word software to add comments to the specific selected data, as shown in Figure 4.5-4 is an example of where comments were added to documents.

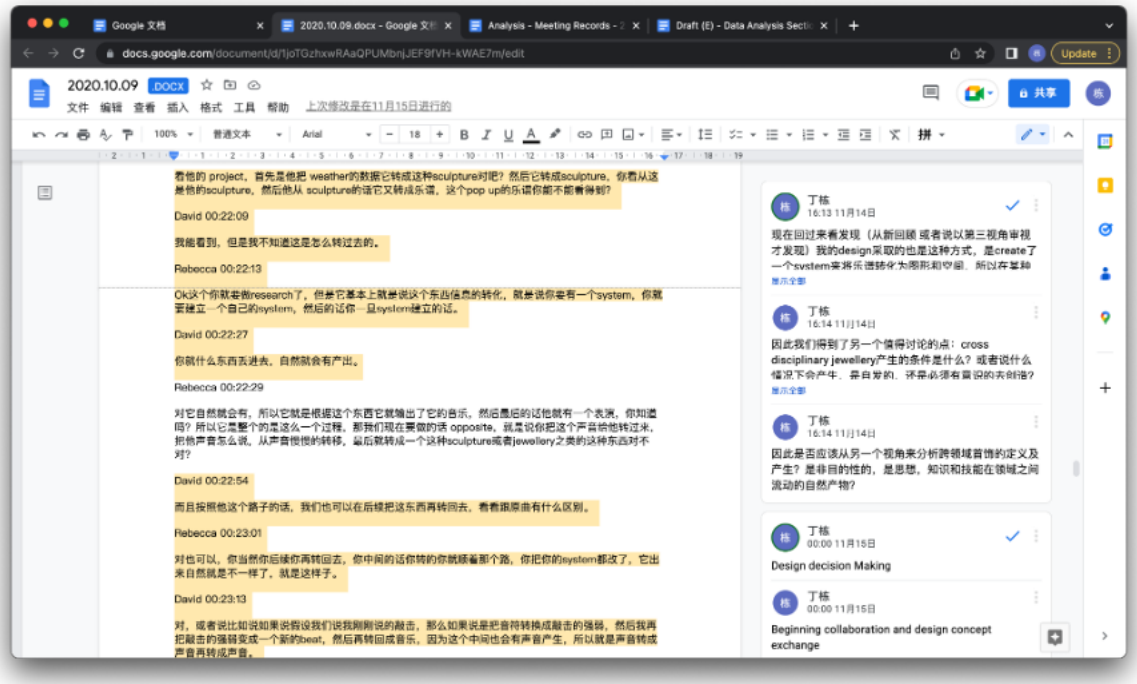
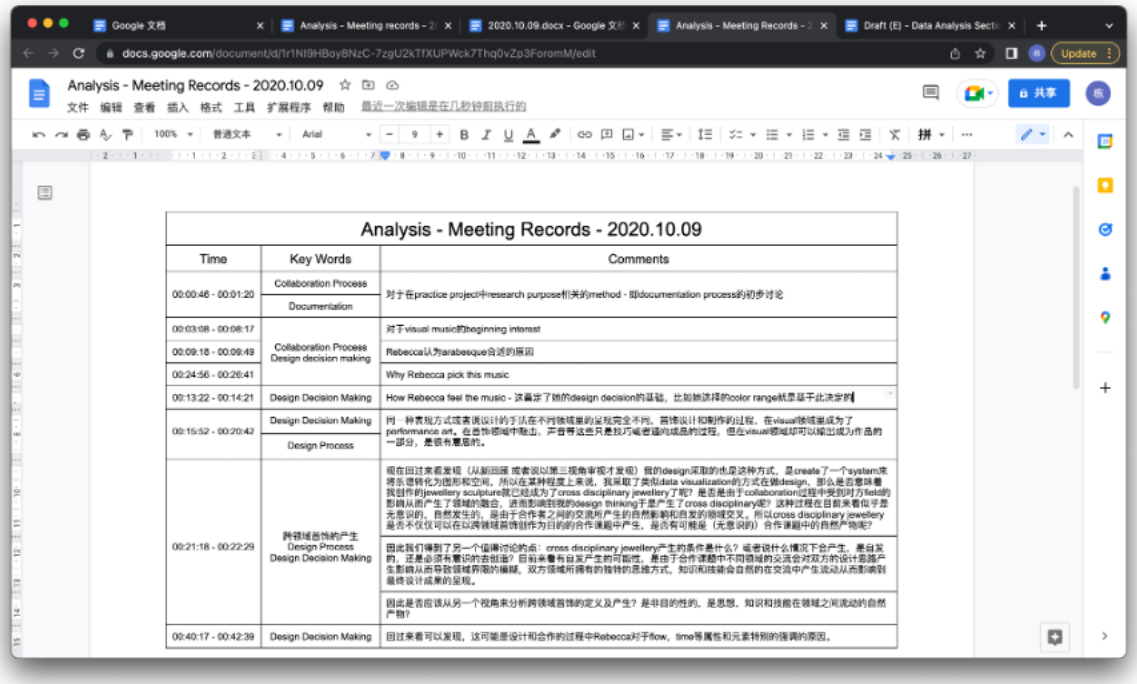


Figure 4.5-4: Example of round 1.2 data review - Detailed breakdown and comments of the data

4.5.3.3 Data review round 2.1 - Thematic classification of the data



Analysis - Meeting Records - 2020.10.09

Time	Key Words	Comments
00:00:46 - 00:01:20	Collaboration Process Documentation	对于在practice project中research purpose相关的method - 即documentation process的初步讨论
00:03:08 - 00:08:17	Collaboration Process Design decision making	对于visual music的beginning interest
00:09:18 - 00:09:49		Rebecca认为arabesque合适的原因
00:24:56 - 00:26:41		Why Rebecca pick this music
00:13:22 - 00:14:21	Design Decision Making	How Rebecca feel the music - 这首歌下她的design decision的基础，比如她选择的color range就是基于此决定的
00:15:52 - 00:20:42	Design Decision Making Design Process	对一种表现方式或者说设计的于达在不同领域里的呈现完全不同。首饰设计和制作的过程。在visual领域里成为了performance art。在音乐领域中融合，产音等这些只是技巧或者通向成品的过程。但在visual领域却可以输出成为作品的一部分，是很有意思的。
00:21:18 - 00:22:29	跨领域首饰的产生 Design Process Design Decision Making	现在回过来看发现（从新回顾 或者说以第三视角审视才发现）我的design采取的也是这种方式，是create了一个system来将乐谱转化为图形和空间，所以在某种程度上来说，我采取了类似data visualization的方式在做design，那么是否意味着我创作的jewellery sculpture就已经成为了cross disciplinary jewellery了呢？是否是由于collaboration过程中受到对方field的影响从而产生了领域的融合，进而影响到我的design thinking于是产生了cross disciplinary呢？这种过程在目前来看似乎是无意识的，自然发生的，是由于合作者之间的交流所产生的自然影响和启发的领域交叉。所以cross disciplinary jewellery是否不仅仅可以在以跨领域首饰创作为目的的合作课题中产生，是否有可能是（无意识的）合作课题中的自然产物呢？ 因此我们得到了另一个值得讨论的点：cross disciplinary jewellery产生的条件是什么？或者说什么情况下会产生。是自发的，还是必须有意识的去创造？目前来看有自发产生的可能性。是由于合作课题中不同领域的交流会对双方的设计思路产生影响从而导致领域界限的模糊，双方领域所拥有的独特的思维方式，知识和技能会自然的在交流中产生流动从而影响到最终设计成果的呈现。 因此是否应该从另一个视角来分析跨领域首饰的定义及产生？是非目的性的，是思想，知识和技能在领域之间流动的自然产物？
00:40:17 - 00:42:39	Design Decision Making	回过来看可以发现，这可能是设计和合作的过程中Rebecca对于flow，time等属性和元素特别的强调的原因。

Figure 4.5-5: Example of round 2.1 data review - Thematic classification of the data

In the next round (round 2.1), data was thematically classified based on the comments from the first two rounds. Data was processed in a tabular format, as shown in Figure 4.5-5, by thematically tagging each single data file (divided by the date of meeting). Each table contains the location of the original data (i.e., time code), keywords, themes, and comments on the original data.

4.5.3.4 Data review round 2.2 - Collating data into thematic datasets

During the following review (round 2.2), the data were organised based on the thematic tables generated in the earlier round (2.1). This process involved not just a single document, but rather extended across all data files, sorting relevant data and clustering it into smaller datasets. The table above (figures 4.5-6 and 4.5-7) shows one example of such a dataset, with each dataset containing critical information about the document in which the data is located. This includes the date of the meeting, the location of the original data (i.e., the time code), the content of the original data, and the annotations and discussions related to it. For further analysis in this round,

selected raw data segments were translated, yet the original Chinese versions were kept for enhanced clarity of cross-referencing in later stages.

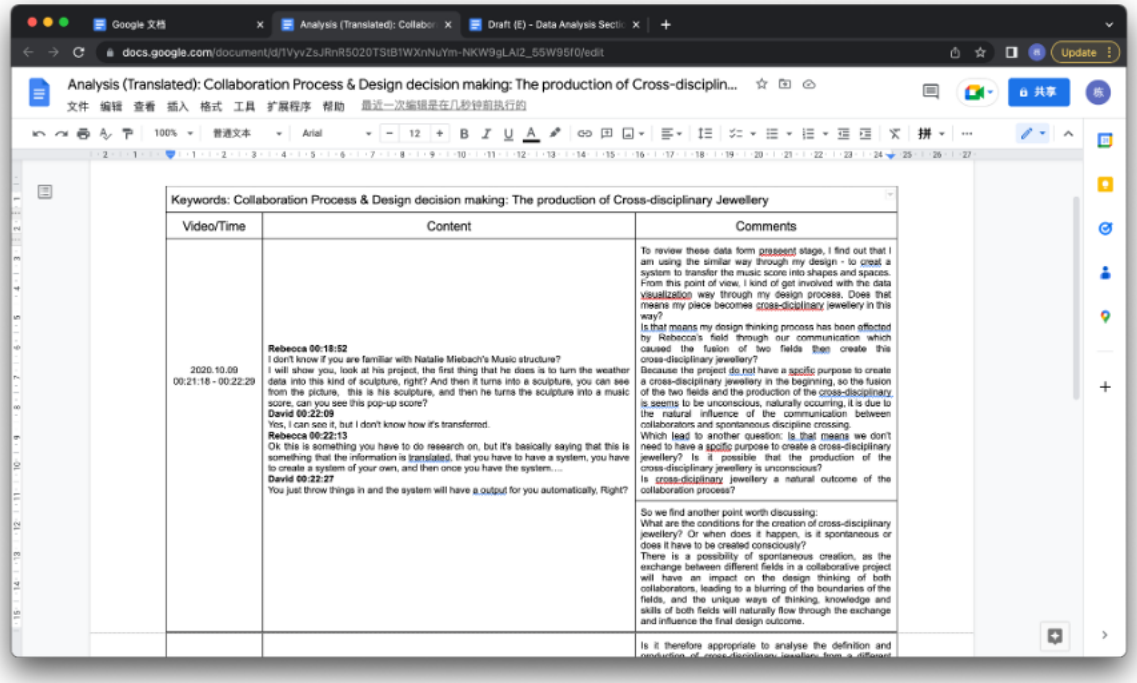


Figure 4.5-6 & 4.5-7: Example of round 2.2 data review - Collating data into thematic datasets

4.5.3.5 Data review round 3.1 - Locate involved ‘Boundary Objects’

Subsequent to several data review rounds (from 1.1 to 2.2), most potential themes’ further analysis was pinpointed. However, some themes not previously discussed in the literature review section prompted a revisit to the literature review after round 2.2. An interesting potential theme - 'Boundary Objects’ was emerged as intriguing and deserving of discussion. This discovery initiated round 3.1 of data review, focusing on a new thematic dataset titled 'Boundary Objects.' The goal for this round was to identify all boundary objects involved in the collaborative process and delineate the roles they played throughout the collaborative process.

During round 3.1, I went back to all meeting transcripts to locate all the 'boundary objects’ involved (totalling 37). These were systematically recorded in a table detailing the date of the meeting, the location of the boundary objects (i.e., time codes), the types of boundary objects (such as contextual examples, journals, digital models, among others), and any comments or discussions pertaining to the original data.

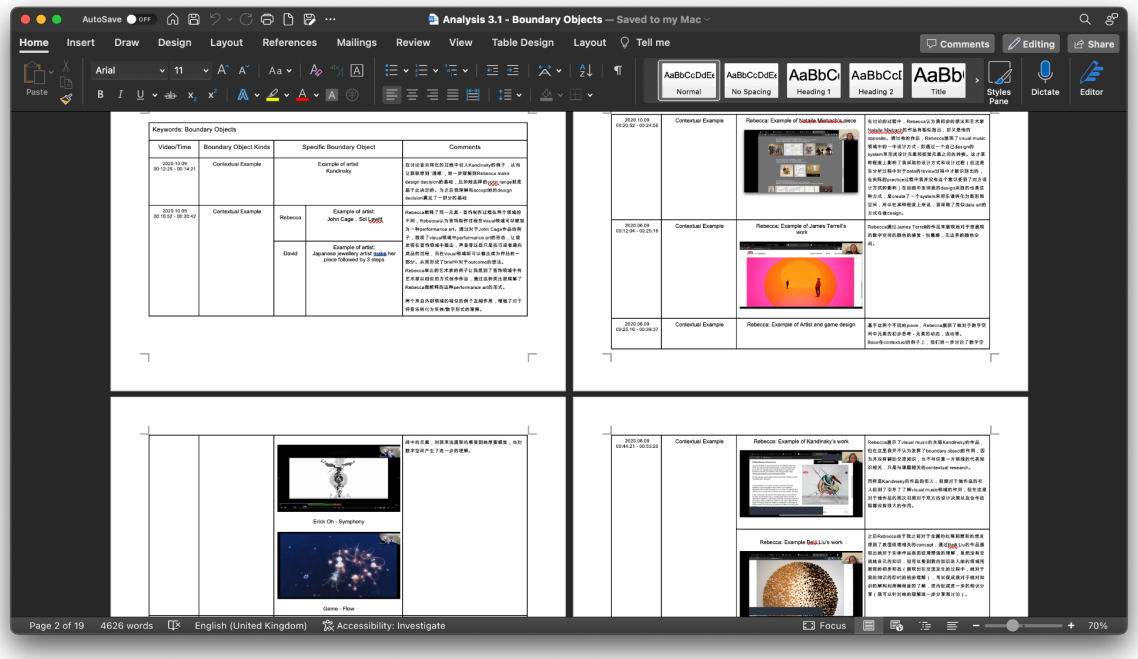
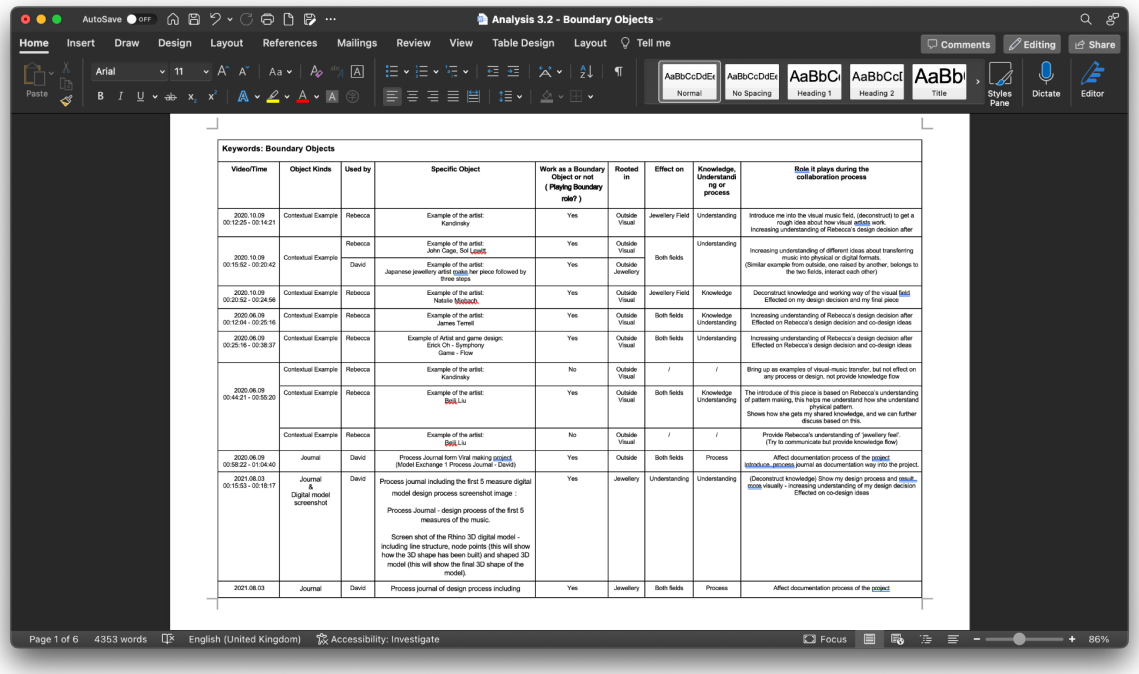


Figure 4.5-8: Example of round 3.1 data review - Locate involved ‘Boundary Objects’

4.5.3.6 Data review round 3.2 - Mapping the features and details of each boundary object

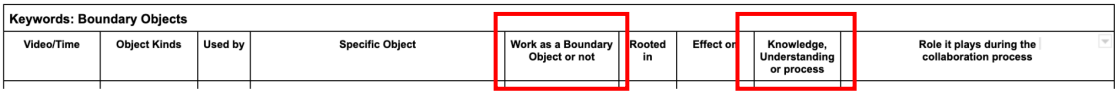


Keywords: Boundary Objects

Video/Time	Object Kinds	Used by	Specific Object	Work as a Boundary Object or not (Playing Boundary role?)	Rooted in	Effect on	Knowledge, Understanding or process	Role it plays during the collaboration process
2020.10.09 00:12:25 - 00:14:21	Contextual Example	Rebecca	Example of the artist: Kandinsky	Yes	Outside Visual	Jewellery Field	Understanding	Introduce me into the visual music field, (deconstruct) to get a rough idea about how visual artists work. Increasing understanding of Rebecca's design decision after
2020.10.09 00:15:52 - 00:20:42	Contextual Example	Rebecca	Example of the artist: John Cage, Sol LeweS	Yes	Outside Visual	Both fields	Understanding	Increasing understanding of different ideas about transferring music into physical or digital formats. (Similar example from outside, one raised by another, belongs to the two fields, interact each other)
		David	Example of the artist: Japanese jewellery artist makes her piece followed by three steps	Yes	Outside Jewellery			
2020.10.09 00:20:52 - 00:24:56	Contextual Example	Rebecca	Example of the artist: Natalie Miebach,	Yes	Outside Visual	Jewellery Field	Knowledge	Deconstruct knowledge and working way of the visual field Effected on my design decision and my final piece
2020.06.09 00:12:04 - 00:25:16	Contextual Example	Rebecca	Example of the artist: James Terrell	Yes	Outside Visual	Both fields	Knowledge Understanding	Increasing understanding of Rebecca's design decision after Effected on Rebecca's design decision and co-design ideas
2020.06.09 00:25:16 - 00:38:37	Contextual Example	Rebecca	Example of Artist and game design: Erics Ch - Symphony Game - Flow	Yes	Outside Visual	Both fields	Understanding	Increasing understanding of Rebecca's design decision after Effected on Rebecca's design decision and co-design ideas
2020.06.09 00:44:21 - 00:55:20	Contextual Example	Rebecca	Example of the artist: Kandinsky	No	Outside Visual	/	/	Bring up as examples of visual-music transfer, but not effect on any process or design, not provide knowledge flow
	Contextual Example	Rebecca	Example of the artist: Bodi Liu	Yes	Outside Visual	Both fields	Knowledge Understanding	The introduce of this piece is based on Rebecca's understanding of pattern making, this helps me understand how she understand physical pattern. Shows how she gets my shared knowledge, and we can further discuss based on this.
	Contextual Example	Rebecca	Example of the artist: Bodi Liu	No	Outside Visual	/	/	Provide Rebecca's understanding of 'jewellery feel'. (Try to communicate but provide knowledge flow)
2020.06.09 00:58:22 - 01:04:40	Journal	David	Process Journal form Viral making project (Model Exchange 1 Process Journal - David)	Yes	Outside	Both fields	Process	Affect documentation process of the project introduce, process journal as documentation way into the project.
2021.06.03 00:15:53 - 00:18:17	Journal & Digital model screenshot	David	Process journal including the first 5 measure digital model design process screenshot image : Process Journal - design process of the first 5 measures of the music. Screen shot of the Rhino 3D digital model - including line structure, node points (this will show how the 3D shape has been built) and shaped 3D model (this will show the final 3D shape of the model).	Yes	Jewellery	Understanding	Understanding	(Deconstruct knowledge) Show my design process and result, more visually - increasing understanding of my design decision Effected on co-design ideas
2021.06.03	Journal	David	Process journal of design process including	Yes	Jewellery	Both fields	Process	Affect documentation process of the project

Figure 4.5-9: Example of round 3.2 data review - Mapping the features and details of each boundary object

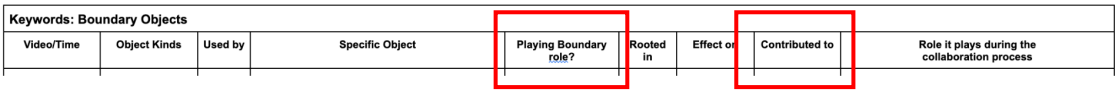
Round 3.2 maintains its focus on boundary objects, building on the identifications made in round 3.1. In this round, detailed features for each identified 'boundary object' were mapped. The analysis continues to utilise tabular formats to organise the data systematically. For each boundary object, ten feature categories were outlined, including: the date of the meeting, the location of the boundary objects existed (i.e. the time code), the kinds of the boundary objects, used by which collaborator, the specific object, whether it plays boundary role, which field it rooted in, effect on which filed, contribute to what, and the role it plays during the collaboration process.



Keywords: Boundary Objects

Video/Time	Object Kinds	Used by	Specific Object	Work as a Boundary Object or not	Rooted in	Effect on	Knowledge, Understanding or process	Role it plays during the collaboration process

Figure 4.5-10: Feature categories in round 3.2 data review at the beginning



Keywords: Boundary Objects

Video/Time	Object Kinds	Used by	Specific Object	Playing Boundary role?	Rooted in	Effect on	Contributed to	Role it plays during the collaboration process

Figure 4.5-11: Feature categories in round 3.2 data review in the end

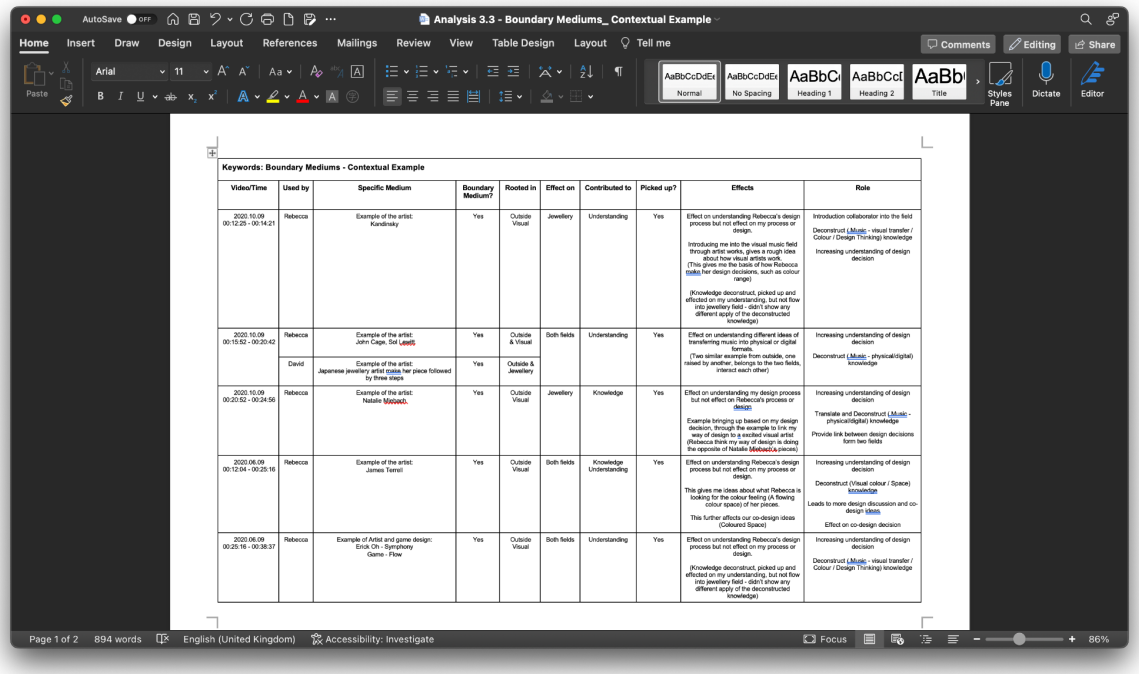
The process of identifying and categorising boundary object features underwent development and changes throughout this round. Initially, the identification and features of the boundary objects were grounded in definitions and attributes sourced from existing literature (see chapter 3, section 3.4). Yet, as the analysis progressed, distinctive features not detailed in the existing literature emerged, prompting revisions and expansions tailored to this research (as illustrated in figures 4.5-10 and 4.5-11).

For instance, the 'playing boundary role?' category began as 'working as a boundary object or not', aligning with the initial goal of locating boundary objects within the collaborative process. Subsequent reviews revealed that many identified objects functioned as 'boundary objects' only partially or exhibited some boundary object characteristics while still influencing knowledge flow and the collaborative exchange. This led to a shift from a binary definition of function to an assessment of the boundary role played.

Additionally, the 'contributed to…' category aimed to discern whether the 'boundary object' contributed to knowledge or the collaborative process and was initially termed 'knowledge or process'. However, it was observed that some objects contributed only to knowledge flow or had a minimal effect on the collaborative process, instead mainly facilitating mutual understanding of design decisions. Initially labelled 'others', this category was adapted to 'understanding' and evolved to 'knowledge, understanding or process', before being finalised as 'contributed to...'.

4.5.3.7 Data review round 3.3 - Cluster and identify features of each boundary object kinds

In this subsequent review stage (round 3.3), each category of boundary objects was further clustered, and their distinct features were more finely identified. Continuing with the tabular format, all 37 boundary objects were categorised into 8 types, including: Contextual Examples, Journals, Process Images, Process Videos, Digital Models (Rhino 3D Models), Digital Models (Rendered Images), Digital Models (Rendered Videos), and Physical Models.



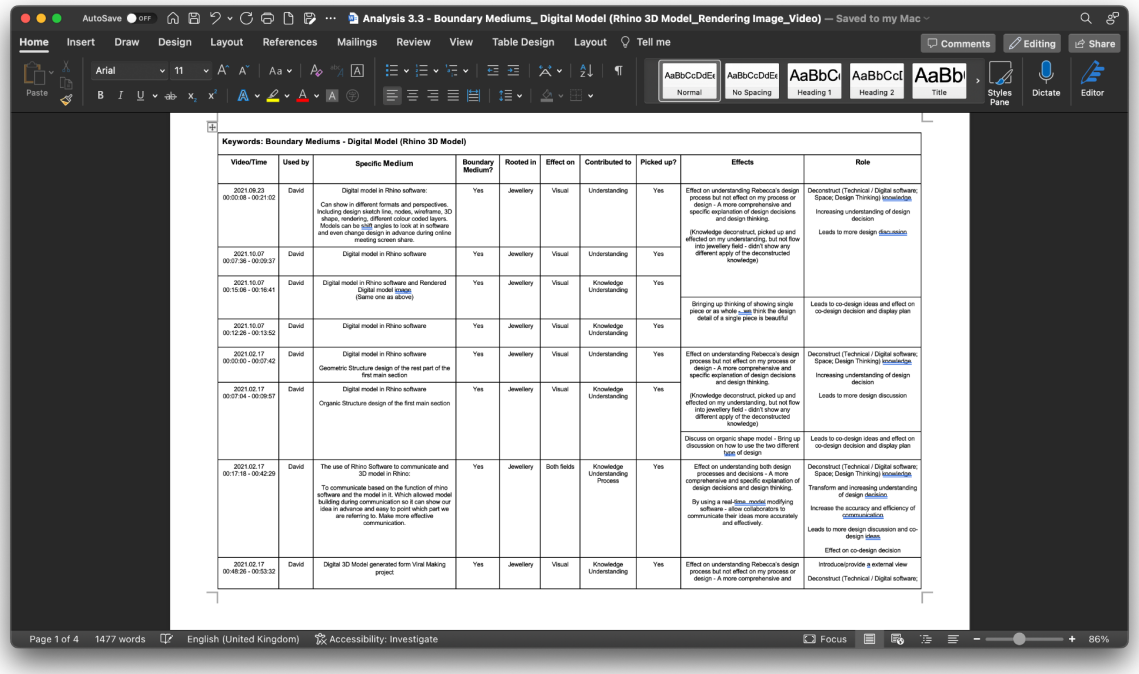


Figure 4.5-12 & 4.5-13: Example of round 3.3 data review - Cluster and identify features of each boundary object kind

The feature categories (11 in total) was defined to assess these objects: the date of the meeting, the location of the boundary objects existed (i.e. the time code), used by which collaborator, the specific object, whether it work as boundary object, which field

it rooted in, effect on which filed, contribute to what, whether the knowledge it deconstructed been picked up, its effects, and the role it plays during the collaboration process.

This detailed clustering and identification of boundary object features allowed for a more detailed understanding of how each object type functioned within the collaborative setting, providing a foundation for further analysis and findings.

4.6 Analysis within the Boundary Objects Concept – An Integrating Framework

In the discussion from the last section, we can see that in this research, the review and analysis of data is a process where the raw data interacts with related research and concepts and brought them into play - all concepts related to boundary objects were identified and developed during the analysis and thus were not used in the design process itself.

The theoretical development method adopted in this research is based on multiple rounds of data review, which involves a back-and-forth process between data and theory - reviewing the raw data to see if it corroborates the experiences and claims from existing research and vice versa, assessing whether the theory helps understand the empirical data from this practice. This process permeates the entire data analysis phase and the writing stage of the discussion chapter, where the review and citation of raw data in the writing are intended to make the arguments “alive" (Yanow & Schwartz-Shea, 2006: 11), rather than describing the entire collaborative process.

In the last section, we discussed how boundary objects were established as the main theme and core analytical method of this research. Now, we will discuss the formation of the analytical framework used in this research. After completing the identification process of all boundary objects involved within the collaborative process, the researchers returned to literature review, attempting to find cutting-edge research related to boundary objects in the design and craft fields. During this process, some extended concepts related to boundary objects were identified: Semantic, Syntactic, and Pragmatic Boundary Objects (Carlile, 2002; 2004); Existing, Built, and Appropriated Boundary Objects (Halpern, 2012); and Dynamics of Boundary Objects

(Nicolini et al., 2012). (See section 3.4 for a more detailed analysis of literature and concepts discussion.)

Throughout the back-and-forth process between data review and literature exploration, the researcher plays with the raw data through these related concepts in the existing literature. During this interactive process between data and literature, it became evident that the boundary objects identified in the 'Data-Music-Jewellery' project often perform more than a single function - they might align with the operational mode of semantic boundary objects at one moment and act as existing boundary objects the next, or even manage multiple roles simultaneously. This dynamic and shifting operational mode makes it difficult to analyse based on any single boundary object concept perspective. Consequently, based on these prior studies, this research integrates various concepts into an integrating framework to analyse the role of the identified boundary objects in shaping cross-disciplinary jewellery within the 'Data-Music-Jewellery' project.

This integrating framework aims to extend existing concepts of the boundary object research to collaborations related to the jewellery field, particularly in the creation of cross-disciplinary jewellery. By applying this integrating framework, boundary objects in jewellery-related distributed collaboration can be viewed from a more open and diverse perspective, exploring their features and roles, as well as their contributions to understanding, communication, knowledge flow, and cross-disciplinary jewellery creation during the collaborative process.

Chapter 5 Cross-disciplinary collaborative practice projects

5.1 Introduction

In previous chapters, a provisional definition of cross-disciplinary jewellery was established based on historical perspectives in the literature and extant cross-disciplinary practices within the jewellery field. This chapter introduces the practice-based element of the research, with a focus on the establishment of cross-disciplinary jewellery within a collaborative environment (boundary zone). The practice-based enquiry comprises two collaborative projects, aimed at identifying other potential features to supplement the provisional definition previously established, thereby creating a more informed definition. This chapter will also explore the creation process of cross-disciplinary jewellery through the collaborative process. The analysis of practice will also explore the features of the knowledge flow involved in joint creation, as well as the relationship between this knowledge flow and the establishment of cross-disciplinary jewellery.

The two collaborative projects were *'Viral Making'* and *'Data-Music-Jewellery'*. For this thesis, only the dataset collected from the *'Data-Music-Jewellery'* project was selected for analysis and discussion. The reasons for choosing this specific dataset will be discussed first in the following section.

Subsequently, this chapter will conduct a detailed analysis and discussion of the establishment process and knowledge flow of cross-disciplinary jewellery based on collaboration, utilising an integrated analytical framework constructed from the concept of boundary objects and their derivatives. This discussion will involve exploring the boundary objects identified during the data review process within the *'Data-Music-Jewellery'* project, their features, and a specific discussion on the creation process of cross-disciplinary jewellery from the dynamic perspective of boundary objects.

In these sections, discussions will focus on the features and roles of individual boundary objects identified based on specific cases, as well as on the concept development and the process of cross-disciplinary jewellery creation in which these boundary objects participate. However, the summarisation of these processes and features will be reserved for Chapter 6. This thesis is structured in this way because the identified features of each boundary object are inseparably linked to the subsequent processes of cross-disciplinary jewellery creation in which they are involved. Placing these summaries in Chapter 6, rather than at the end of each section in Chapter 5, allows for a more fluid and focused discussion.

5.1.1 Choice of dataset for analysis

During the practical phase, two parallel collaborative projects were established: *'Viral Making'* and *'Data-Music-Jewellery'*, each engaging with different design fields: the *'Data-Music-Jewellery'* project with the field of visual arts, and *'Viral Making'* with the field of architecture. Table 5.1-1 displays the basic information about these two projects.

The two projects were established in the initial stages of the research based on the craft thinking methodology as discussed in Chapter 4. It was expected that relevant potential themes would emerge during development. Therefore, collaborating with partners from different fields and implementing similar but distinct practices were deemed necessary at the time to gather as rich datasets as possible. As mentioned in Section 1.2, the focus of the research experienced changes. Initially, when setting up the collaborative projects, it was thought there was potential for this research to analyse the differences between the jewellery field collaborating with different fields, thus establishing projects with various fields was considered beneficial at the time. Subsequently, even though the focus of the research shifted, establishing collaborations with different fields continued to be regarded as an effective way to obtain richer data, hence both collaborative projects were retained and carried on.

Name	**Data – Music - Jewellery**	**Viral Making**
Field	Visual Art/Data Visualization	Architecture
Collaborator	Rebecca Ruige Xu Computer Art and Animation Professor College of Visual & Performing Art Syracuse University, USA	Jo McCallum Digital Craft PhD Candidate School of Architecture University of Queensland, Australia
Project Description	This project invites artists from different art and design areas, to creating art pieces based on the same design element, in this project a specific piece of music by Claude Debussy: 'Arabesque No. 1', https://youtu.be/Yh36PaE-Pf0). This project will produce different forms of art pieces and also try to explore the transformation and application of cross-disciplinary knowledge and skill sets within different fields; in tandem throughout various stages of the project such as independent creation, collaborative co- creation, reflection and feedback to each other and recreation and evaluation.	Viral Making will explore adaptive digital tools (Rhino & Grasshopper) and mixed reality platforms (Fologram), in order to craft connections, deliver novel pedagogy, and share practice research methods. We are committed to investigating innovative tools and techniques, with a view to informing and enhancing engagement across a range of disciplines.
Initial Project aims	• To invite artists from different design fields to create art pieces based on the same design element. A range of different creative possibilities and applications of the same design elements by artists from different fields will be created. • To explore the transformation and application of cross-disciplinary knowledge and skills across different fields. • To record and analyse the communication and creation process of artists from different professional fields during the collaboration process and to discuss the process of cross-disciplinary presentation of knowledge and skills.	• Preserve, harness, and enhance practice research, utilising adaptive digital tools (Rhino & Grasshopper), alongside mixed reality platforms (Fologram). • Explore a process of Training & Experimentation by sharing skills, and digital/physical models. • Craft a process of Growth through Iteration by developing a series of shared models, made collaboratively across two continents. • Document and reflect upon this process to deliver Demonstration & Dissemination, including a Viral Making toolkit (knowledge sharing strategy, process diagrams, workflows, material logs, short films, and opensource files).

Table 5.1-1: Basic information of the two practice projects

Note: All references to collaborators' names, work, and personal information within the practice data of this paper have been used with the consent of the participants, who signed informed consent forms prior to the commencement of the research. This consent includes the use of their personal information in related thesis and publications.

Comparison between two projects in initial project workflow plan		
	Data – Music - Jewellery	**Viral Making**
Field	Visual Art/Data Visualization	Architecture
	Phase one	
Process	Independent design process by using the same design element (Piece of Music) to create two different pieces by each one of us	3-4 Model Exchange cycle
Outcome (Data related)	Process Journals Reflection Journals Records of making process (Models, sketches, test pieces, process images) Making process record video	Process Journals Reflection Journals Digital Models
Potential Data/ Themes	Different thinking between professional form craft and visual design filed on the same design element	Different thinking between professional form craft and architecture filed on the same design element Effects of the mutual feedback and reflection process on design development and iteration (Not in real time) Knowledge follows between fields
	Compare the two project to see difference between collaboration with different design fields (May lead to different process, feedback, thinking, outcome among others)	
	Phase Two	
Process	Co-design process by using the selected section of the music to create one piece	Co-design process by manipulate and modify the same selected model through online platform Fologram in virtual space
Outcome (Data related)	Records of the communication process (conversations through online meetings) Records of making process (Models, sketches, test pieces, process images) Process/Reflection journal	Records of the communication process (conversations through online meetings) Records of making process (Through Fologram platform) Process/Reflection journal
Potential Data Themes	Different thinking between professional form craft and visual design filed on the same design element Effects of the mutual feedback and reflection process on design development and iteration (in real time) Knowledge follows between fields	Different thinking between professional form craft and architecture filed on the same design element Effects of the mutual feedback and reflection process on design development and iteration (in real time) Knowledge follows between fields
	Compare the two project to see difference between collaboration with different design fields (May lead to different process, feedback, thinking, outcome among others)	
	Phase Three	
Process	Recreation of the final outcome form the first phase (Based on mutual feedback from each other about the final outcome form the first phase, still remain independent design process, two outcomes by each one of us)	
Outcome (Data related)	Process Journals Reflection Journals Records of making process (Models, sketches, test pieces, process images) Making process record video	
Potential Data Themes	Compare with Phase one to see effects of the mutual feedback and reflection process on design development and iteration (Not in real time) Knowledge follows between fields	

Table 5.1-2: Comparison between two projects in initial project workflow plan

Comparison between two projects in actual project workflow		
	Data – Music - Jewellery	**Viral Making**
Field	Visual Art/Data Visualization	Architecture
	Phase one	
Process	Independent design process by using the same design element (Piece of Music) to create two different pieces by each one of us with mutual feedback process throughout the whole design process through online meetings	3-4 Model Exchange cycle
Outcome (Data related)	Records of the mutual feedback and communication process (conversations through online meetings) – transcript into meeting transcription including images from the records of the making and design development process Records of the making and design development process (3D Models, Physical Models, sketches, test pieces, process images and videos)	Process Journals Reflection Journals Digital Models
Data/ Themes	Different thinking between professional form craft and visual design filed on the same design element Effects of the mutual feedback and reflection process on design development and iteration (Both in and not in real time) Knowledge follows between fields	Different thinking between professional form craft and architecture filed on the same design element Effects of the mutual feedback and reflection process on design development and iteration (Not in real time) Knowledge follows between fields
	Phase Two	
Process	Co-design process by using the selected section of the music to create one piece (Action on one of the co-design ideas created and talked through the first phase)	Co-design process to explore the different possibilities of the same selected model through the interaction between among AR based platform Fologram, 3D Modelling software Rhino and reality
Outcome (Data related)	Records of the mutual feedback and communication process (conversations through online meetings) – transcript into meeting transcription including images from the records of the making and design development process Records of the making and design development process (3D Models, Physical Models, sketches, test pieces, process images and videos)	Records of the communication process (conversations through online meetings) Records of making process (Through Fologram platform and real-life perspective)
Data/ Themes	Different thinking between professional form craft and visual design filed on the same design element Effects of the mutual feedback and reflection process on design development and iteration (Both in and not in real time) Knowledge follows between fields	Different thinking between professional form craft and architecture filed on the same design element Effects of the mutual feedback and reflection process on design development and iteration (In real time) Knowledge follows between fields

Table 5.1-3: Comparison between two projects in actual project workflow

Table 5.1-2 outlines the initial expectations for the outcomes (data related) of the two projects in terms of data that could potentially be collected and themes that might be of interest. Table 5.1-3, on the other hand, compares the actual outcomes (data related) and the data collected during the practical process of the two projects. The initial

intentions behind establishing the two collaborative projects at the beginning of the research, as well as the reasons for ultimately selecting only the 'Data-Music-Jewellery' dataset for analysis will be discussed next.

The mutual feedback and reflection process based on model exchanging in the 'Viral Making' project (viral making project stage 1 model exchanging cycle), as shown in Table 5.1-2, was considered beneficial and necessary for observing the flow of knowledge between different fields in the collaborative environment at the beginning of the research. This data collection process, utilising 'process journals' and 'reflection journals,' was highly targeted and focused on the flow and transformation of knowledge. Therefore, it was believed at the time that it could more clearly demonstrate the knowledge transformation process during collaboration, thereby obtaining richer and more targeted data.

However, in practice, as can be seen from Table 5.1-3, the types of data collected during stage 1 of the *'Viral Making'* project were no different from those collected during stage 1 of the *'Data-Music-Jewellery'* project.

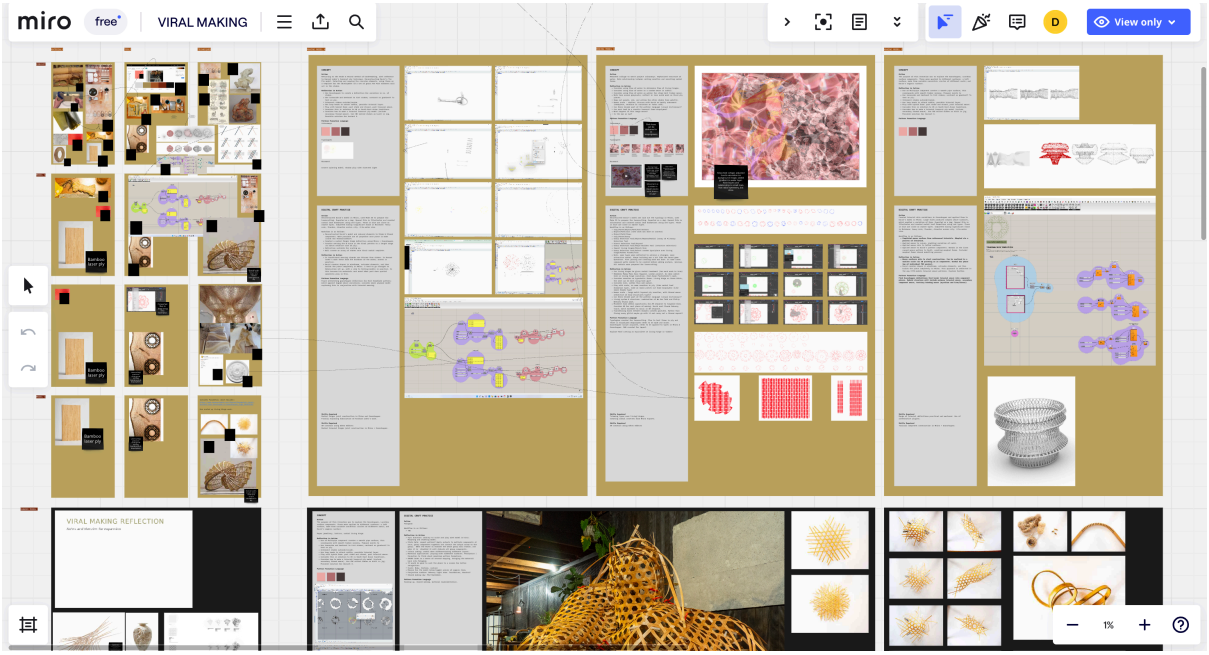


Figure 5.1-1: Miro Board of the *'Viral Making'* project

In terms of the richness of the data, since the journal method of data collection depends on collaborators to record their design processes independently, the content documented is pre-selected dependent on individual motivation - only selected data is recorded. Therefore, this approach limits the richness of the data collected, both the quantity of the data and the quality of the selected data are not meeting my expectation.

Compared to the real-time feedback process, data collected through journals has difficulty fully capturing the dynamic interactions that occur during online meetings. Although efforts are made to document key discussion points in online meetings using tools like Miro boards, these records are still summarised and filtered into bullet points. Furthermore, the data entered into the reflection journals after online meetings cannot completely capture the entirety of the real-time feedback process, and due to the delay in recording, the richness of the data recorded is significantly diminished.

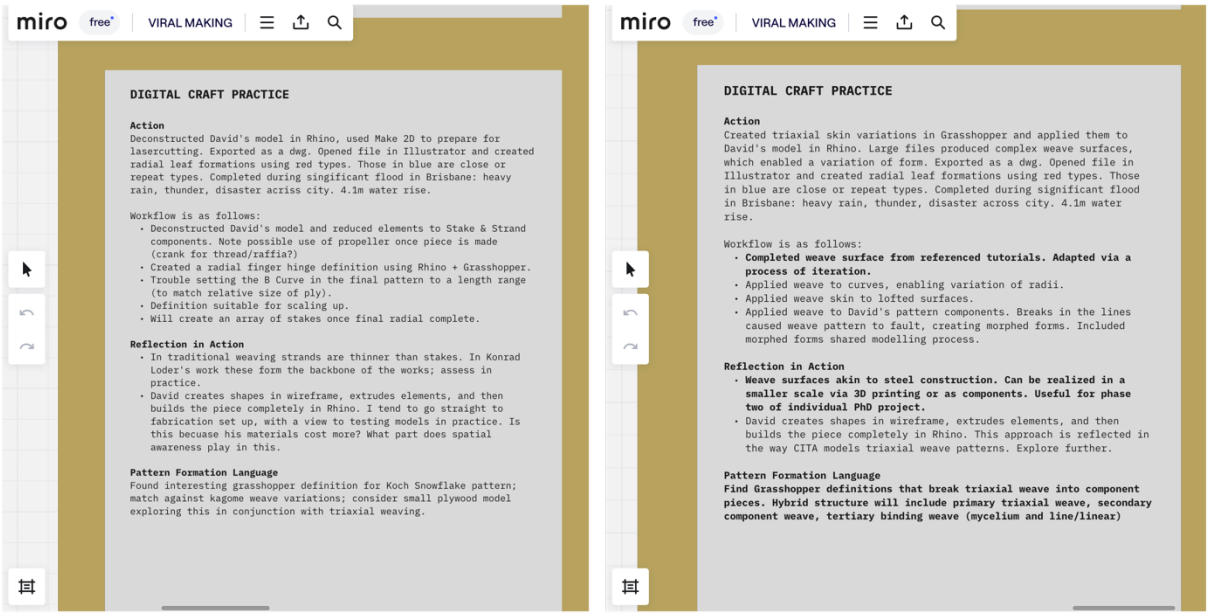


Figure 5.1-2: Samples of Jo’s Journal (zoom in to see detail)

In contrast, the method of data recording based on online meeting records used in the *'Data-Music-Jewellery'* project captures a more complete representation of the mutual feedback process between the collaborators, presenting a more complete record of the collaboration process and knowledge flow. (This will be further demonstrated in the subsequent sections of this chapter.)

From the perspective of data analysis, during the review process, a framework based on boundary objects was established - identifying themes related to boundary objects as one of the core contributions of this research and using the boundary object framework to analyse the creation process of cross-disciplinary jewellery and the cross-disciplinary flow of knowledge. Therefore, during the review of data from the two practical projects under the boundary object framework, it was found that the data collected in the *'Viral Making'* project did not yield enough insight into boundary objects-related discussion.

Boundary objects, as a concept used to explain the exchange of knowledge in cross-disciplinary collaborations, are mainly present in the communications between collaborators. Therefore, data related to the process of communication (the mutual feedback process) is crucial. In the practical process, a research perspective focused on boundary objects was not established, hence data specifically related to boundary objects was not intentionally captured. As mentioned earlier, the data collection method adopted by the *'Viral Making'* project relied on the autonomous selection of data by the collaborators, with limited recording of the communication process between them. Consequently, the dataset from the *'Viral Making'* project was severely lacking in data related to boundary objects.

Conversely, the *'Data-Music-Jewellery'* project, which utilised online meeting records, captured a large and comprehensive amount of data related to the mutual feedback process. This provides an extensive body of raw data for analysis from the perspective of the boundary object framework.

From the standpoint of data analysis, compared to the *‘Viral Making’* project, the *'Data-Music-Jewellery'* project offers a complete and more substantial amount of effective data. Therefore, after an initial review of the *'Viral Making'* project dataset from the perspective of the boundary object framework, it was considered unnecessary to perform a detailed duplicate analysis on the *'Viral Making'* project's data. Though similar, it is far less extensive than that of the *'Data-Music-Jewellery'* project.

On the other hand, although there is a significant overlap in the data between the *'Viral Making'* project and the *'Data-Music-Jewellery'* project, the unique aspects of the *'Viral*

Making' project cannot be overlooked. Analysis of these uniqueness will be detailed in Section 6.5, discussing potential future research directions for this research.

Since the analysis in this research is based on the dataset from the *"Data-Music-Jewellery"* project, the *"Viral Making"* dataset is not included in the formal analysis. However, journals from the *"Viral Making"* project are referenced in this chapter to illustrate the development of a journal-based data collection method in the *"Data-Music-Jewellery"* project and the iterative exchange where digital models from the *"Data-Music-Jewellery"* project were modified in the *"Viral Making"* project and returned with external perspectives that influenced the design process. While these references provide context for methodological and conceptual development, the *"Viral Making"* dataset itself was not systematically analysed. Further details on the *"Viral Making"* project can be found in Appendix 2-9.

In the following sections, this chapter will first describe the practical process of the *'Data-Music-Jewellery'* project. Due to the project's frequent adjustments based on evolving collaborative circumstances, this chapter will begin by outlining the initial project brief, initial project structure and process plan, and the actual project process of the *'Data-Music-Jewellery'* project.

5.2 Cross-disciplinary Collaborative Practice

5.2.1 Initial Project Structure and Process Plan

This project was initially structured into several stages and steps. (A detailed initial project brief can be seen in Appendix 10) Diagrams here are provided to facilitate understanding of the process structure (See figure 5.2-1 & 5.2-2).

Figures 5.2-1 and 5.2-2 illustrate the entire planned process of the *'Data - Music - Jewellery'* project. The outcomes of the first stage were expected to serve as the foundation for the development of the third stage, hence the first and third stages are continuously linked, as seen in Figure 5.2-1. Figure 5.2-2 separately shows the research process of the second stage. The detailed workflow of the different stages was as follows:

Stage 1: In the first stage, based on the same piece of music (Debussy: Arabesque No. 1), we planned to adopt our respective professional perspectives to independently transform this music into art pieces using data visualisation technology (by Rebecca) and handcraft/digital making skills (by myself).

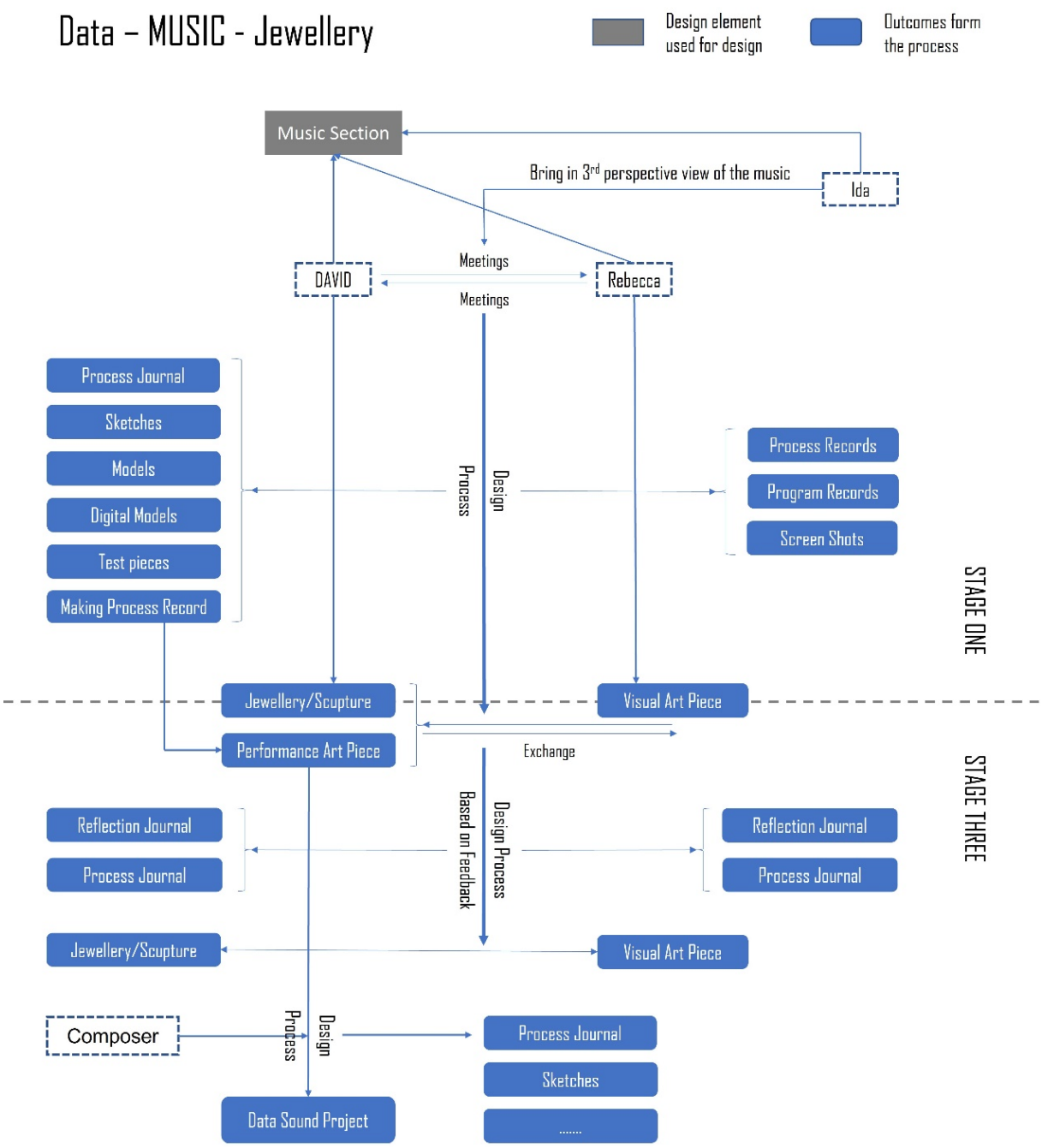


Figure 5.2-1: Initial '*Data - Music - Jewellery*' Project Workflow - Stage 1 & 3

This stage was to present two independent works: a physical jewellery/sculpture art piece from myself and a visual/video piece from Rebecca. I planned to document this making process, providing a video art performance of the jewellery and sculpture as well. Rebecca was to approach from the perspective of data visualisation; the music will be analysed through programming and used as the foundation to create visual elements for a visual music outcome.

Conversely, I intended to use the perspective of craft to transform music into digital 3D and physical forms (either jewellery or sculptural pieces) using handcraft and digital making skills. The outputs were to include not only the final physical product but also video documentation of the making process as a performance. Additionally, the sounds generated during the making process were planned to become integral parts of the final outcome, providing the material basis for feedback and collaboration in subsequent stages.

Throughout this process, all drawings, sketches, test pieces, and digital files were to be considered as various formats of data. Some of which will be included in the process journal that both Rebecca and I would maintain to record our thoughts and actions during the process. The journal was intended to showcase the transformation and different methods of employing the same design elements and knowledge by individuals from distinct design fields.

Stage 2: In the second stage, we planned to select a section of the music upon which we both agree to create a collaborative piece. This stage was expected to result in a collaborative art outcome, the format of which would be decided at that time. Video recordings and transcriptions were to be employed as methods to generate qualitative data for future analysis. The Process and Reflection Journals were also intended to continue to be utilised during this stage.

Stage 3: In the following stage, Rebecca and I were to provide feedback on each other's works and create a second piece based on that feedback. Collaborating with a composer to integrate the artwork(s) into a new piece of music was also considered. The outcome of this stage was to include the creation of new pieces after receiving feedback and a data-sound project with the composer.

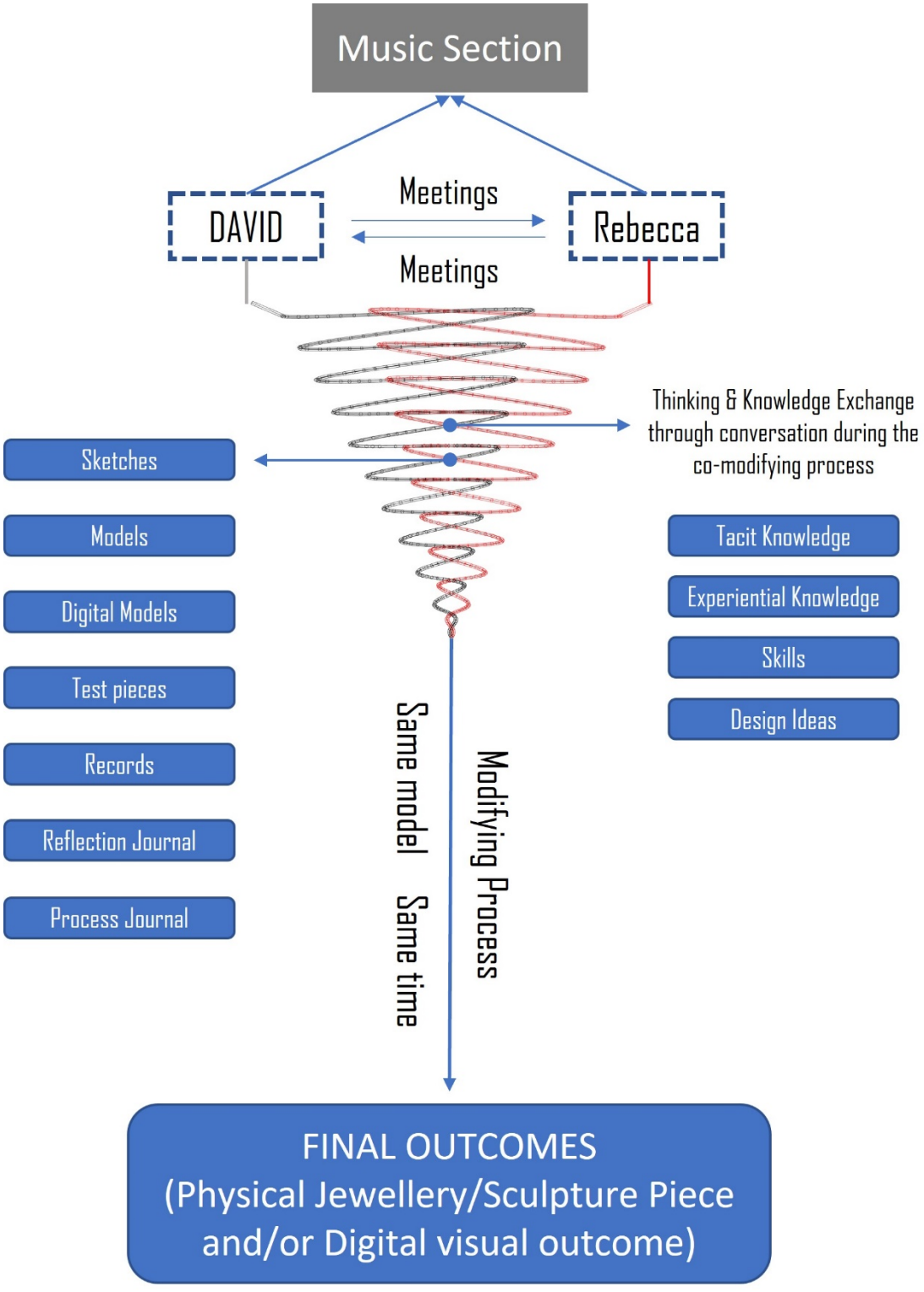


Figure 5.2-2: Initial '*Data - Music - Jewellery*' Project Workflow - Stage 2

5.2.2 Actual Project Process - Changes to the Project Workflow

As mentioned in previous chapters, the project brief initiated a contemplative approach on the collaboration process between two distinct fields, establishing a trajectory for the partnership at the outset. However, the actual collaborative process did not strictly adhere to the brief; it was dynamic and frequently adjusted based on the evolving circumstances of the collaboration. This section will explore the changes in the process of the *'Data – Music - Jewellery'* project based on the new project's flow chart (figure 5.3-3) after these modifications.

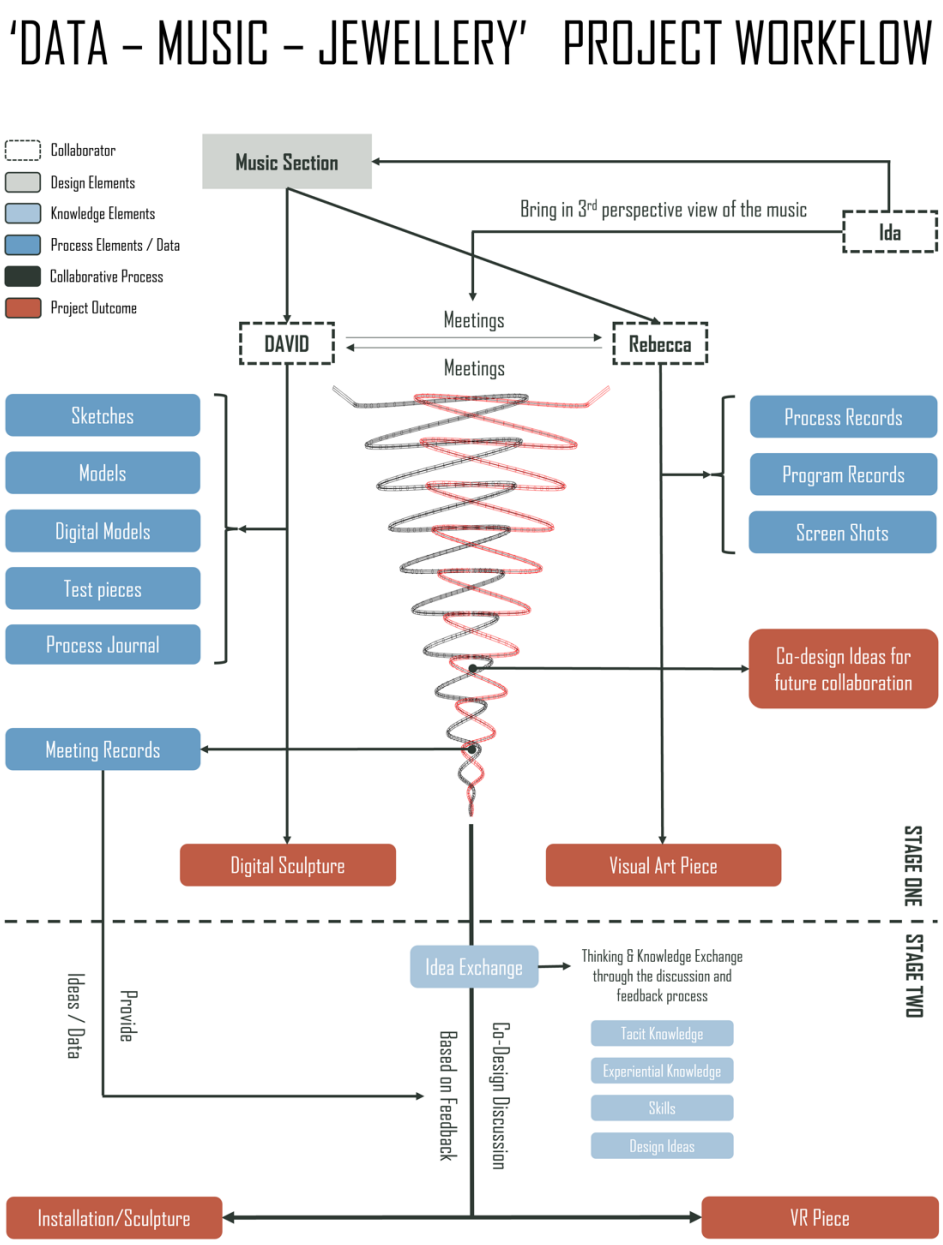


Figure 5.2-3: Actual *'Data – Music - Jewellery'* Project workflow

5.2.2.1 Changes and merging of project stages

The first perspective to examine is the evolution and integration of the collaborative stages. As outlined in the previous section, the data music project was initially planned in three distinct stages, with the first and third stages interconnected - the output from the first stage was intended to inform the third. The third stage was envisioned as a design process characterised by mutual feedback and iterative development based on that feedback. Conversely, the second stage was conceptualised as a co-creation process, isolated from the first and third stages (as illustrated in figure 5.2-1 and 5.2-2 in section 5.2.2).

In practice, however, the three stages converged into two. The planned third stage, which focused on mutual feedback, was absorbed into the first (independent design) and second (co-creation) stages. Furthermore, this merging prompted the previously distinct first and second stages to intersect and link; the co-creation ideas in the second stage were built upon and refined through feedback and discussions initiated in the first stage. Overall, it was the continual scheduling of online meetings throughout the collaborative process that diminished the independence of the project stages, leading to blurred boundaries and eventually a fusion of stages.

First stage:

The initial plan for the first stage as an independent design phase aimed to keep both collaborators immersed in their respective fields, allowing them to work independently. This setting was intended to showcase each collaborator's design thinking and working patterns without external influence from one another. However, the necessity for complete isolation to achieve independent design was not fully considered at the project's outset, leading to the establishment of a regular online meeting protocol. These meetings were initially perceived merely to report on each participant's progress and maintain a collaborative relationship, ensuring the project's smooth continuation.

Contrary to initial expectations, the ongoing online meetings became forums not just for progress updates but for substantive discussions about each other's design ideas. This dialogue facilitated an exchange of design thinking and concepts, significantly

influencing each other's design decisions, both explicitly and implicitly, as evidenced by the meeting transcript on 2023.05.01:

> *"... Because your plan, I look very logic as a plan, but when it actually happens, such as the result of our collaborate, unless we have a very strict control - such as we keep us isolated to make our own design, like we didn't meet at all through the process, we have to have that kind of control. But actually, we keep having meetings and communications …"*
>
> *(Rebecca, Meeting time code: 2022.05.01 - 00:13:05)*

> *".. I can feel that although there is a clear… like I take your advice and do some changes on the design, but it still has a subtle influence. Such as when I see your process, I will naturally have some thinking on that design idea which may change my thinking and perspective …"*
>
> *(David, Meeting time code: 2022.05.01 - 00:13:48)*

> *"... Yes, so I think the collaboration is more of an organic process other than a fixed structure …"*
>
> *(Rebecca, Meeting time code: 2022.05.01 - 00:14:04)*

Our analysis reveals that both Rebecca and I concur that the first stage's online meetings and the resultant feedback process profoundly affected the decision-making and overall outcome of the collaborative endeavour. This was a primary factor in the earlier-mentioned integration of the collaboration stages. Moreover, due to this integration, the first stage now encompasses nearly all the collaboration process. All online meetings and mutual feedback occur during this initial stage, where co-creation ideas are also discussed and formulated.

Second stage:

As the first stage assumes the majority of the project's functional roles, the second stage increasingly serves as an extension of the first rather than as a distinct, isolated design phase as originally planned. Its principal function now is to select and implement the co-creation ideas discussed during the first stage. Throughout stage one, the discussion of co-creation ideas often stemmed from the sharing of design concepts between collaborators. This exchange of knowledge not only stimulates the generation of new design ideas but also enables the deconstruction of knowledge by

one collaborator. Subsequently, the other collaborator can re-interpret this information through their own knowledge framework, leading to the creation of innovative design expressions manifested as preliminary draft design ideas.

These drafts then re-enter the collaborative process through ongoing exchanges, where they are dynamically discussed. Through this iterative process, collaborative ideas are continually shared and refined. Given that the generation of collaborative ideas is dependent on the flow of knowledge from mutual feedback, decisions regarding co-creation are predominantly made during online meetings. Consequently, the main activities of the co-creation stage are effectively contained within the first stage, occurring concurrently with the independent design activities but also interconnecting and influencing them in various ways.

Third stage:

As discussed earlier, the continuous mutual feedback intrinsic to the project's methodology meant that the third phase, as originally planned, began to dynamically and continuously influence both the process and the outcome of the collaboration in the first stage. Consequently, during our discussion on 2022.05.01, both collaborators came to view the third stage as 'already happening' and therefore 'no longer necessary'. This led to its eventual cancellation, as affirmed in our meeting on 2022.05.01:

> *"... But actually, for us, for me, from my perspective, actually the first stage is a bit blurry. As this is such a long process, there is not a very clear …"*
>
> *(Rebecca, Meeting time code: 2022.05.01 - 00:11:44)*

> *"... Yes, I have a similar feeling about that. So, I think, because our stages are already blurry, so actually our third stage, which is the feedback process, is already included in the first stage. My idea now is to take the third stage off. Because it has already happened in the first and second stages. Because although we are more doing independent design, but we also get feedback from each other as well. It might not change our design a lot, but it has a large effect on our co-design ideas which is our planned stage two. We are actually already planning the second stage through the process; we already got a lot of co-design ideas just not doing it yet. So, I think we can just take the third stage off and it has already flow through the process and merged into the first and second stage"*
>
> *(David, Meeting time code: 2022.05.01 - 00:12:02)*

5.2.2.2 Changes to data collection methods

The second deviation from the original plan concerns the methods of data collection used in the project. While the documentation process is already analysed in more detail in section 4.4, this section will focus solely on the changes in data collection methods. Initially, data was to be primarily collected through 'process journals', 'reflection journals', and records of online meetings. However, as the collaboration progressed, the methods of data collection were modified and iterated several times to better align with the practical demands of the project.

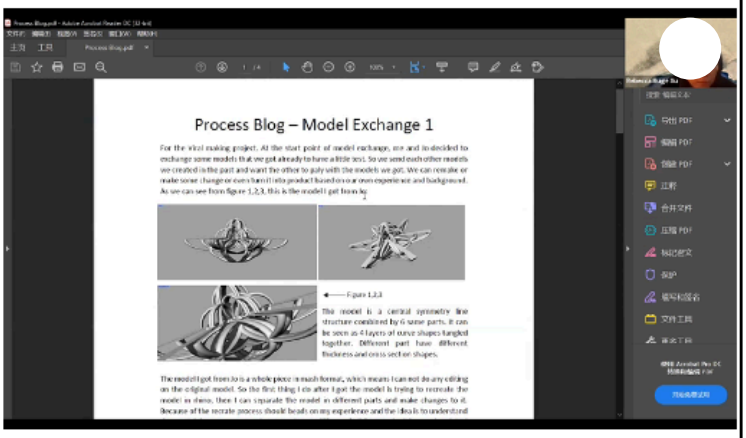
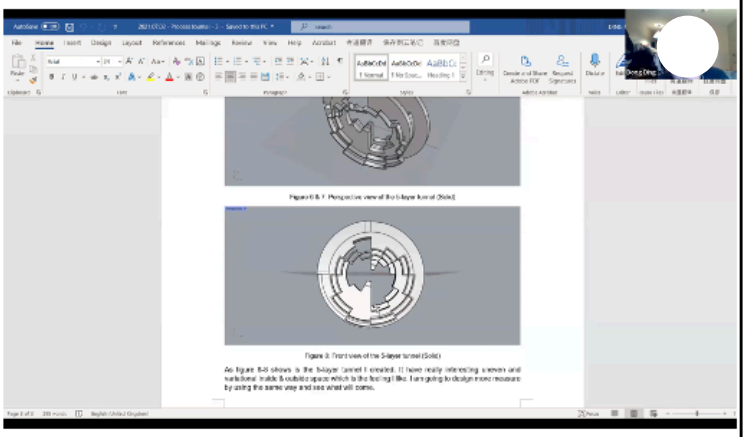
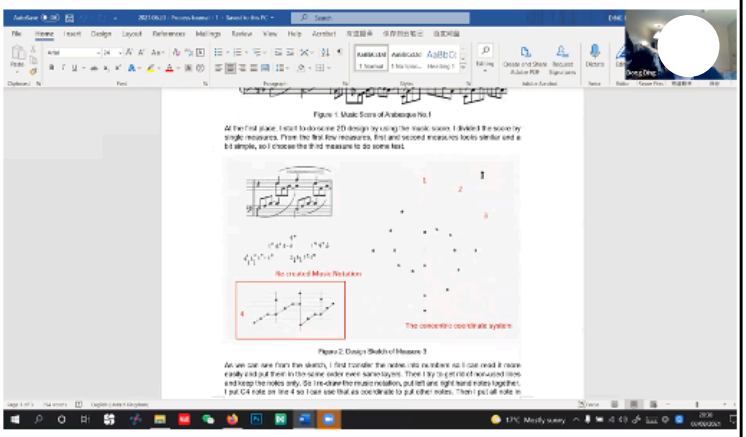
Stage one:

The data collection methods for the project were defined and agreed upon at an early stage, with an initial agreement reached with Rebecca, as documented in the meeting record transcription from 2020.06.09:

> *"... there is another thing related to my own research. I would hope that after our meeting, or in the process, we can write something like a reflection to record our actions and ideas. This kind of textual documentation will be very helpful for my research after the practice. I will write a reflection journal during my design process and if you have time, please also do the same …"*
>
> *(David, Meeting time code: 2020.06.09 - 00:42:19)*

> *"... I understand, I'll try my best …"*
>
> *(Rebecca, Meeting time code: 2020.06.09 - 00:43:04)*

Initially, I adopted a 'process journal' and 'feedback journal' approach for data recording and collection at the outset of the design process. In the early stages and during the first few meetings, these journals were shared through our online sessions, as detailed in the table below:

Meeting Timecode	Shared by	Content
2020.06.09 00:58:22 - 01:04:40	David	 … this is the first journal I write for our first mode exchange for my other project. This is the process blog, and I am waiting for her modified model to come back. Then I can write a reflection journal on that, so this is how it works …
2021.08.03 00:15:53 - 00:18:17	David	
2021.08.03 00:19:26 - 00:20:55	David	

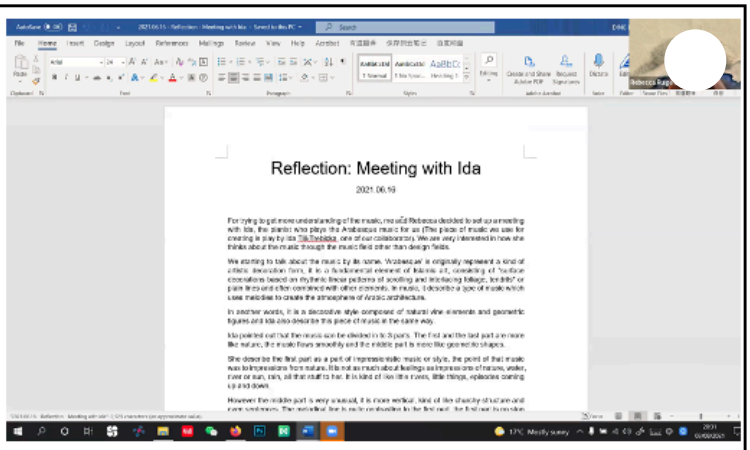
2021.08.03 00:20:55 - 00:22:57	David	 … this is the reflection journal I wrote after our meeting with Ida. I am talking about her view on the music, which is different from a design perspective like ours. The way I am using it is to use our meeting record. I am listening to the recording and wrote this journal …

Table 5.2-1: The 'process journal' and 'feedback journal' approach to data recording and collection at the beginning of the design process

Initially, the journals shared in our meeting on 2020.06.09 were from the *'Viral Making'* project - a related initiative within this program of research that adopts a similar approach to data collection. The purpose of referencing these journals was to illustrate an effective data collection method through sharing. Subsequently, in our exchange on 2021.08.03, I shared journals that I had developed earlier in this project to introduce Rebecca to the methodology of recording and sharing the design process through the creation and use of journals.

Stage two:

However, during our discussions, Rebecca expressed that process documentation was uncommon in her practice due to her working style and habits, making it challenging for her to document the design process in writing or to provide written feedback afterwards. Although my efforts to encourage and remind Rebecca to document her process in several meetings, these attempts were ultimately unsuccessful, as detailed in the table below:

Meeting Timecode	Content
2021.06.09 00:42:19 - 00:43:27	**David 00:42:19** … I would hope that after our meeting, or in the process, we can write something like a reflection to record our actions and ideas … **Rebecca 00:43:04** I understand, I'll try, but this is the part I am lacking. My document process is weak.
2021.06.09 01:04:07 - 01:04:40	**Rebecca 01:04:07** Okay, well I agree, I will try. Because for visual artists, normally it's very hard to, especially when you are in the creating process. **Rebecca 01:04:40** Ok, I'll try to record as much as I can when I produce an image.
2021.07.06 00:07:05 - 00:07:36	**David 00:07:05** If you have time, can you write a small piece that includes your thinking process, which may be very helpful for my analysis process later. Like how your mind changed, or how you think about it. **Rebecca 00:07:29** Do I have time to write? I don't know if I have time to write. That's the problem here, I know I am lacking in the documentation process…. **David 00:07:36** Just take some notes when you have time, like 100 words by 100 words, so we can have them all together in the end to become a larger piece of writing.
2021.09.09 00:17:26 - 00:18:13	**David 00:17:26** Can you maybe record all these things you just talked about your thoughts about all the shifts among this software. **Rebecca 00:17:3** I know, you tell me every time. **Rebecca 00:18:04** Sorry about that, I know that's the part I am lacking. **Rebecca 00:18:13** But also, i think it is because i am still more like a practice and artist mindset. When I am doing the practice, I will just focus on how to process the practice and ignore the document process. But I know this is something I should do. I really should have it.
2022.03.21 00:02:14 - 00:02:38	**David 00:02:14** If you have time to write a few sentences next to each picture, or just put it in a word document, like why didn't you choose this one? Because you think it's dirty, it doesn't match the feeling of the music, just to have something like that. Or maybe you can record a video, talking about all these reasons of why you like this or not when you are reviewing all these pictures

Table 5.2-2: Recoding of discussion on data collection method

During the discussion process, different ways of recording data were also proposed (as shown in the table below):

Meeting Timecode	Content
2021.06.09 00:43:27 - 00:44:21	**David 00:43:27** Yes, but it doesn't have to be textual documentation, it can also be sketches, or even process records, for example some screenshots of your program, I think these will be very useful for me, if we can keep as much of this sketches or process documentation as possible, then it will be very helpful for my analysis afterwards.
2021.06.09 00:57:52 - 00:58:07	**Rebecca 00:57:52** Ok. I was just thinking, because we're also recording this conversation now, right? **David 00:58:02** Yes, we can also take something like bullet points or transcript from this record. **Rebecca 00:58:07** Yes, it's possible to document in that way. And on the other hand, of course, when I work on my own piece, that is something that needs to be documented.
2021.06.09 01:03:41 - 01:05:05	**David 01:03:41** … I think for this step we need to document our design and make the process more … **Rebecca 01:04:07** Right, it's like that. Okay, well I agree, I will try. Because for visual artists, normally it's very hard to, especially when you are in the creating process. **David 01:04:23** It's also very difficult for me, we normally don't have a written record, I'll just take photos whenever I want, but I might put all the photos in my sketchbook and write a little bit of notes beside it to record what I am thinking at that time. I think it is the same if you can make a little note when you are doing your design. **Rebecca 01:04:40** Ok, I'll just try to record as much as I can when I produce an image.
2021.07.06 00:07:05 - 00:08:32	**David 00:07:55** It doesn't need to be very professional like your other writing pieces. It's just something like notes, it will be enough for my analysis. **Rebecca 00:08:05** I think it will be a little bit hard for me to write, but I am ok now when I am talking to you, so a verbal recording might work for me better. **David 00:08:18** Ok, if you can take a record when you are doing design thinking and send it to me then I can do the transcript afterwards. **Rebecca 00:08:27** Yeah, I think it might be a little bit easier that way. **David 00:08:30** Ok, I am ok with all kinds of formats.
2021.08.03 00:19:26 - 00:22:16	**David 00:19:26** … these three are the process journals I am written during the design process. I just use this as an example to show you, you can do the same as me or like you said before, to do audio recording. The main thing is to document your thinking, whatever the language or format is … **Rebecca 00:19:56** So, you want me to document more about my process, right? **David 00:20:03**

	Yes, as you can see this, I just record what I did, why I made the decision, and how I thought about it. So, it is more like a process record. **Rebecca 00:20:28** I will try. I think it's really better for me to do recording than writing. **David 00:20:37** I think record is a possible choice. I think all formats are ok, but there has to be something. **Rebecca 00:20:42** Okay, that's fine. I will record when I have a conversation with Sean about the project. **David 00:20:55** Right, and like after meeting with Ida, I wrote a reflection like this … **Rebecca 00:21:35** Ok, send it to me, I'll read it and I have to keep it in mind at all times. You know we are artists; we always have a lot of ideas, and our design ideas often change a lot and very fast. **David 00:21:52** Yeah, me too. So that's the way I would take it. I will take notes even if 100 words is fine, so I got evidence for my process. **Rebecca 00:22:16** Okay, I will do that.
2021.08.03 00:26:05 - 00:26:51	**David 00:26:05** If you didn't do any documentation before, for example some test pieces are already done, you can record a video, like you have your piece show on the screen and you can just sit there and talk about it, for example, how I thought about it originally, then what happened next, how it looks in the end, why you like it or not, something like that. **Rebecca 00:26:30** Ok it's fine, I certainly have some other simple documentation that I can sort out for you, no problem.
2021.09.09 00:17:26 - 00:18:53	**David 00:17:26** Can you maybe record all these things you just talked about your thoughts about all the shifts among these software. **Rebecca 00:17:3** I know, you tell me every time. **David 00:17:42** If you really don't have time, I can use the things we just talked about to do a transcript and send it to you. You can check and add things to it. **Rebecca 00:18:02** Ok **David 00:18:02** That will save your time **Rebecca 00:18:04** Ok thank you. Sorry about that, I know that's the part I am lacking. **David 00:18:11** No worries, I know you are busy. **Rebecca 00:18:13** Yes. But also, I think it is because i am still more like a practice and artist mindset. When I am doing the practice, I will just focus on how to process the practice and ignore the document process. But I know this is something I should do. I really should have it. **David 00:18:42** No worries, I can help on this part. I can do a transcript on what we just talked about and send it to you, you just need to check and add things, it will save a lot of time. **Rebecca 00:18:53** OKOK

2022.03.21 00:02:14 - 00:02:38	**David 00:02:14** If you have time to write a few sentences next to each picture, or just put it in a word document, like why didn't you choose this one? Because you think it's dirty, it doesn't match the feeling of the music, just to have something like that. Or maybe you can record a video, talking about all these reasons of why you like this or not when you are reviewing all these pictures. **Rebecca 00:02:38** Ok well, we're doing this now. I'm talking to you now, I'm talking to you now about this stuff you can use as a record.

Table 5.2-3: Recoding of discussion on data collection method

Ultimately, Rebecca concluded that it would be more effective for her to transition from a textual journal format to a visual one, such as screenshots documenting the design process. She decided to share these visuals during our online meetings. The content shared and the discussions generated during these meetings could then be recorded and transcribed, providing the raw data for the project. As Rebecca states:

> *"... Ok, I am thinking that, because we are recording this right? … We can get some points from this … it's possible to document in that way …"*
>
> *(Rebecca, Meeting time code: 2021.06.09 - 00:57:52 - 00:58:07)*
>
> *"... for me, I think sometimes it is very difficult for me to write about something, but when I am talking to you like this … So, I think it might be easier for me to do some verbal recording …"*
>
> *(Rebecca, Meeting time code: 2021.06.09 - 00:08:05 - 00:08:27)*
>
> *"... Actually, I think the recording we are doing right now is ok to use, I am talking to you about this (design process), the things (design process) I am telling you right now …"*
>
> *(Rebecca, Meeting time code: 2022.03.21 - 00:02:38)*

This approach was endorsed by me and recognised as a more effective method of data recording in this project. It also allowed for a more immersive engagement with the practical aspects of the project by minimising the intrusion of research-oriented thinking into the creative process. Consequently, the original method of documenting progress through individually created 'journals' was abandoned. Instead, a new data

collection method centred around 'online meetings' was developed. In this format, Rebecca shares her design process through online meetings, supplemented by screenshots of her program design process, providing the raw data for collaborators from the visual field in this project. Similarly, I share my process through online meetings, using digital models, renderings, and physical models to support the sharing and documentation of my work, thus forming the raw data from the jewellery design perspective of this project.

5.3 Boundary Objects in the *'Data-Music-Jewellery'* Project

As mentioned in Section 4.4, during the review process of the *'Data-Music-Jewellery'* project dataset, from the perspective of the integrated boundary object framework, 37 boundary objects were identified and classified into 8 categories: Contextual Example, (Process and Reflective) Journal, Process Image, Process Video, Digital Model (Rhino 3D Model), Digital Model (Rendered Image), Digital Model (Rendered Video), and Physical Model. In this section, the roles and characteristics of these eight types of boundary objects in the cross-disciplinary jewellery creation process and in the knowledge flow process based on a collaborative environment will be discussed.

5.3.1 ‘Contextual Examples’ as Boundary Objects

The term "Contextual Examples" refers to a kind of abstract object found in the practice this research focuses on, which plays boundary roles. Essentially, they are examples of artists, or their works borrowed from other contexts to aid communication during the collaboration process. When these examples are incorporated into this practice, they are endowed with the narrative of this particular practice and only serve their purpose within this context, thus called "contextual examples."

Rebecca seemed to use contextual examples more often than I did. In the early stages of the project, Rebecca primarily utilised these contextual examples to demonstrate the form and working methods of the visual field. Within the context of the entire project, their main application was to assist Rebecca in presenting the desired design effect she aimed to achieve, especially when no models or finished products were available. In these cases, the 'contextual example' primarily operates in the capacity

of the 'semantic boundary object' as mentioned in the research by Marheineke et al (2016).

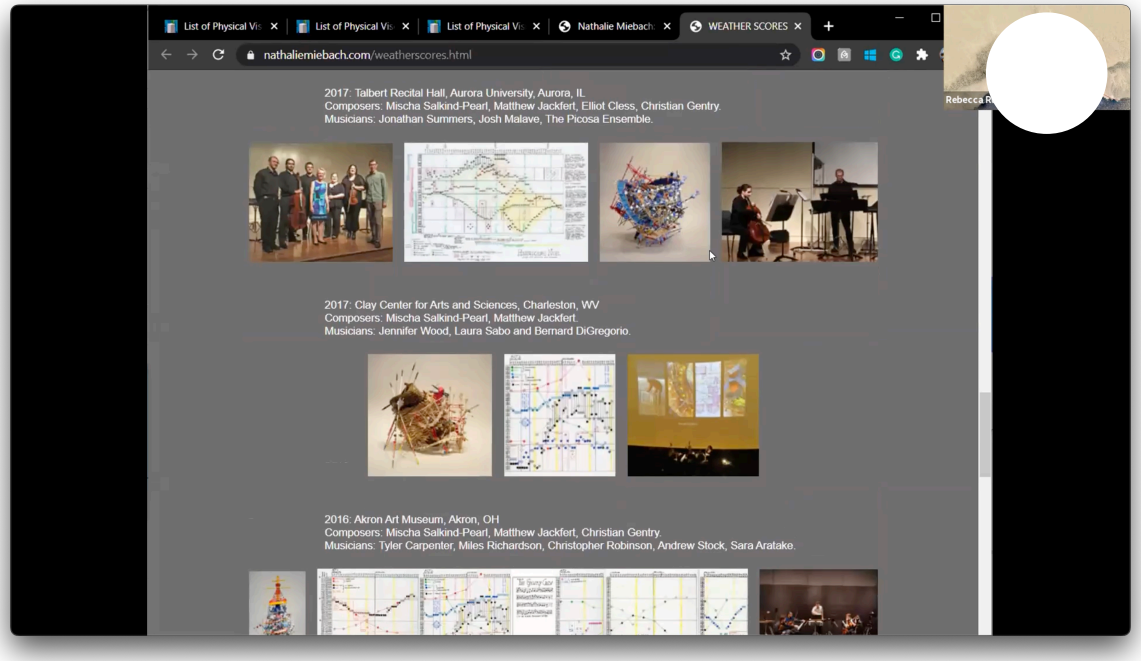


Figure 5.3-1: Work form Nathalie Miebach shared by Rebecca during online meeting

Firstly, the 'Contextual Example' played an 'introduction' role in the initial meetings of the project. Here, the contextual examples Rebecca cited were random, referencing the works of visual artists unrelated to the design process of this project. This was part of an early phase aimed at broadly exploring potential directions of interest by establishing collaborative themes. In this process, the 'Contextual Example' not only demonstrated its standalone 'introduction' role but also its capacity for knowledge deconstruction. At this point, both roles interacted and operated in tandem — knowledge related to the visual field was initially deconstructed, thereby introducing me to the visual field and its operational methods.

By referencing notable artists in the visual domain, Rebecca showcased the forms and working methods of the visual music field. In this process, Rebecca's personal experiences and her expertise in the visual field were deconstructed into fragmentary knowledge: For instance, through the presentation and interpretation of the works of artist Nathalie Miebach (Figure 5.3-1), Rebecca illustrated one of the working methods

in the visual field — creating one's own system to facilitate a transition between data and visual elements.

> *"... you have to have a system, a system of your own, and once your system has been settled …"*
>
> (*Rebecca, Meeting time code: 2020.10.09 - 00:22:13*)

In the subsequent review of data, the design approach exhibited by Rebecca, with distinct visual characteristics, was also identified in my design method. During the data review and analysis, it was recognised that my design also adopted a similar approach - creating a mapping system to facilitate the conversion between musical score (data) and design elements.

As shown in Figure 5.3-2, Rebecca's perception of the data (for her, the sounds of the music) is manifested through her emotional feedback to the auditory experience. As well as her application of the mapping system - involves visual elements such as colour, free and coherent form changes, and dynamic transformations of visual components – all embedded within her unique experiential knowledge, design thinking, and the digital manifestation of her work.

Similarly, as shown in Figure 5.3-3, my perception of the data (which to me is the musical score itself) is oriented solely around the score. I view the arrangement of the musical notes as a pattern, isolating it from the emotional interaction with the sound of the music. Additionally, the design and application of my mapping system create intricate spatial structures by repositioning musical notes through a 'sonar' mapping system, further evolve them into physical design elements. This perception of data form and the design and usage of the mapping system are deeply rooted in my personal experiential knowledge, design style, and the physical manifestation.

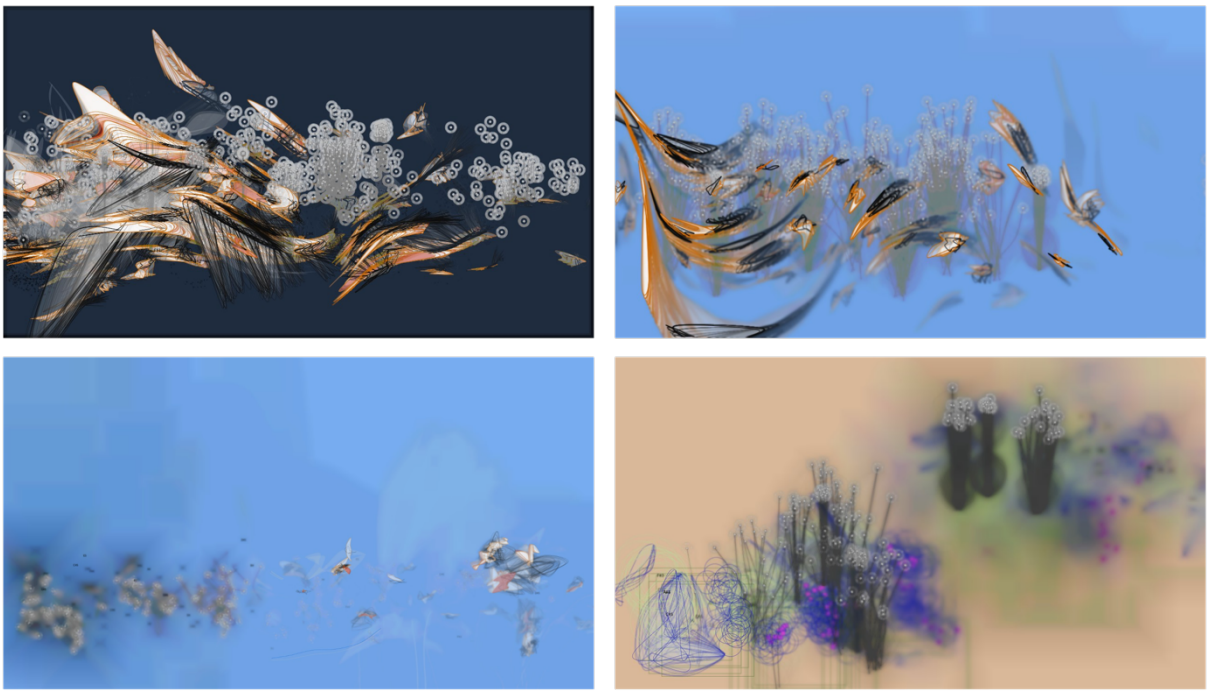


Figure 5.3-2: Examples of Rebecca’s Creating progress image

Therefore, while to some extent I adopted a data art approach to design, similar to Rebecca’s. However, the application of this method is distinct:

- In terms of accessing data, Rebecca tended to approach from emotional feedback of sound, while I found the pattern arrangement of the score engaging.

- In terms of the design and application of the mapping system, Rebecca's system relates to colour and the transformation of visual elements in form and dynamics, inherently linked to the 'digital' form of representation. Conversely, my mapping system pertains to the spatial positioning of elements and the modelling of complex spatial forms, intrinsically tied to the 'physical' representation.

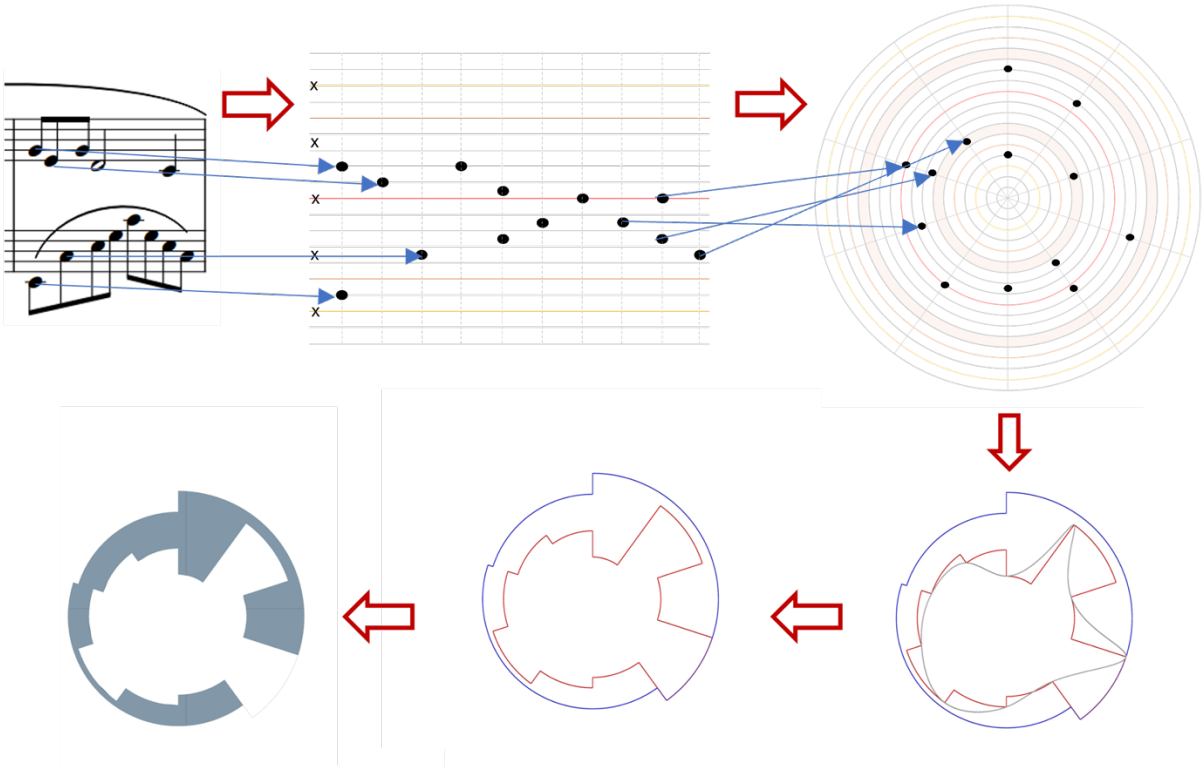
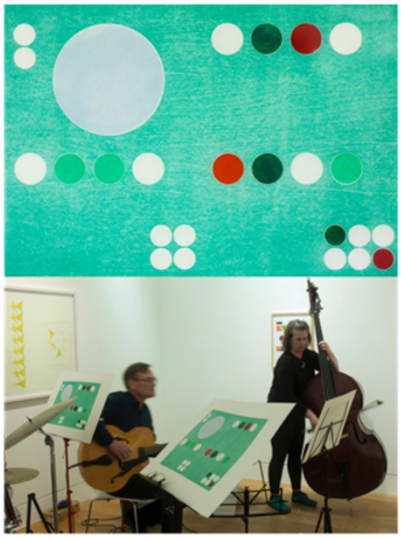


Figure 5.3-3: Design progress image shows my design approach

In this context, it seems to suggest that Rebecca's design approach, demonstrated through the contextual example – centralising around a self-created system for data and design element conversion (deconstructed fragmented knowledge) – was recognised, picked up, applied, and then expressed anew by me based on my own knowledge structure. This translated into a self-created system centric conversion between data and physical design elements and complex spatial structures (a new expression of the picked-up fragmented knowledge according to my knowledge structure). This transformation carries the distinctive marks of my personal experience.

What is being showcased here is that, when the 'contextual example' serves as a boundary object, executing the function of 'translation and interpretation' associated with the 'semantic boundary objects' mentioned by Marheineke et al. (2016), it has the capacity to deconstruct the knowledge of the proposer of the boundary object into fragmented pieces. These pieces are then reconstructed by the receiving collaborator, integrating personal experience to form a completely new expression of knowledge. Notably, this realisation emerged only upon retrospective analysis of the data; during the actual collaborative process, such knowledge deconstruction, reconstruction, and

transformed expressions were not consciously recognised by either collaborator. Thus, this deconstruction and appropriation of knowledge based on the contextual example seems to have occurred on a somewhat subconscious level.



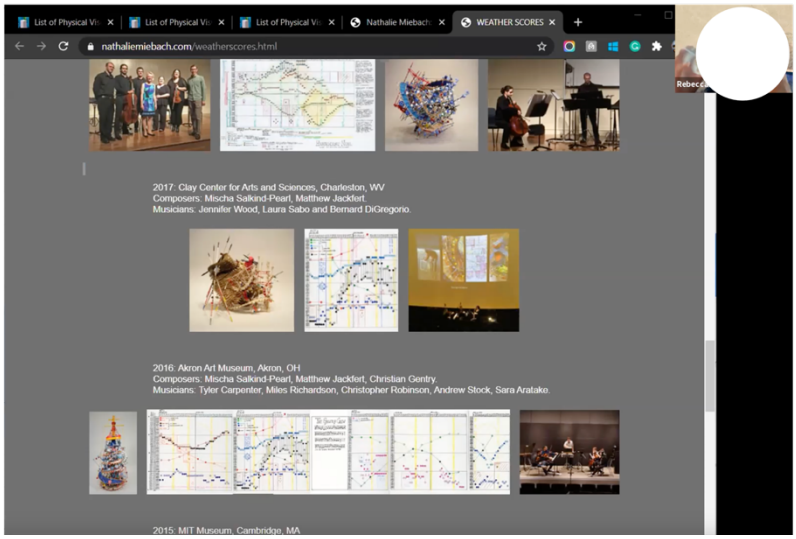


Figure 5.3-4 (Left): Silent Music | Seeing Sound
- by Jo Ganter RSA in collaboration with musician and composer Raymond MacDonald (Shared by me during online meeting)

Figure 5.3-5 (Right): Nathalie Miebach's work on her website
(Shared by Rebecca in responding my contextual example)

In the collaborative process, there were instances when different external examples were brought into the conversation by both parties, influencing one another. In such scenarios, contextual examples, acting as boundary objects in their translational role, shaped the connections between design decisions due to interactions between the examples, thus enhancing mutual understanding among us as collaborators. Here, Nicolini et al.'s (2012) framework of "dynamics of boundary objects" can provide a valuable lens through which to observe and interpret the interactions between contextual examples:

David 00:12:28
In the project I saw, they started from a music score. They redesigned the music score and transformed it into a graphic and colours. Then they had musicians play this score again. The approach in the first half is somewhat similar to mine.
Rebecca 00:12:42
I know. I think I've seen a similar project. Do you remember the sculpture by Natalie I mentioned to you? Even though her sculpture didn't start with music, it resembles the latter part of this method. The data formed by her sculpture was converted back into a music score...
David 00:27:12
Like those two people we just talked about, they transformed the music score into a graphic, and then the graphic was transformed back into music by musicians. For our piece, especially my part which is a physical sculpture, could we possibly transform it back into music from its physical form? Because as a sculpture, mine is 3D, which contains much more information than their 2D graphics. Suppose we find a musician and I explain how to read the sculpture. If he can try to reinterpret it back into music based on what I've told him, there will be a change on the recreated music. The understanding will be biased, which will result in something entirely different.
Rebecca 00:27:56
Right, we could definitely try that."

(*Rebecca & David, Meeting timecode： 2021.11.17 00:12:28 - 00:27:56*)

For instance, in one meeting, I presented two examples related to visual music named ‘silent music and seeing sound’ (Figure 5.3-4) that I discovered during the independent development stage of the practice. These examples illustrated the transition from music to sculpture and back to music. I believed they were highly enlightening and worth sharing. Following my sharing, Nathalie Miebach’s example (Figure 5.3-5) was revisited by Rebecca. Although the same example had been used by Rebecca in our first meeting (Figure 5.3-1 & Figure 5.3-5), unlike the previous mention of Nathalie Miebach 's example (Figure 5.3-1), this instance (Figure 5.3-5) was brought up based on the examples I provided (Figure 5.3-4) and was cited by Rebecca in response to my examples.

Here, the connection between the two examples (the manner of creation, use of design elements, etc.) facilitated mutual understanding. Based on Nathalie Miebach 's work, Rebecca could better comprehend the examples I proposed and further relate them to my design approach during the discussion. Through subsequent discussions, the sharing and deliberation on these two examples gave rise to new ideas for our collaborative design.

Moreover, we observe here the dynamic change in the function and role of Nathalie Miebach's work as a boundary object. As Nicolini et al. (2012: 37-38) mentioned,

"collaboration objects follow a trajectory or have a career (Engeström & Blackler 2005); they perform certain functions and then disappear behind the scenes until the plot requires them to resume centre stage." At the beginning of the project, Nathalie Miebach's work (Figure 5.3-1) was introduced to showcase the working methodology and form in the visual field. After completing its role, it temporarily concluded its on-stage presence, taking a step back. However, once I shared the 'silent music and seeing sound' projects, Nathalie Miebach's work (Figure 5.3-5) returned to the spotlight, interacting with the 'silent music and seeing sound' examples, and once again performing its function as a boundary object.

Moreover, the interaction of the two contextual examples here indicates that such examples can not only be used to enhance the understanding of others but also be cited to reinforce one's own understanding. The two examples, belonging to two different fields, are built upon each other and proposed and cited by different collaborators. (For better explanation and comprehension, the collaborator who first introduces an example will be referred to as A, while the collaborator who subsequently introduces another example based on A's example is referred to as B.) We can see that, using our practice as an illustration, A employs a contextual example with the intention of deconstructing their own knowledge and perspective in a more intuitive and vivid manner, facilitating B's understanding and grasp of fragmented knowledge. The example that B cites, which is based on A's example, serves to reinforce comprehension through certain similarities between the two examples, ensuring a deeper grasp of A's knowledge. The example B brings up is then feedback into the understanding process, consolidating and enhancing comprehension, leading to a cyclic flow of knowledge between the two collaborators.

Back to our practice and viewing it from a dynamic perspective, Nathalie Miebach's work, from the inception of the project to its evolution, has undertaken a recurring journey from being a boundary object to a non-boundary object and then back to a boundary object. Furthermore, the roles and functions it assumed when it re-entered the working domain on both occasions were not entirely identical. Although both served as a kind of "semantic boundary object" to facilitate "translation" between collaborators, the first time it aided the deconstruction and reconstruction of knowledge independently, while the second time, in collaboration with other contextual examples,

it mediated knowledge disparities between the collaborators, fostering mutual understanding and collaboration.

Collaborators occasionally integrate parts of their existing projects into the project discussions, utilising them as external contextual examples. For instance, during one of our discussions, Rebecca emphasised the significance of 'time' as a pivotal attribute in her musical perception. To elucidate this notion, she presented one of her existing projects as a contextual example (Figure 5.3-6) to facilitate the conversation on this topic:

> ***Rebecca 00:22:39***
> *In this project, I took a very interesting approach... I used a program to draw the sections of music, but I didn't erase the results after each section. So there's an accumulation here, it's not music that corresponds one-to-one. What I mean is, for instance, I generate images for every second of the music, but I don't erase the result, making 5 seconds a layer, so the image you see is the accumulation of these 5 seconds. So it's not just the sum of one moment (second), it's the sum of a period of time. So from this perspective, it bears some resemblance to the approach in your current project.*
> ***David 00:23:45***
> *Yes, I've been thinking about the same thing too.*
> ***Rebecca 00:23:48***
> *Because my work is time-based, for me, 5 seconds produces an image, and then I just move on, the next 5 seconds become another image, and I put all the 5 seconds together. I get a superimposed effect.*
> *But you don't superimpose, you place things side by side.*
> ***David 00:24:50***
> *But in my work, if you look at it from the side, it's layered, but if you look straight on, it has a superimposed effect.*
> ***Rebecca 00:24:57***
> *Right, but our superimposition is different. Mine is this progressive overlay, like steps.*
> ***David 00:25:10***
> *My overlay is a vertical (depth-wise) overlay.*
> ***Rebecca 00:25:12***
> *Yes, yes, so that means there are some similarities. I find it interesting that in this case, you transition the entire time-base into a space, so I think it's quite meaningful."*
>
> (*Rebecca & David, Meeting time code: 2021.11.17 00:22:39 - 00:25:12*)

In this case, Rebecca's previous work (Figure 5.3-6) initially functioned akin to a 'semantic boundary object' (Marheineke et al., 2016) – it aided in articulating Rebecca's understanding of the 'time based' attribute of music through a 'visual representation' (Nicolini et al., 2012), shaping a potential mutual comprehension between both collaborators regarding the 'time base' attribute of music. Concurrently, this example underscored Rebecca's emphasis on the 'time base' attribute of music,

suggesting that the ‘time base' attribute of music might become a focal point in our future design decisions. Here, the introduction of this example established a foundation for potential design decisions by offering and setting up negotiable shared grounds.

Additionally, this example, when initially introduced, also operated as an 'existing boundary object' (Halpern, 2012), functioning concurrently with its role as a ‘semantic boundary object’ – this example was part of Rebecca's existing work and was introduced by Rebecca into the boundary zone to assist in explaining her understanding and expression of the 'time base' attributes of music. However, subsequently, Rebecca endowed this example (the design method adopted by Rebecca in the original topic, which will be referred to as '5 seconds accumulation' for better understanding) with a new meaning in the collaborative context through its comparison and association with my design approach in our practice.

Through Rebecca's description and our discussions, the '5 seconds accumulation' connected with my design method in this project - both aimed to solidify time in some way. Since Rebecca's work was presented digitally, the inherent attributes of the digital format (i.e., allowing dynamic changes) shaped Rebecca's design approach. In contrast, my work was presented in a physical form, where each individual sculpture represented an accumulation of a short section, and the entire tunnel shape represented the accumulation of the entire piece of music. This was a design approach consistent with the physical form of the work. Due to these differing design methods, the temporal attribute of music was expressed differently by both of us. Through this contextual example, we discussed and linked the different approaches we applied to the same design element. Although the modes of expression varied, the attributes expressed were the same, and the methods we used related to the experiential knowledge we embodied, and the design methods rooted in our respective fields.

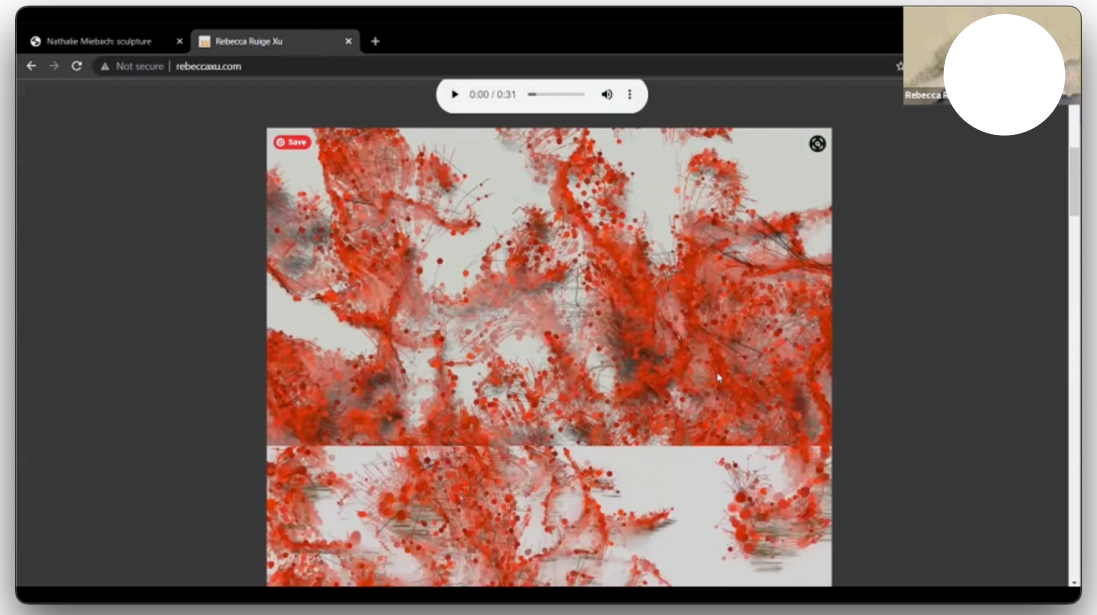


Figure 5.3-6: Rebecca's previous work 'Agitato' shared by Rebecca during online meeting

For Rebecca, the '5 seconds accumulation' initially represented her design approach within her original project context. It is the result of a series of design decisions based on that specific design context. When the '5 seconds accumulation' was introduced into the collaborative context of this project, its original meaning became only discernible to Rebecca due to the loss of its original design context. However, when Rebecca attempted to compare and link it to my design method in our practice as 'a way to solidify time', '5 seconds accumulation' began to hold a new meaning for both of us. This new significance was bestowed upon it through its interaction with my design method in our practice and our shared design thinking within the boundary zone. Throughout this process, '5 seconds accumulation' facilitated the connection between two distinct design methods. It underwent a transition from decontextualization to recontextualization. The function and nature of its boundary object role also shifted—as it was imbued with a new meaning in the boundary zone, it began to operate as an 'appropriated boundary object' (Halpern, 2012).

5.3.2 ‘Journal’ as boundary objects

Journals represent a type of digital object that acts as a boundary object in the practice projects of this program of research. They signify a form of recording the practice process, divided into process journals and reflection journals. The referenced journals come from two sources: external, which were created within another practice project related to this research (the *'viral making'* project), and internal, consisting of process and reflection journals created by myself in the early stages of the *'Data-Music-Jewellery'* project.

The use of journals all from the jewellery field (by myself), primarily serves to manage the project process and knowledge sharing. The primary function of the journals - particularly in managing the data collection process within the project - represents their core responsibility and was the initial reason for their incorporation. In these instances, journals often function as syntactic boundary objects and pragmatic boundary objects as described in Marheineke et al.’s (2016) research.

Initially, the journals used in the *‘Data-Music-Jewellery'* project were from another practice project related to this research (the *'viral making'* project). Their inclusion aimed to negotiate, establish data recording and collection methods within the *'Data-Music-Jewellery'* project with collaborators. In the *'viral making'* project, a method based on 'process journals' and ‘reflection journals' was adopted for data collection and recording. This method involved collaborators creating 'process journals' to document the design development process, including the sources and reasons for design decisions. After mutual interaction, ‘process journals' were created to reflect the communication process, gather inspiration, and understand the impact on each other's design development.

In the early stages of the *'Data-Music-Jewellery'* project (Second meeting on 2020.06.09), a discussion on the attempt to adopt this method of data recording and collection. Hence, a journal from the *'viral making'* project (Figure 5.3-7) was referenced and discussed with the collaborator (Rebecca) to address the documentation process within the *'Data-Music-Jewellery'* project.

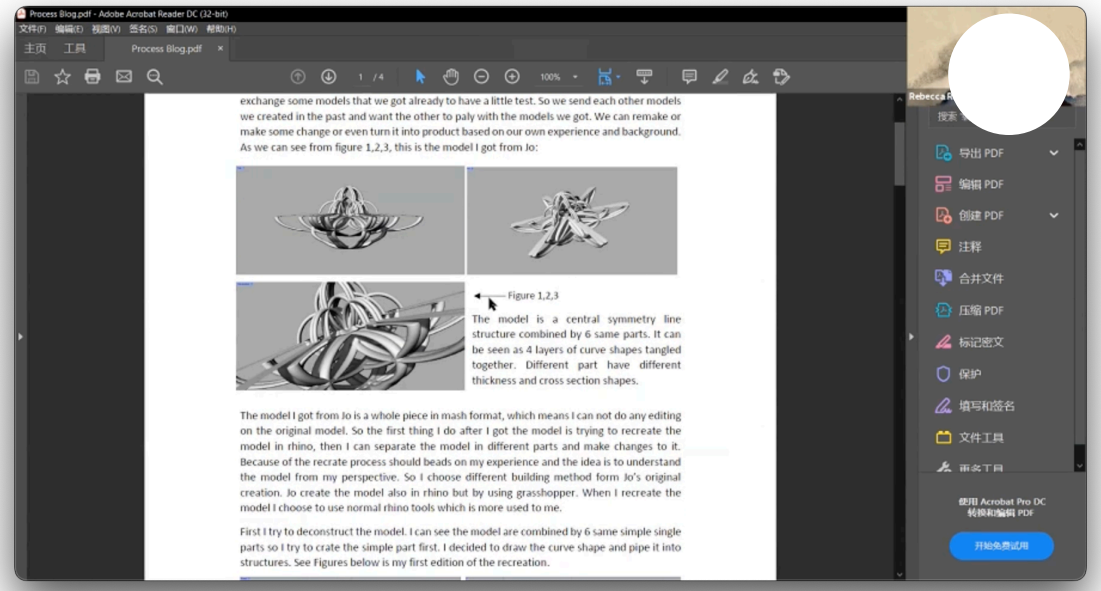


Figure 5.3-7: Me sharing process journal form from the *'Viral Making'* project during online meeting

David, 00:57:40
We should try to keep some written records.
Rebecca, 00:57:52
Ok. When we work on our own projects, that stuff can be documented.
David, 00:58:22
Did I mentioned my other project. During that project, we exchange models. When I modify her model, I will write something called a 'process journal' to record why I make these changes, how I make them, and what my thoughts are while making them. She will write something similar. After that, we exchange the modified models. At this point, I will write a 'reflection journal', which records my thoughts upon seeing her modifications to my model. I think this method could be similarly applied to our situation here.
Rebecca, 01:00:19
Have you started writing the journals? I'm quite curious.
David, 01:00:35
Yes, I can show you. I think our first step is the independent design process, so in the first step, we can record our own creative processes. In the second step, including what we just talked about, you using my design for modelling and me using your design, this already creates an exchange, and during this process, we can have a reflection journals.
Rebecca, 01:04:07
Right, that's how it is. Okay, I agree, I'll try my best. I'll try to record more when I produce images.

(David & Rebecca, Meeting Time Code: 2020.06.09)

Here, using process journals created from another project as examples, 'journals' act as syntactic boundary objects as mentioned in Marheineke et al.'s (2016) research, attempting to establish a standardised method of information collection and storage

within a boundary zone. Furthermore, the creation of journals not only serves as a medium for collecting feedback on design processes and ideas but also plays a role in reconciling the differences in working methods between collaborators. This enables the sharing of design processes in a common format and logic, facilitating smoother and more effective communication between different fields and work methods – this demonstrates a working approach similar to pragmatic boundary objects.

Following this meeting on 2020.06.09, I experimented with this data recording approach and brought the 'process journals' and ‘reflection journals' I created into the next meeting on 2020.08.03, to continue the previous dialogue on establishing data collection methods. Compared to the previous example of referencing a journal from an external project (Figure 5.3-7), these journals, rooted in the context of the *'Data-Music-Jewellery'* project, provided a more concrete understanding of this method within our practice context. Based on such discussions and considering the working habits of both collaborators, we later realised that this method was not the most suitable in the context of our project. Consequently, through further discussions, we established a method of data collection through records of online meetings based on direct sharing of digital models and process creative artefacts. (This process of change has been detailed in the previous section 5.2.3.2 on the change to data collection methods.)

Additionally, even within the same meeting, the function of a journal can shift depending on the different context of the discussion. When a journal is used to share the design process, it transforms into the role of semantic boundary object, contributing to the mutual understanding of the collaborators. In the previously mentioned meeting on 2020.08.03, while the primary purpose of using the 'process journals' (Figure 5.3-8) and ‘reflection journals' (Figure 5.3-9) was to demonstrate to Rebecca the specific application of journals as a data collection method in our project context, but the sharing of this approach also included a presentation of my early design process using the journals at the same time.

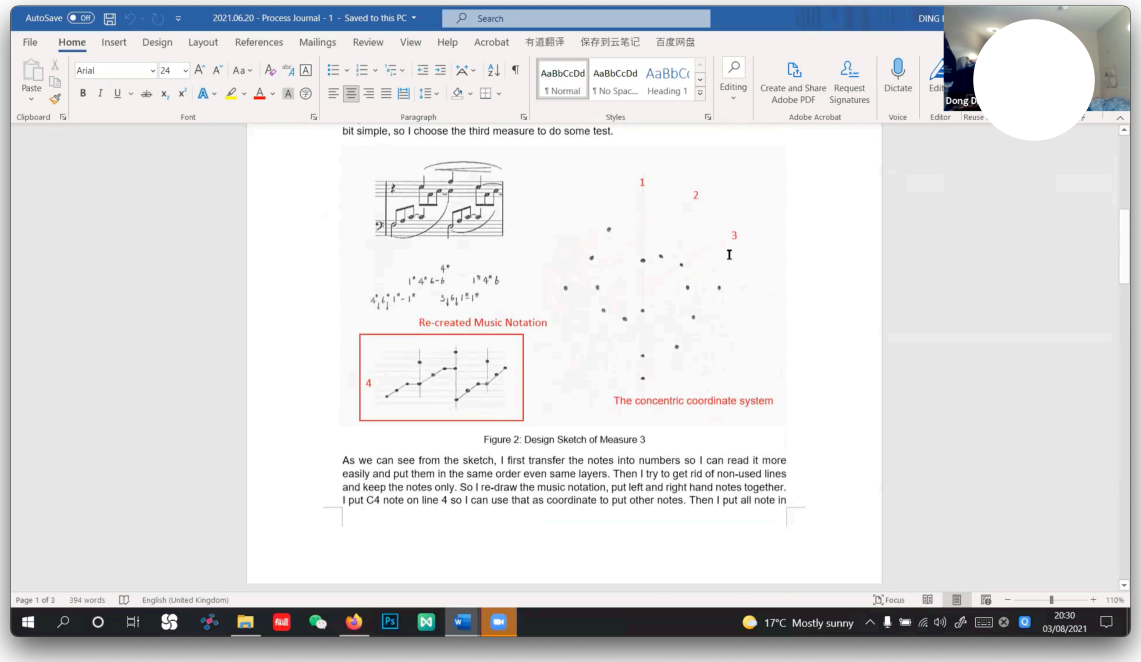


Figure 5.3-8: Myself showing process journal about my independent design process for the *'Data-Music-Jewellery'* project during online meeting

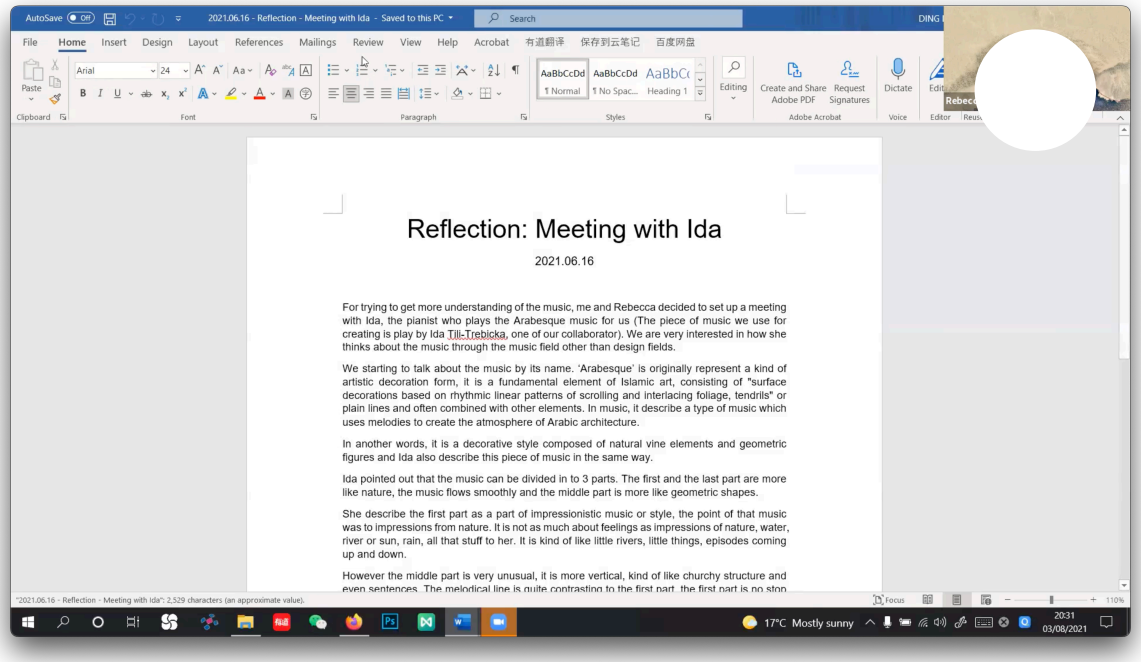


Figure 5.3-9: Myself showing reflection journal about meeting with Ida for the *'Data-Music-Jewellery'* project during online meeting

As illustrated in Figure 5.3-8 and 5.3-9, the 'process journal' (Figure 5.3-8) displays my early design process and some preliminary sketches, while the ‘reflection journal' (Figure 5.3-9) reflects on feedback from the meeting with our other collaborator, pianist Ida. It records Ida's understanding of the fundamental design element in this project (Arabesque No.1) from a musician's perspective, as well as my response to her interpretation.

At this point, the function of the journal undergoes a transformation – while it continues to act as a syntactic and pragmatic boundary object attempting to establish a standardised data recording method, it also adopts the role of a semantic boundary object. However, it's important to note that in this context, the journal fundamentally serves as a record of digital models (another type of boundary object identified in this practice, which will be analysed in detail in the following sections). Its mode of operation is akin to that of digital models.

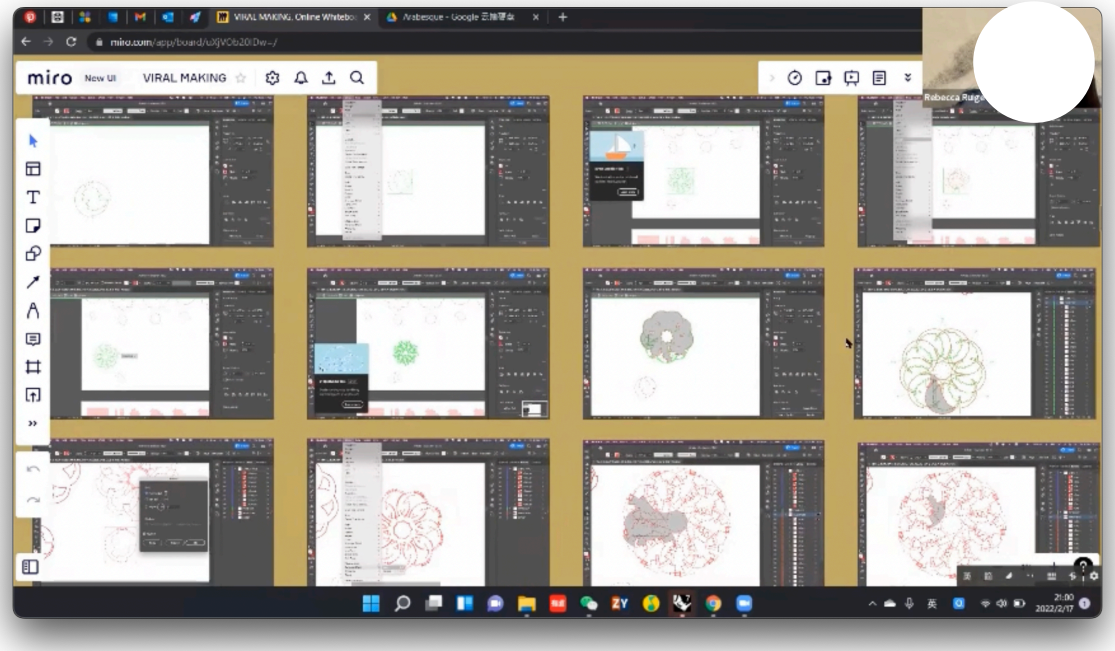


Figure 5.3-10: Myself showing Jo’s process journal from the *‘Viral Making’* project during online meeting

As a semantic boundary object in this case, the journal merely exhibits the capability to deconstruct knowledge – it deconstructs my knowledge through visualised

information (sketches involved in the design process, screenshots of models, etc.), enhancing Rebecca's understanding of my design process and decisions. However, this deconstructed, fragmented knowledge only reinforces her understanding and does not impact her independent design process (no reconstruction of new knowledge occurs). Simultaneously, the deconstruction of knowledge and the establishment of a standardised data collection method occur concurrently. This implies that the journal fulfils the multi-role of a semantic and pragmatic boundary object, as well as a syntactic boundary object at the same time.

In certain specific contexts within the *'Data-Music-Jewellery'* project, the use of journals has provided an external perspective to the development of the project. Since the digital models created in this project were used across different projects, the models I developed independently in the first phase of the *'Data-Music-Jewellery'* project were introduced into the *'viral making'* project, participating in the first phase of the model exchange cycle. (More detailed description of this process can be seen in appendices 3 & 4, where I describe the practice process of the *'Viral Making'* project.) The journals created by collaborators from the other project offered an external viewpoint. Specifically, the journals from the *'viral making'* project, which essentially record Jo's modifications to the same digital model, provided an external perspective to this project.

During this process, a new external viewpoint - Jo - was introduced into the project. Jo's transformation of the model from a 2D perspective sparked new ideas for the development of the model on my part. Based on Jo's innovative development of the model, and my new models developed from Jo's work, a discussion with Rebecca ensued:

> ***David, 00:46:49***
> *After taking my piece, she made changes to the 2D shape. She chose one of the patterns and then did a rotational duplication to create a new form.*
> ***Rebecca, 00:48:14***
> *What does the final form look like?*
> ***David, 00:48:26***
> *Because her own work is using weaving technique, she used a very interesting weaving technique here. It's like when you cut certain patterns like this into a harder material like wood, it can gain flexibility, somewhat similar to the paper used for wrapping apples …*
>
> *(David & Rebecca, Meeting Time Code: 2022.02.17 00:46:49 – 00:48:26)*

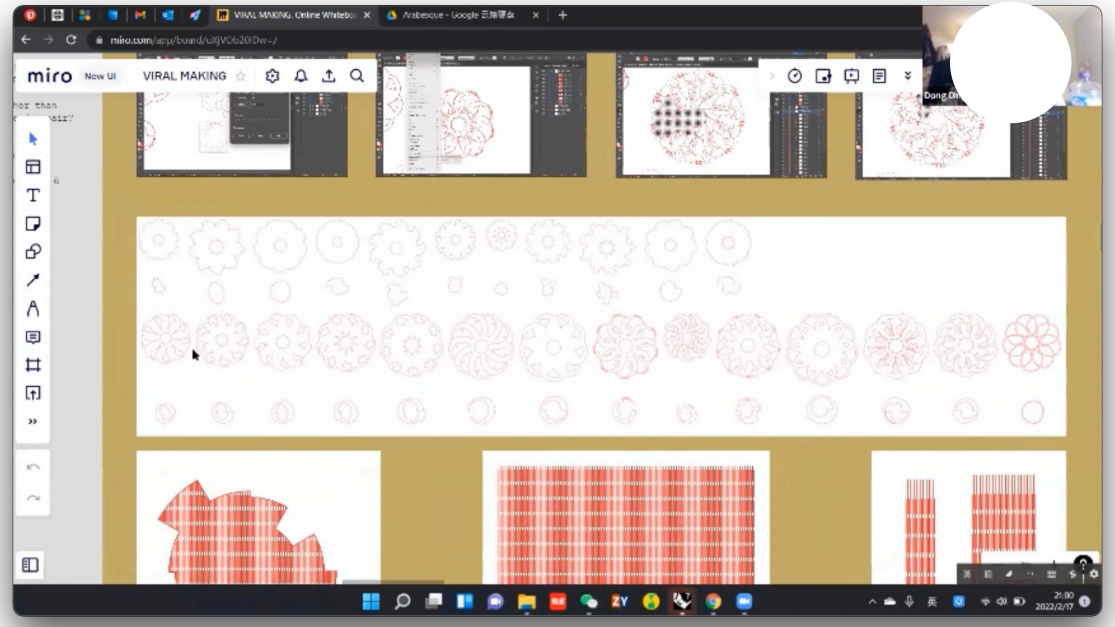


Figure 5.3-11: Myself showing Jo's process journal from the *'Viral Making'* project during online meeting

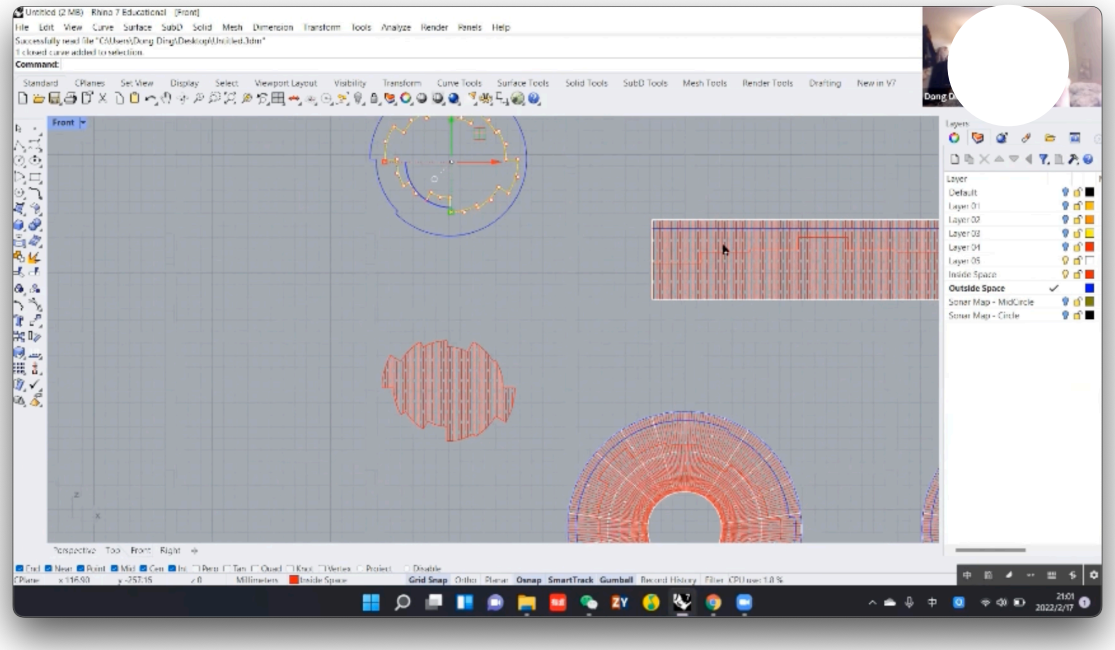


Figure 5.3-12: Myself showing my new developed model based on Jo's process journal from the *'Viral Making'* project during online meeting

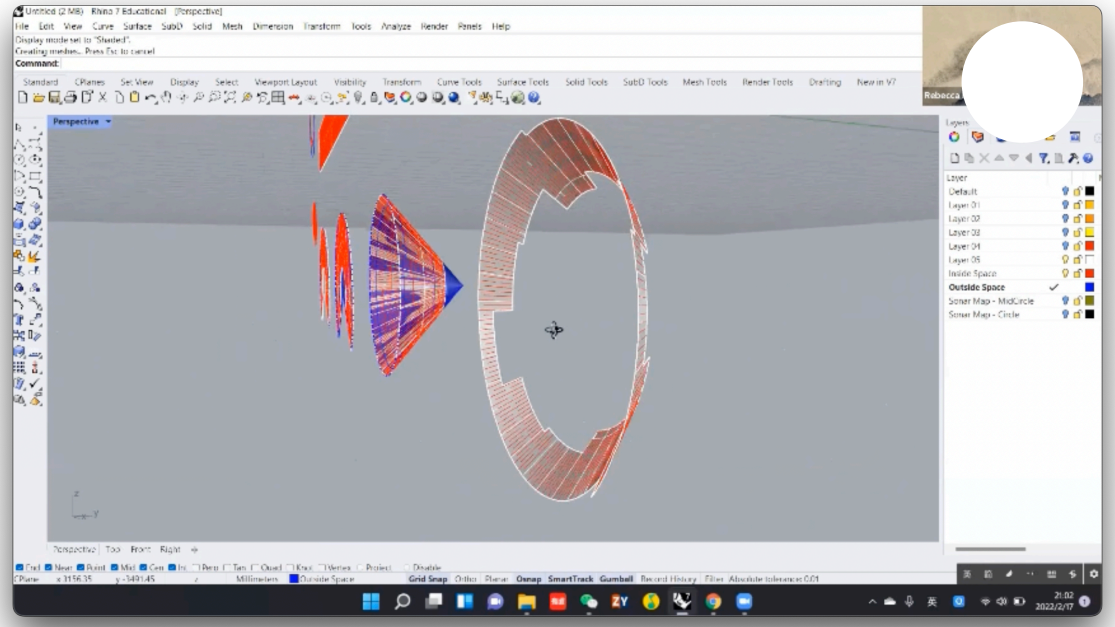


Figure 5.3-13: Myself showing my new developed model based on Jo's process journal from the *'Viral Making'* project during online meeting

David, 00:48:26
After seeing this, I had a new idea. I think her pattern has a limitation; it can only expand horizontally and can't transform vertically or in other directions. I modified her pattern, and it formed something new like this. It retains the shape I originally had, but also able to create a very interesting space.
Rebecca, 00:50:38
Right, that's quite fun. It adds another dimension.
David, 00:50:48
Actually, that's how it is. It moved from a pure 2D – my original 3D was creating space by adding thickness – but now it creates space through curling.
Rebecca, 00:50:56
Right, right. Because originally, the thickness corresponds to each note in time, right? But now, it means giving it a thickness, and the thickness isn't fixed because it's slanted, so it varies in length, which is also quite interesting.
David, 00:51:25
The spatial dimension is now more complex. Originally, it was completely flat, but now this space has depth. Each little space has different depth, which I find very meaningful.
Rebecca, 00:53:18
Right, it's quite interesting. There are many ways to do this project, we are slowly creating variations step by step. There are a lot of potential future possibilities.

(David & Rebecca, Meeting Time Code: 2022.02.17 00:48:26 – 00:53:18)

In this case, a unique cycle of feedback, design and knowledge development process was formed:

First, the model originally rooted in my independent design process (representing the original form of knowledge), crossed project boundaries and was introduced into another project - the *'viral making'* project.

- After that, in the *'viral making'* project, the model underwent further development by the collaborator Jo, resulting in a pattern form and documented as a process journal (representing new knowledge reconstructed by Jo).
- Next, inspired by Jo's development of the model, I generated new ideas for its adaptation within the context of the *'Data-Music-Jewellery'* project (forming new knowledge reconstructed by myself in the context of *'Data-Music-Jewellery'* based on Jo's innovations).
- Finally, Jo's process journal and the new model I developed based on it were introduced into the context of the *'Data-Music-Jewellery'* project. This led to new discussions with Rebecca, facilitating the development of potential co-design ideas (representing new knowledge reconstructed again through the feedback process between Rebecca and myself).

In this process, the journal played an important role in the construction of the transformation of knowledge and information forms - starting from the *'Data-Music-Jewellery'* project, the model travelled to another project and then returned to the context of *'Data-Music-Jewellery'* in the form of a journal. Moreover, the journal, through its documentation of the design process, established a connection between the contexts of two distinct projects. This facilitated the deconstruction and reconstruction of knowledge by different collaborators in varying contexts. This showcases the unique characteristic of the journal in the context of this project, functioning as a semantic boundary object to alter information structures and introduce external perspectives into the project.

5.3.3 'Process image and video' as boundary objects

Processing images and videos is the process record of Rebecca's independent design process, representing a kind of 'process model' rooted in the visual field of the *'Data-Music-Jewellery'* project. Due to the nature of design methods in the visual field, Rebecca's design process involves generating a large number of images or videos

within a short time through programs. This means that Rebecca is unable to keep all the process images and videos. Therefore, Rebecca only selects the images and videos that she thinks are worth keeping. As Rebecca states:

> *… Let me show you this, it's actually some process that already been selected.*
>
> *(Rebecca, Meeting time code: 2022.03.21 00:00:29)*
>
> *… So, as you can see, there are a lot of visuals in this process, and then we choose from them …*
> *… We've tried many different paths. In fact, until two weeks ago, I was working on VR stuff, but I felt that the work in VR was not quite enough, as it still fell far short, so I didn't keep any of it …*
>
> *(Rebecca, Meeting time code: 2022.05.01 00:07:14)*
>
> *… Let me see, I'll find some for you. I didn't keep some of them. For instance, the things we tried on Shader Toy, I remember very clearly, we made an entire version of that thing, but I immediately shut it down …*
>
> *(Rebecca, Meeting time code: 2022.03.21 00:27:54)*

This means that only the images and videos containing details that Rebecca considers worth taking further are preserved as process images. These retained process images will then be presented by Rebecca in meetings as support to communicate the design aesthetics she pursues, including colour, the selection of design elements, and the visual dynamics, flow, and expression of design elements.

For instance， as shown in Figure 5.3-14 – 5.3-17, Rebecca shows these examples of her process image and state:

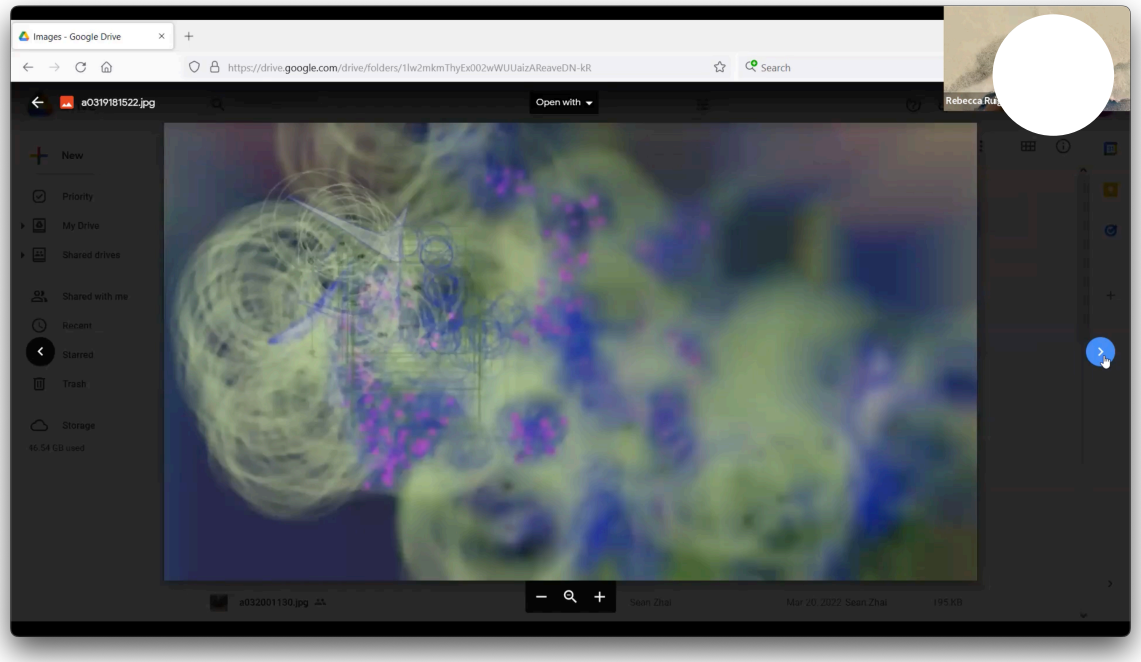


Figure 5.3-14: Creative Artefact of Rebecca's Creating Process shared by her during online meeting

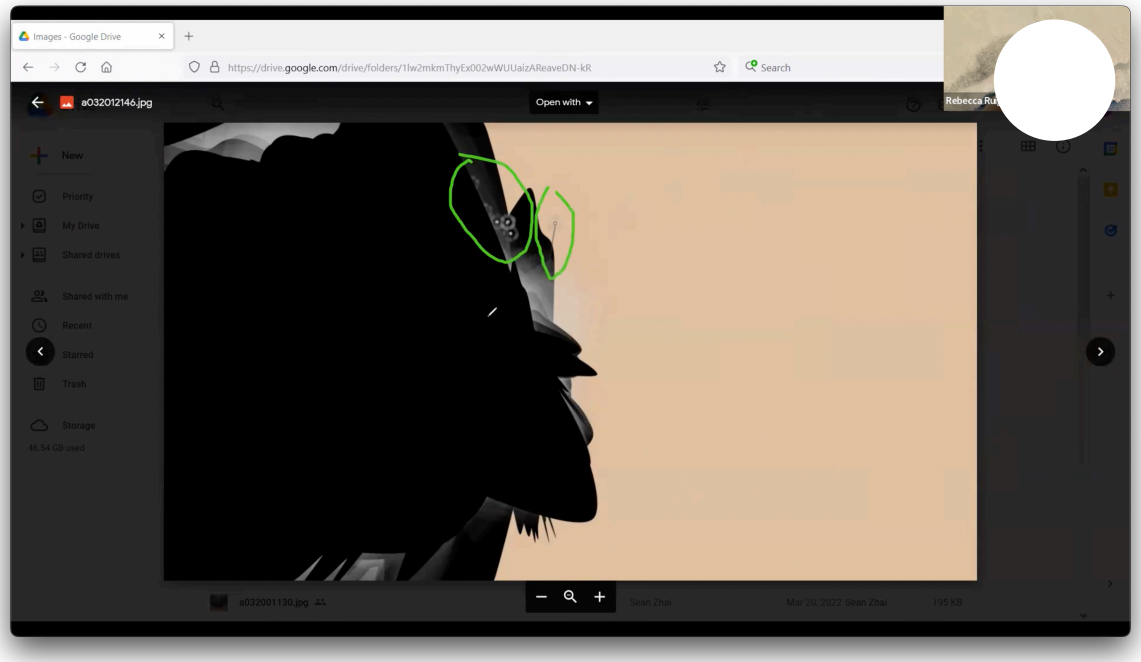


Figure 5.3-15: Creative Artefact of Rebecca's Creating Process shared by her during online meeting

Rebecca, 00:04:04

(For Figure14) ... I think the colours of this group is ok, but the form needs further adjustment...

(For Figure 15) ... This is another style. Actually, it turned out this way because there was a error with the program. But to see these parts, I mark on the screen, these small elements are very nice. Their light and airy feeling matches with the music, which is right, so we can keep that. However, the overall effect doesn't quite fit yet ...

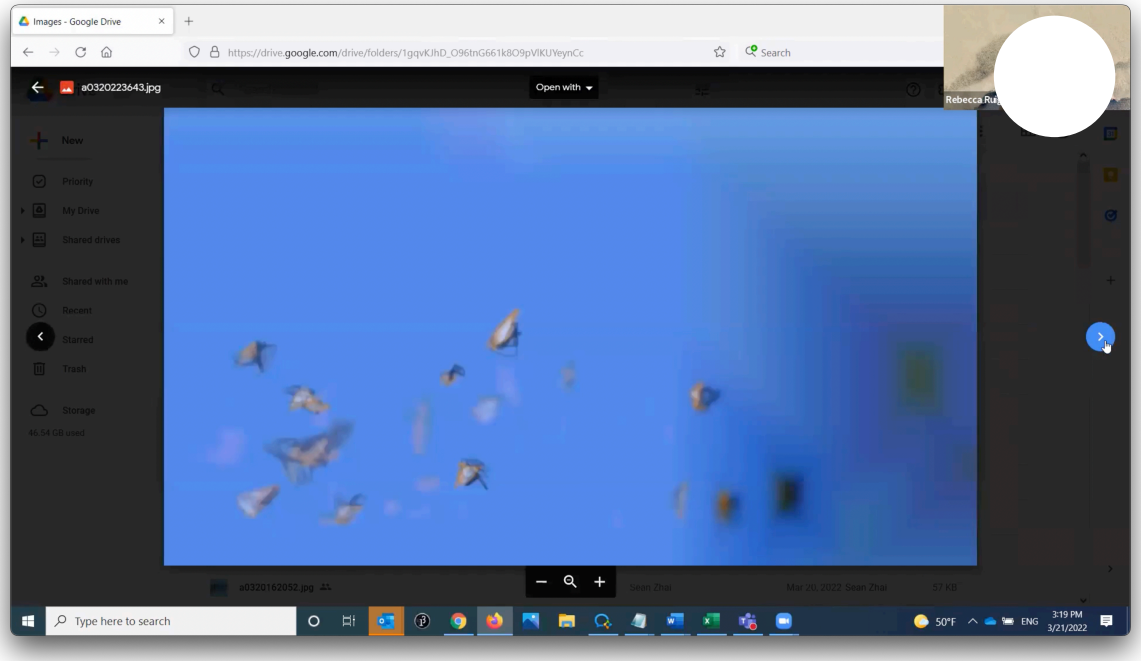


Figure 5.3-16: Creative Artefact of Rebecca's Creating Process shared by her during online meeting

Rebecca, 00:11:35

(For Figure 16) ... I find this group a bit more interesting. It has a kind of ethereal feeling, similar to what I mentioned about the music's ethereal quality, which is just slightly coming through ... It's a bit like the feeling of fireflies at dusk ... In terms of colour, both green and blue are okay, as they contribute to the ethereal feeling. For me, the colour space is primarily in these two ... Also, if you look at the background colour, this group actually added some variety, which is better than a plain colour background. This kind of feel can be maintained ...

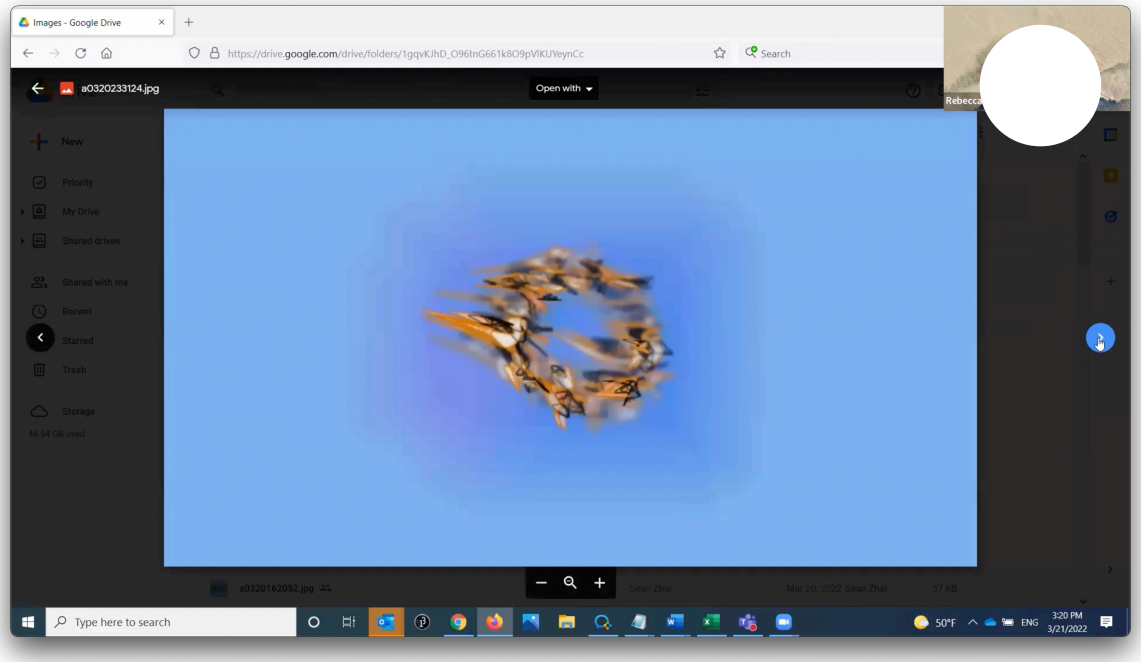


Figure 5.3-17: Creative Artefact of Rebecca's Creating Process shared by her during online meeting

Rebecca, 00:12:36

(For Figure 17) ... I prefer its empty feeling. I've always thought that this should have a very empty feel... Another thing is the intentionally made blurry effect is very interesting...

(Rebecca, Meeting Time Code: 2021.10.07 00:04:04 – 00:12:36)

In Rebecca's sharing mentioned above, we can see that with the help of process images, Rebecca is able to present her understanding of music and design elements in a more intuitive way. Here, process images play an important role of a 'semantic boundary object', visualizing Rebecca's personal experiential knowledge – such as her colour perception of music (as Rebecca said, Arabesque No.1 to her represents a colour range of green and blue), and the use of visual elements (as Rebecca mentioned, the ethereal sense of the overall space, the use of small, light visual elements, etc.). For myself, this kind of deconstructed and concretised knowledge is easier to capture and understand. Based on such communication, I captured Rebecca's visual interpretation of music, and in the subsequent design process, I selectively adopted her understanding of the colour range of the music.

In this way, Rebecca's colour perception of music, with the aid of process images, is deconstructed into ‘colour space of green and blue’ (deconstructed, fragmented knowledge). Then, based on my own knowledge structure, I identified, captured, applied, and produced a new expression, manifesting as part of my final design outcome as shown in Figure 5.3-18 (a new expression of the fragmented knowledge picked up according to my knowledge structure). The form of expression transformed from a visual colour space into physical sculptural components, a transformed expression based on my design form and carrying my personal experiential characteristics.

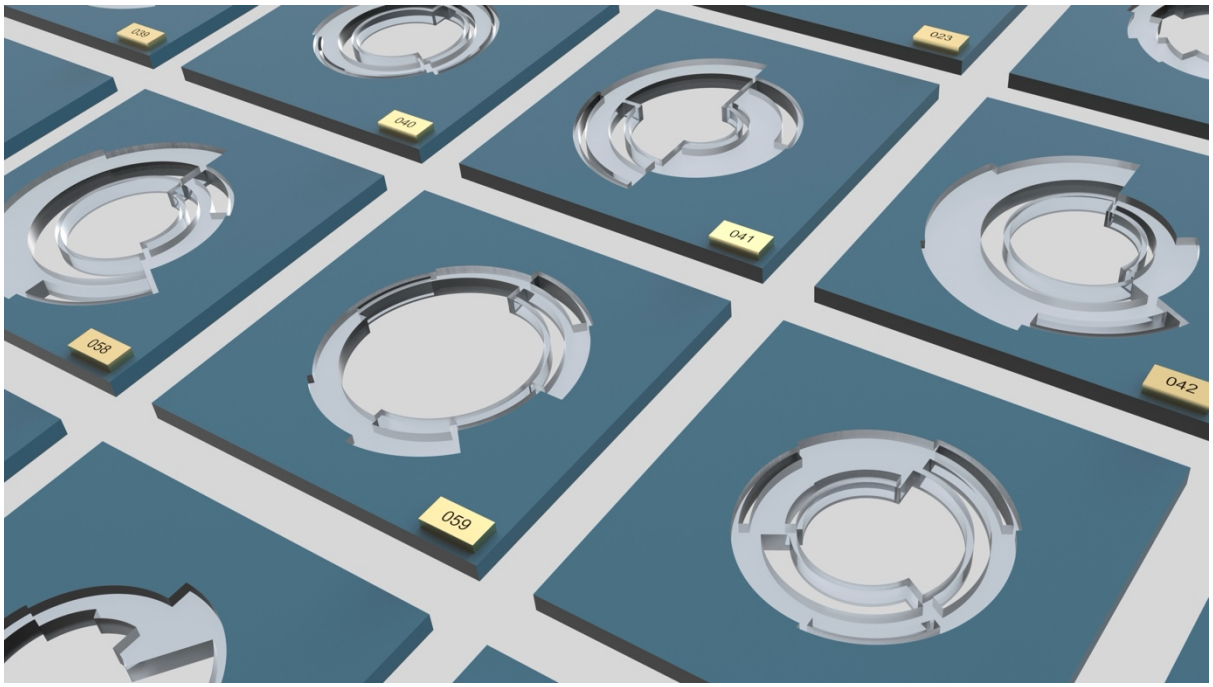


Figure 5.3-18: Rendering of part of my outcome

At the same time, it suggests that in this example, the collaborator who constructs new knowledge (the receiver) has the discretion to choose which pieces of fragmented knowledge to utilise. I (the receiver) have the right to choose a certain piece of fragmented knowledge (in the example above, it is the colour perception of music) for further development, and the reconstruction of knowledge occurs when a certain piece of fragmented knowledge has been picked. The fragmented knowledge that is not chosen (in the example above, it is the application of visual elements) only enhances

my understanding of Rebecca's design decisions, without transforming into new knowledge.

This suggests that in the context of this practice, the 'process image', in its role as a semantic boundary object, can effectively assist in deconstructing the knowledge of the boundary object user, as well as in the reconstruction of the deconstructed fragment knowledge based on the personal knowledge structure and experience of the receiver. One of the key conditions for whether fragmented knowledge can be reconstructed is the receiver's choice of the fragmented knowledge. This choice determines the future of a specific fragmented knowledge and the contribution of process images as boundary objects to knowledge construction.

The phenomenon of the function of process images as boundary objects being influenced by 'choice' (the chosen fragmented knowledge demonstrates the contribution of process images as boundary objects to knowledge deconstruction and reconstruction, while unchosen fragmented knowledge only shows the contribution to knowledge deconstruction) also aligns with the research of Nicolini et al. (2012) on the dynamic changes of boundary objects – the role of a boundary object is given by its interaction and relationship with other objects or people in the process of collaboration.

5.3.4 ‘Digital models (3D models) and Rhino Software’ as boundary objects

The digital 3D model serves as process data relating to my independent design process, while the model-based approach is common in the field of jewellery design. Based on my previous experience in the design process, advancing the design development through the creation of numerous physical models and material testing is a method I frequently use, representing a common work approach rooted in the field of jewellery. However, due to the special circumstances of this project (studio closure due to the pandemic and the remote environment of distributed collaboration), in this project, I extensively used digital models for idea testing and iterative development, substituting the production of physical models (although the design method based on physical models was also used in the development process, it was significantly reduced). This way of working seems to have some characteristics of the visual field, but there is no clear data indicating that this is a change in my common jewellery field

working method due to the influence of the visual field in the boundary zone. It is more due to the unique circumstances of this practice (studio lockdown caused by the pandemic and the remote collaboration environment). Therefore, I believe this is a working method chosen by myself based on the consideration of multiple factors, whose essence is still based on model iteration and development, a design method with characteristics of the jewellery field. Similar to the 'process image and video' discussed in the previous section, the Digital 3D model also performs a function related to 'semantic boundary objects' in collaboration, mainly acting in the deconstruction of knowledge and enhancing the understanding of both collaborators in the design decision-making process.

However, unlike 'process images and videos', when the Digital 3D model functions as a 'semantic boundary object', it only demonstrates the deconstruction of knowledge. The fragmented knowledge was not picked up and integrated into Rebecca's own independent design process to form a reconstruction of knowledge; in the first phase of the practice, it only manifested in enhancing the understanding of my design decisions.

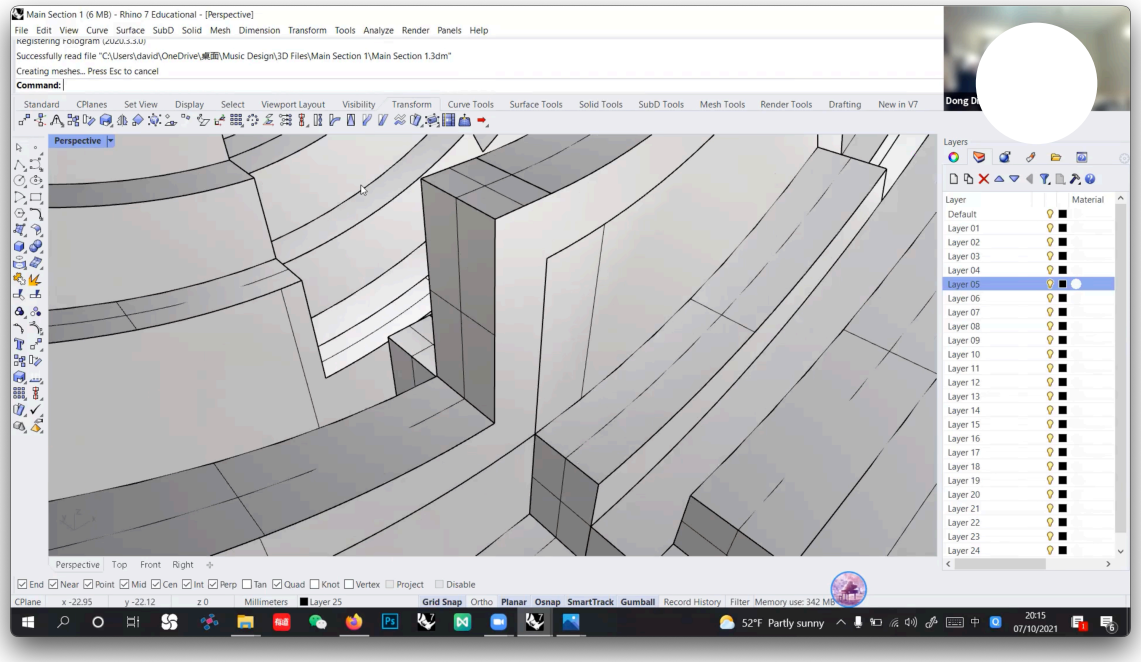


Figure *5.3*-19: Examples of my Creating progress (3D Model) shared during online meeting

David, 00:12:26
In the next stage, I think your VR space could change according to the inner space of my model. The colour of my model could also change based on the colour of your video. For example, if you look at it now, it's a tunnel. The idea for your VR is to have someone walking in a space, moving through it with the music."
Rebecca, 00:12:57
Right.
David, 00:12:59
Look at this picture and imagine someone walking in a real space like this tunnel. Each step they take moves them forward, and for the next step, they might have to jump down this step and then climb up the next step here…
Rebecca, 00:13:16
Okay, I'll take a screenshot. For this interior part. I'll think about it later.

(Rebecca & David, Meeting Time Code: 2021.10.07 00:12:26 – 00:13:16)

Instead, the deconstruction of knowledge and the enhanced understanding of design decisions facilitated by the Digital 3D model had a significant impact on the co-creation process (the second phase of the practice). Due to the improved mutual understanding of design decisions, more co-creation ideas were proposed and discussed. For example, in the meeting on 2021.10.07, based on the sharing of Figure 5.3-19, Rebecca and I proposed and discussed preliminary ideas for the second phase of co-creation.

In this context, the 3D model assisted in visualising the potential development directions in the second phase. During this discussion, we explored the possibility of using VR technology to create digital pathways for viewers to virtually walk in it. The 3D model effectively represented the potential form of these pathways and simulated the visual effect of an audience walking through the virtual tunnel by real-time zoom-in of the model. Based on this visualised simulation, we agreed that this co-creation idea was worth further discussion. The 3D model, by providing a visualised simulation of design ideas, enhanced the mutual understanding of these ideas between the collaborators, thereby facilitating the further development of the design.

Additionally, during the online meetings, the sharing of the Digital 3D model was facilitated through the use of the 3D modelling software Rhino, which is also the software I used to create the 3D models. The advantage of using real-time model modification software like Rhino for sharing digital models and the design process is significant - models within the software can be zoomed in, zoomed out and even taken

apart. This allows us to view the model from different angles, enabling a more comprehensive discussion based on the detailed aspects presented by the model.

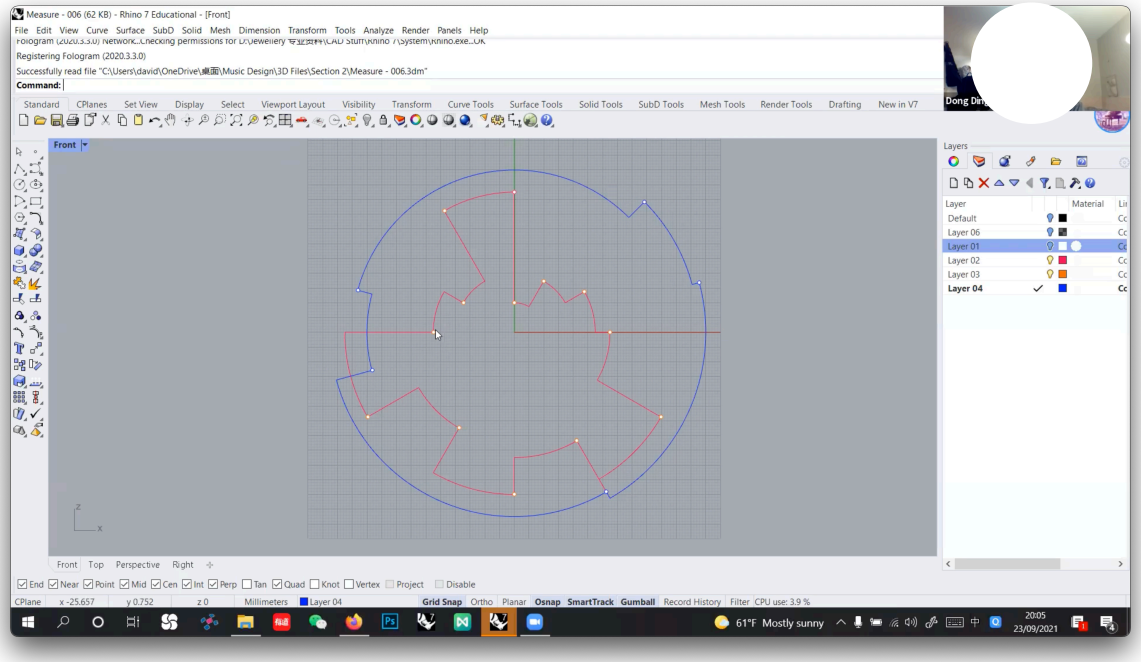


Figure 5.3-20: Examples of my Creation progress (3D Model) shared during online meeting (Wireframe mode of measure 006 model)

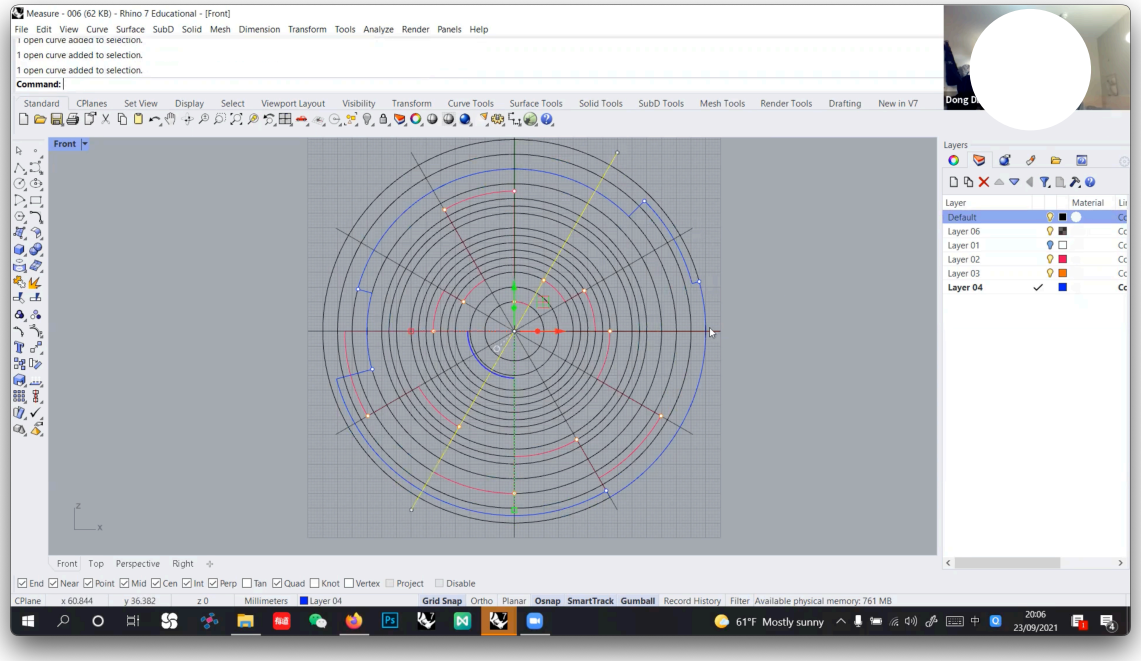


Figure 5.3-21: Examples of my Creation progress (3D Model) shared during online meeting (Wireframe mode of measure 006 model with ‘sonar map’ grid)

David, 00:00:54

Ok I will bring up this sonar map grid, like this, here is the first note, the second note, the third note... This note here is probably around the tenth note, and it corresponds to two notes, here is the left-hand part and here is the right-hand part. This creates an tangled space, which I find very interesting.

Rebecca, 00:01:38

Okay. Yes, that's quite interesting.

(Rebecca & David, Meeting Time Code: 2021.09.23 00:00:54 – 00:01:38)

As shown in the discussions based on Figures 5.3-20 and 5.3-21, the use of the wireframe mode of digital models (a feature of Rhino software) during communication helped to recreate parts of the design modelling process. From the records of this meeting, it is clear that my verbal description of the model was quite limited; communication was primarily based on descriptions of imagery. In particular, the 'sonar map' grid effectively aided in retracing the model-making and design process, demonstrating how the 'tangled space' mentioned in the discussion was formed.

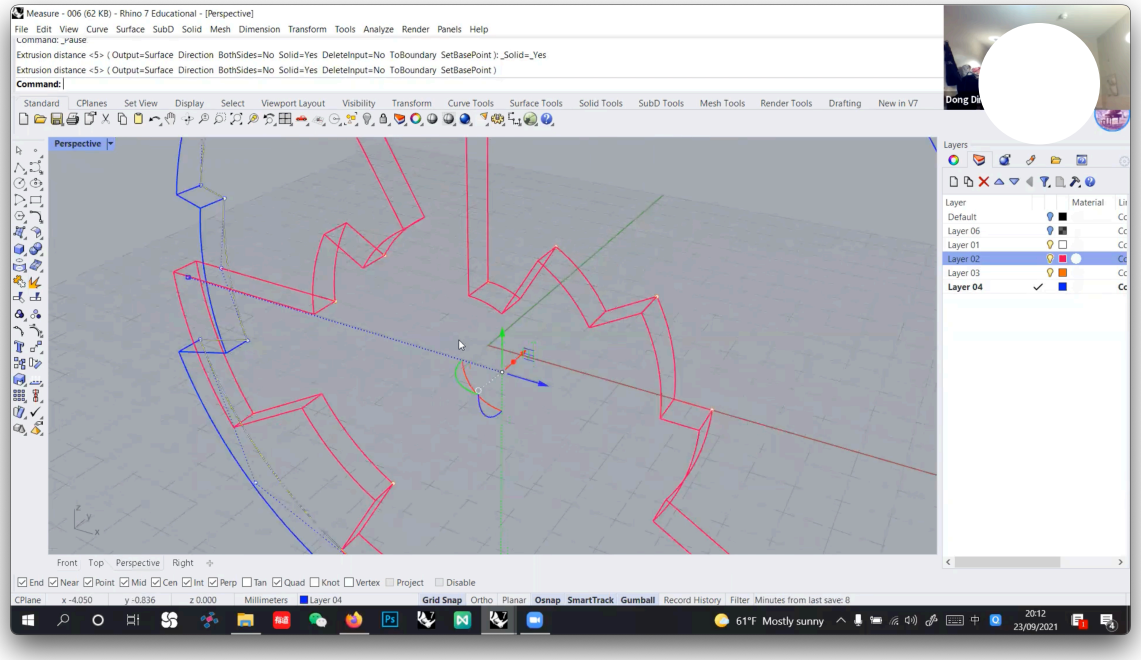


Figure 5.3-22: Examples of my Creation progress (3D Model) shared during online meeting (Development from 2D to 3D sculpture of measure 006 model)

Next, as shown in Figures 5.3-21, 5.3-22 and 5.3-24, based on the modelling capabilities of Rhino, the creation process of the individual sculpture 'Measure - 006' was further reconstructed. This illustrates the development from 2D to 3D sculpture

and the construction of the 'tangled space' in three dimensions that was just mentioned. This visualised design process provided substantial support for Rebecca in understanding my design decisions.

The use of Rhino in online meetings also allowed for the potential uses of different parts and layers of the model to be displayed, as well as visualising the different spatial perceptions of single-layer and overlayed multi-layer spaces:

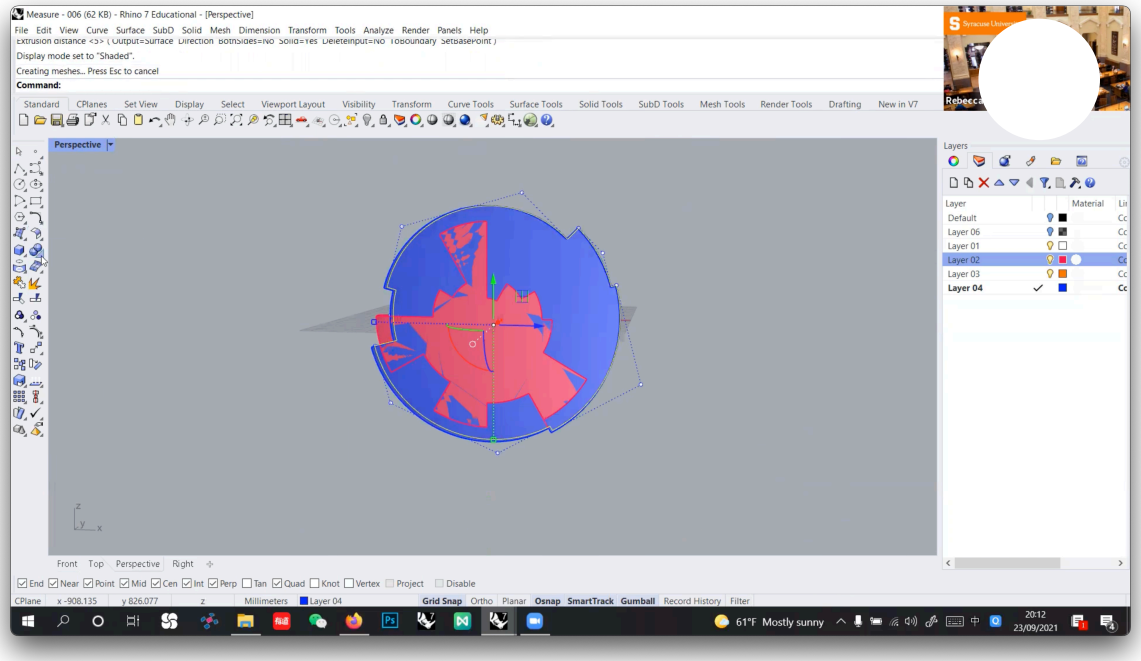


Figure 5.3-23: Examples of my creation progress (3D Model) shared during online meeting (Development from 2D to 3D sculpture of measure 006 model)

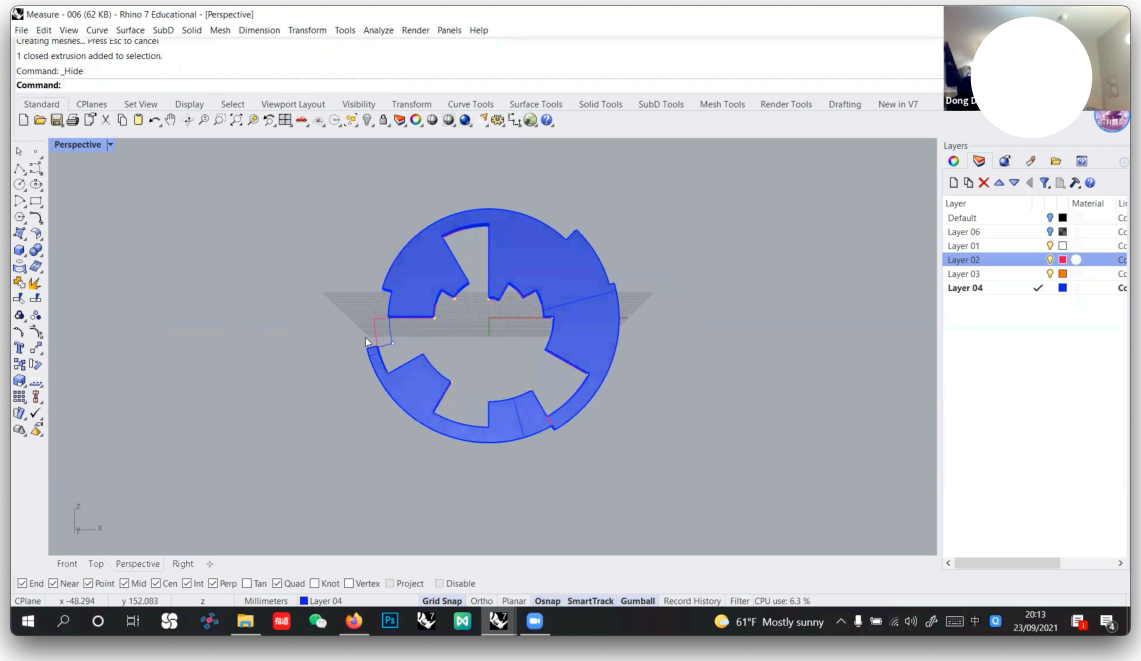


Figure 5.3-24: Examples of my creation progress (3D Model) shared during online meeting (Development from 2D to 3D sculpture of measure 006 model)

David, 00:06:50
... Look, I'll remake it now to show you ... The way I'm doing it is like using the inner part to cut a hole in the outer part ...
Rebecca, 00:07:57
So, okay, show me a bit more of the side view ... Got it, okay ...
And I see you're using Rhino, it's quite convenient and can be built quickly, much more convenient than me using Maya ...

(Rebecca & David, 2021.10.07 00:06:50 – 00:08:31)

As demonstrated in Figures 5.3-25, 5.3-26, and 5.3-28, using Rhino's functionality to hide and show parts of the model reveals details of the single-layer model and the overlay effect of the multi-layer model. By stacking different numbers of layers in Rhino, I was able to more concretely showcase my shaping of the internal and external spaces of the sculpture, as well as the spatial shaping for different lengths of music (one measure, one small section, one main section, or the whole piece). Moreover, using Rhino's zoom in and zoom out features, as seen in Figures 5.3-27 and 5.3-28, both the details and the overall form of the model were fully displayed. Such visual presentations not only showed the design details of the single-layer sculpture but also communicated the spatial feeling of the entire tunnel and the shaping of the internal

overlapping spaces, allowing for a more detailed and diverse presentation of my design decisions.

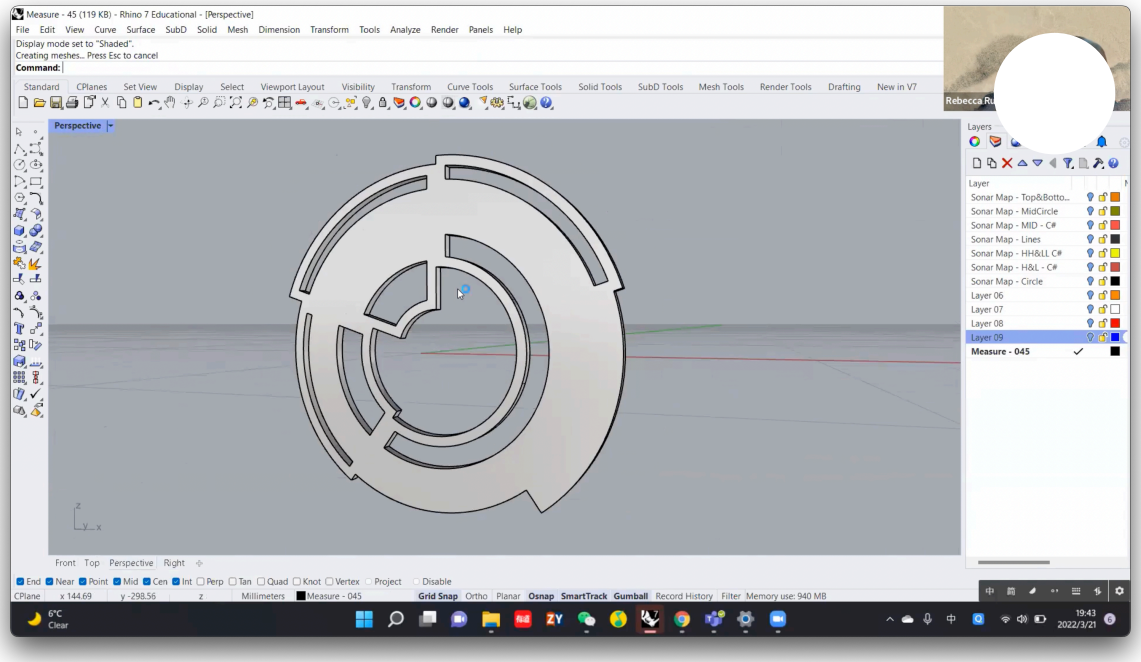


Figure 5.3-25: Examples of my creation progress (3D Model) shared during online meeting (Model of single measure)

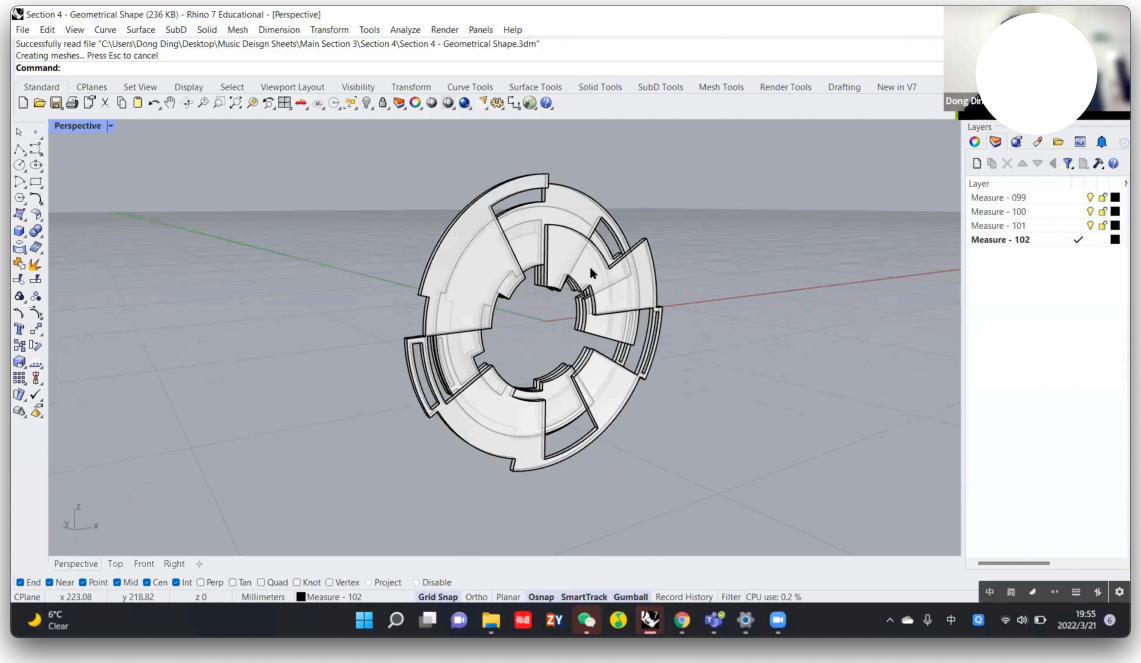


Figure 5.3-26: Examples of my creation progress (3D Model) shared during online meeting *(Model of one small section)*

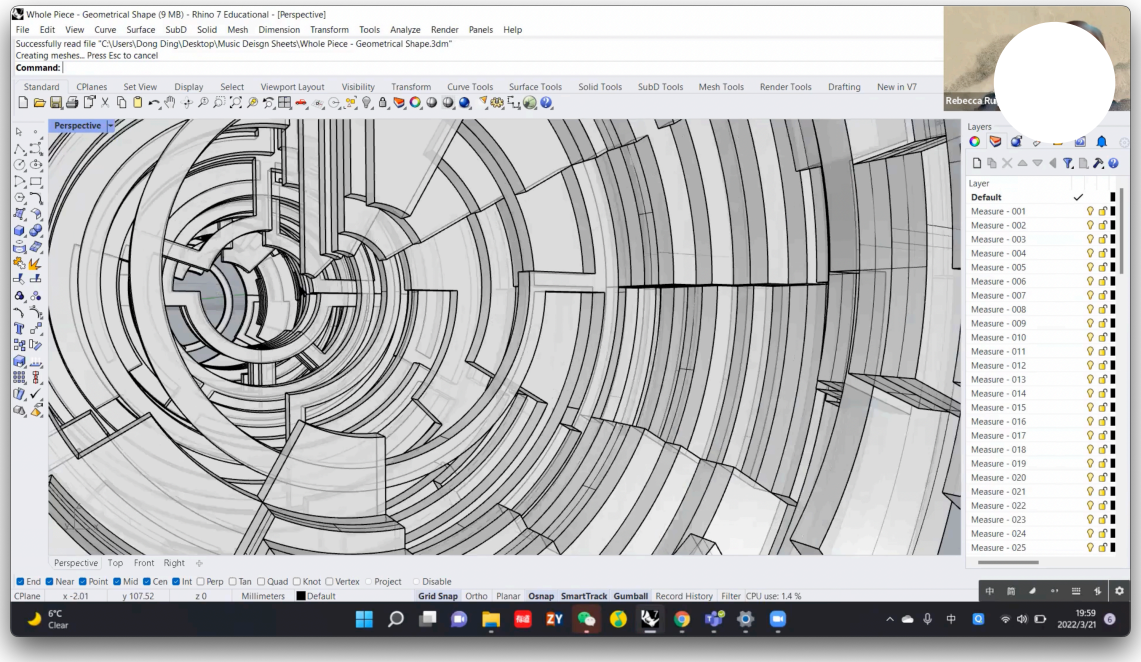


Figure 5.3-27: Examples of my creation progress (3D Model) shared during online meeting *(Zoom in vison of whole piece)*

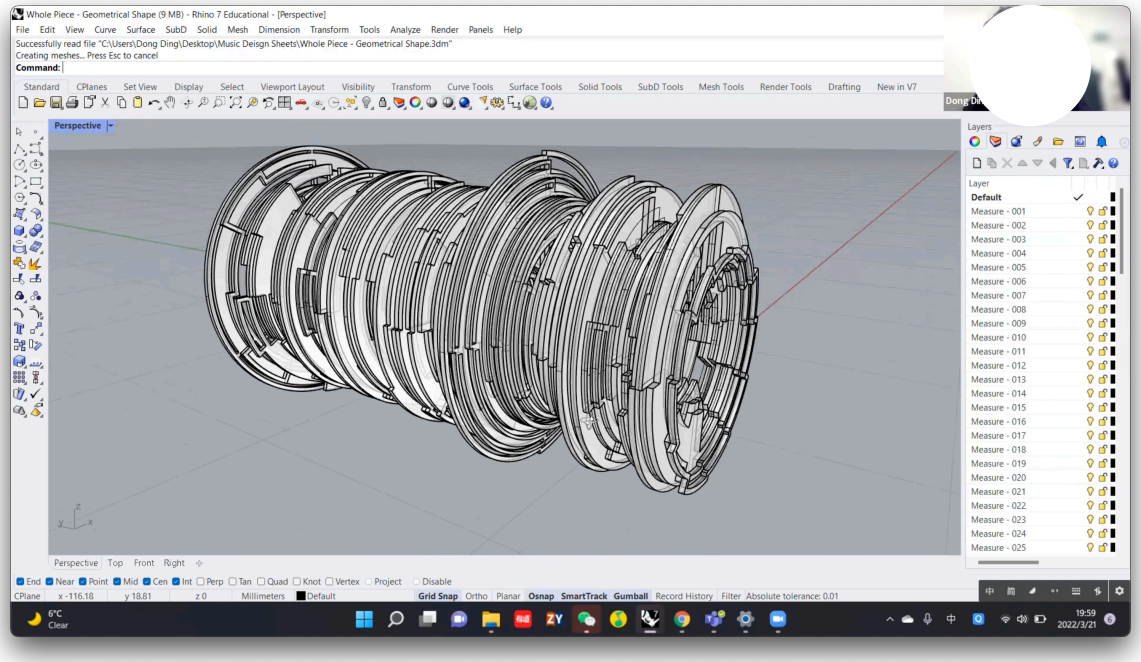


Figure 5.3-28: Examples of my creation progress (3D Model) shared during online meeting *(Zoom out vision of whole piece)*

Rhino, as the modelling software I used, was originally ingrained in my independent design process. However, in the examples mentioned above, where Rhino was used for sharing and discussing my design process in online meetings, it was brought into the boundary zone. It contributed to the deconstruction of my design process and decisions. At this point, Rhino underwent a transformation in function. This backstage tool of design activities stepped into the spotlight, assuming the role of a 'semantic boundary object', deconstructing knowledge and providing negotiable common ground for both collaborators (for the next co-creation stage).

When focus back on Rhino itself, as a form of 3D modelling software, its potential similarities with other modelling software (such as similar manipulation of models; function of zoom in, zoom out, hiding/showing components). This offered a relatively standardised information structure for both collaborators. As Rebecca is also a user of 3D modelling software such as Maya. This means both collaborators in the collaboration are very familiar with the information format related to 3D modelling software. From this perspective, Rhino also plays a role similar to a syntactic boundary object, laying the foundation for both collaborators to communicate and circulate knowledge based on the same data information structure. The complex dynamics of Rhino moving from one field to the boundary zone, taking over and simultaneously playing different roles, also align with the observations of the dynamics of boundary objects mentioned by Nicolini et al. (2012).

5.3.5 ‘Digital models (Rendering image and video)’ as boundary objects

Rendering images and videos of the digital 3D models also represent process data related to my independent design process and are an extension of the digital 3D models. They inherently follow the previously mentioned model-based approach rooted in the jewellery field development process. However, unlike 3D models, which focus on the development of forms and conceptual aspects, rendering images and videos concentrate on material testing and iteration. They endow digital models with virtual textures, reflecting considerations about the material choice of the design outcomes. In the common working methods of the jewellery field, contemplation and selection of materials are based on personal experience and knowledge with material use, developed through multiple experimental tests. In the context of this project, this

process is partly substituted by the capabilities of rendering software (KeyShot), which, to some extent, can display the texture of chosen materials. Models rendered with superimposed virtual materials can allow perception of the visual and spatial effects of the materials on a non-physical basis, thus acting as a substitute for material testing in this project's context. Similar to digital 3D models, rendering images and videos also function as semantic boundary objects and syntactic boundary objects in collaborative communication.

Based on the renderings produced with KeyShot, I proposed my choice of materials (transparent acrylic). This decision was grounded in my experiential knowledge of materials, focusing on functionality – transparent acrylic can display the spatial effects I require (its translucency effectively reveals the complex internal structures of my design). The material simulation in the rendered images enabled Rebecca to gain a more concrete understanding of my design decisions, leading to discussions on exhibition and display ideas:

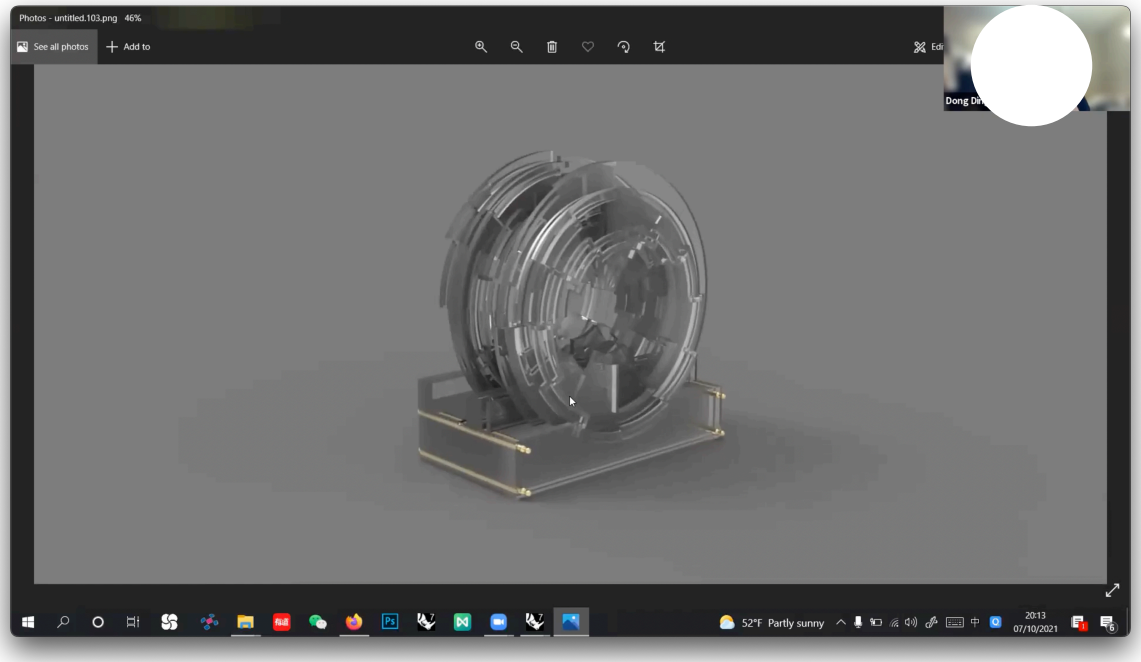


Figure 5.3-29: Examples of rendering video of 3D Models shared during online meeting by myself

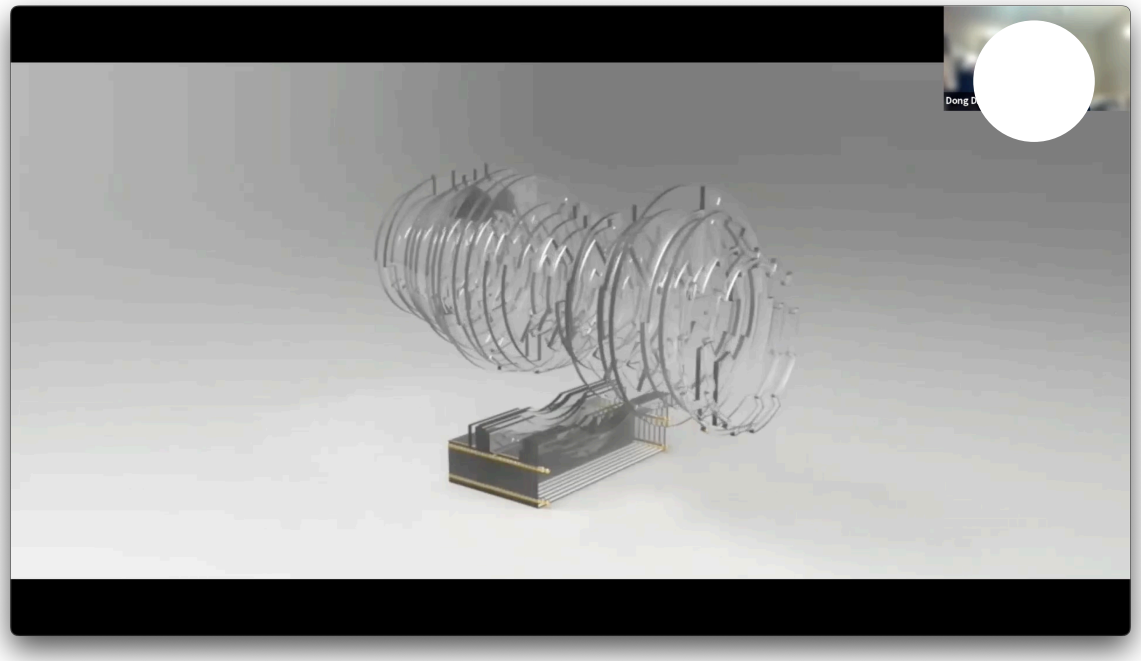


Figure 5.3-30: Examples of 3D model rendering video shared during online meeting by myself

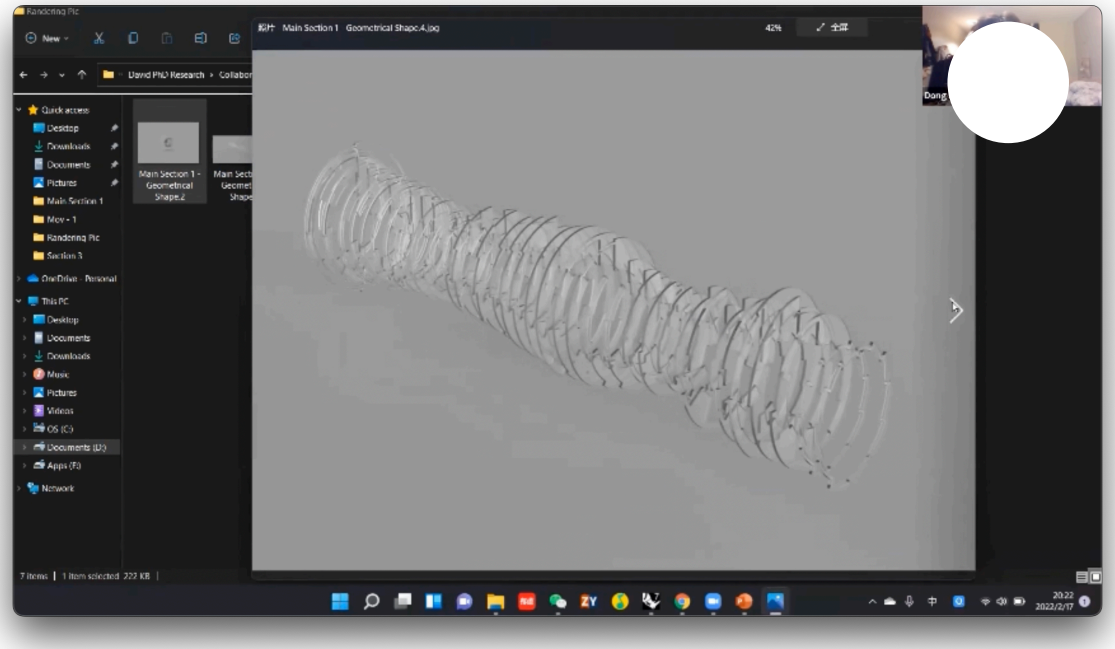


Figure 5.3-31: Examples of 3D model rendering video shared during online meeting by myself

Rebecca, 00:09:22
I really think that, in terms of the display method we discussed, it might look different if it's transparent. Right now, I really want them to be a bit more spaced apart.

(Rebecca, Meeting time code: 2021.10.07 00:09:22)

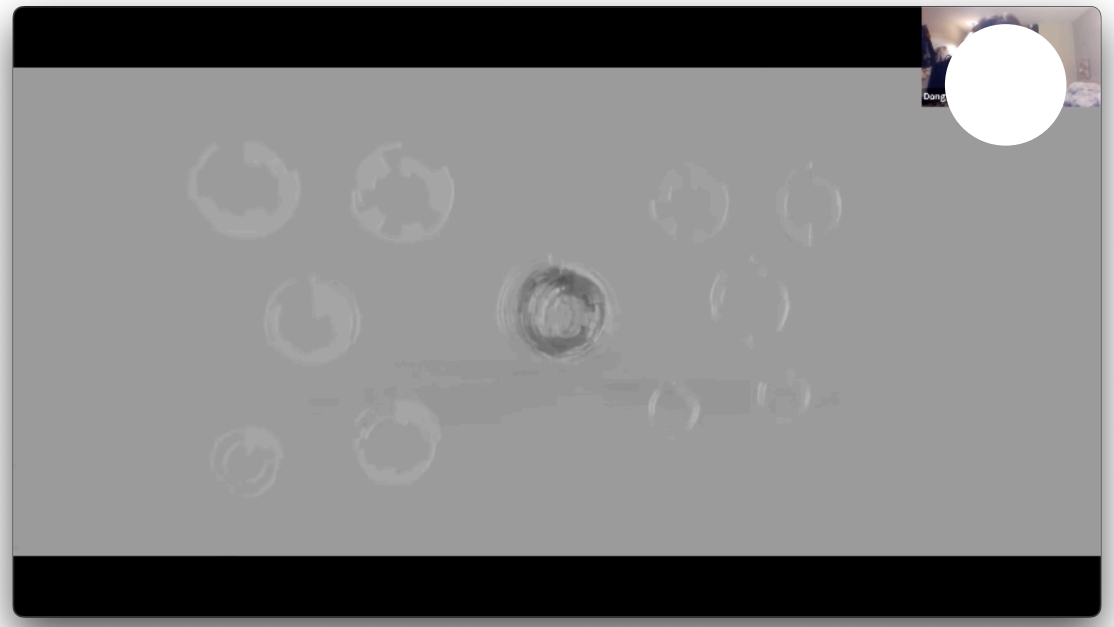


Figure 5.3-32: Examples of 3D model rendering video shared during online meeting by myself

David, 00:09:59
It looks like this when it's spread out. And these are some small details...
Rebecca, 00:12:46
I was thinking about this... I quite like the idea of spreading all these things out in this way...
David, 00:14:49
Also, this can be disassembled, which I think is very interesting.
Rebecca, 00:15:09
Right. It can be disassembled, and its display ways can be different.

(Rebecca & David, Meeting Time Code: 2022.02.17 00:09:59 – 00:15:09)

From the meeting records mentioned above, we can see that based on the sharing of rendering images and videos, we engaged in a comparative analysis of two sculptural forms - tunnel and matrix, in terms of showcasing design details. In this context, the visual representation of materials (transparent acrylic) in the rendering images and videos played a decisive role in both collaborators' understanding. Like digital 3D models, rendering images and videos, originally rooted in my independent design process. They moved to the field boundary and began to function as semantic

boundary objects, which deconstruct my experiential knowledge of material choices, facilitating a shared understanding between us. Additionally, since Rebecca's design process and field also involved model and image rendering techniques. Rendering images and videos established a basis for communication and knowledge flow in a standardised information format familiar to both collaborators, thus assuming the role of syntactic boundary objects. The complex dynamics of rendering images and videos as boundary objects performing different functions at the same time in different contexts were also observed in this instance.

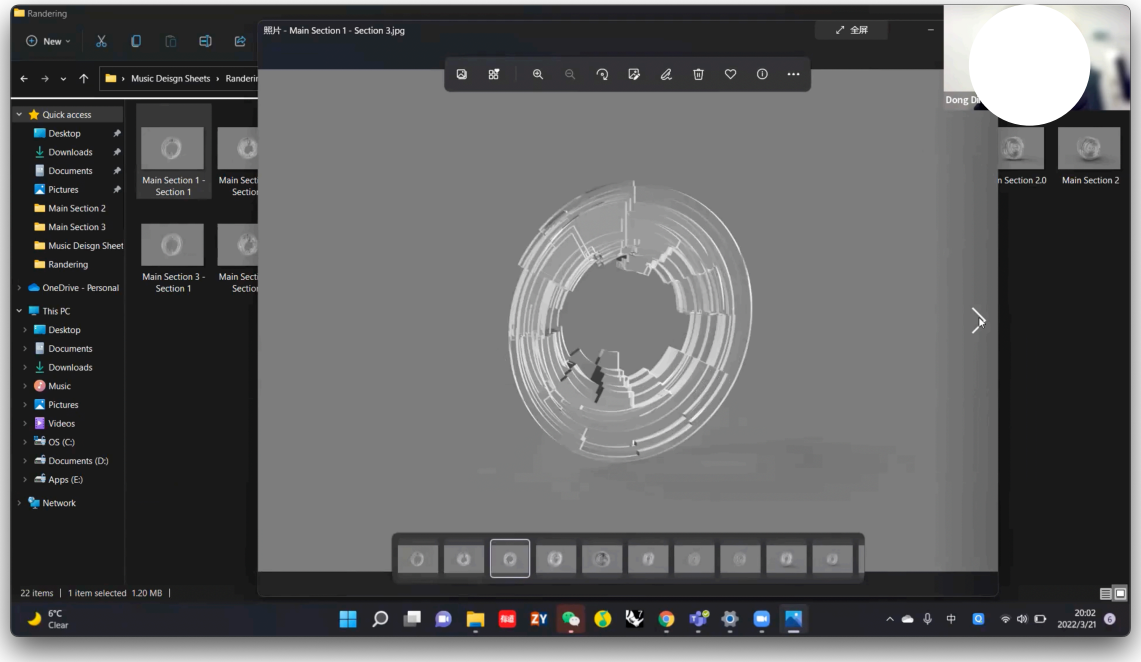


Figure 5.3-33: Examples of 3D model rendering video shared during online meeting by myself

David, 00:53:26
For display in a room, I'm currently thinking of two ways: either a tunnel like this, but large enough for people to walk into, or the other type is to display each piece separately.
Rebecca, 00:54:26
I think ... each piece is very interesting when viewed in detail. So, in this case, if it's your exhibition, it might be better to try and create a matrix. Arrange them piece by piece…

(Rebecca & David, Meeting Time Code: 2022.03.21 00:53:26 – 00:54:26)

5.3.6 ‘Physical Models’ as boundary objects

Within the collaborative context of this project, physical models are unique boundary objects utilised within the jewellery field. Within the background of the collaborating fields in this project, only the jewellery field creates physical models based on actual physical realities. As discussed in previous sections, the iterative development of designs through extensive use of physical models and material testing is a common practice in the jewellery field.

However, in this project, due to the use of digital models, the use of physical models has been reduced as digital models partly take over their functions. It's undeniable that physical models possess distinct characteristics that digital mediums can't fully replicate, their material and spatial qualities can't be expressed digitally. Therefore, they carry unique and irreplaceable information that digital models can't fully capture, aiding in the deconstruction and sharing of knowledge in our collaborative dialogues. Although their role and function are similar to digital media (including models, rendered images, and videos), they offer a unique and unparalleled contribution to the sharing and flow of knowledge for the field of jewellery.



Figure 5.3-34: Me showing physical model during online meeting

The use of physical models during the mid-stage of the project (meeting on 2021.11.04, as shown in Figure 5.2-34) represents a testing for the digital models that have been established and developed. It demonstrates the spatial form and material characteristics of the anticipated outcome. Like the digital 3D model, the physical model exhibits the functionality of a semantic boundary object. Although digital models can present design details more clearly through zoom-in features, physical models can better represent the interior and exterior spatial effects of the design in reality.

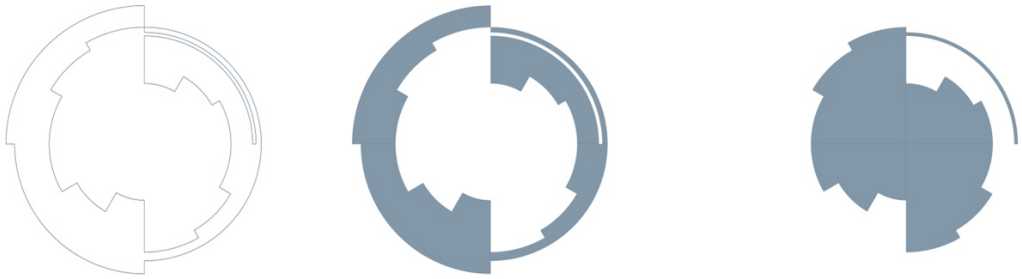


Figure 5.3-35 (Left): Wireframe design and negative part of Measure 004

Figure 5.3-36 (Right): Positive part of Measure 004

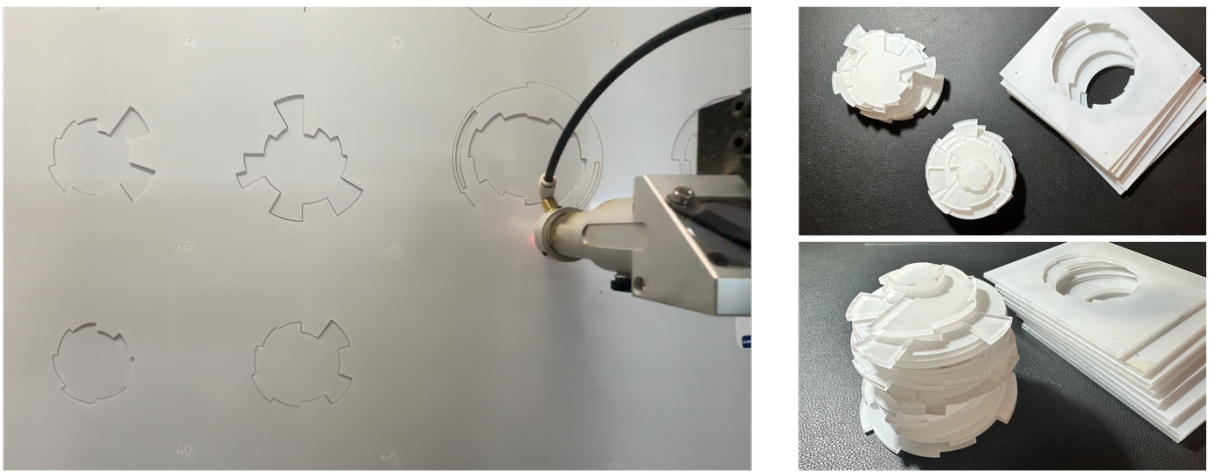


Figure 5.3-37 (Left): Physical Model making process – Laser cutting

Figure 5.3-38 (Right): The ‘Spare materials’ on the table

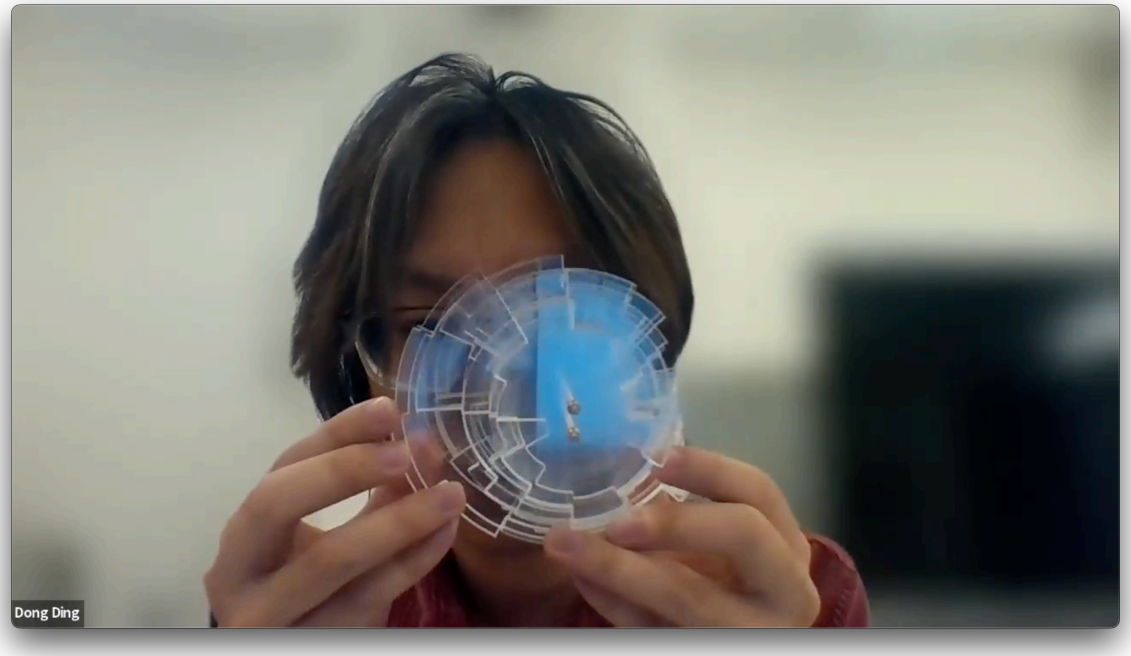


Figure 5.3-39: Me showing the test model of ‘Spare parts’ during online meeting

Based on the physical model, the actual size of objects within the design concept can be seen, allowing for necessary adjustments. This aspect is indispensable for the development of designs in the field of jewellery, where the outcome is a physical object. Compared to rendering images and videos, a physical model can more effectively demonstrate the effects of materials. From the perspective of deconstructing knowledge as a semantic boundary object, the physical model provides a better and more intuitive deconstruction of my knowledge about materials and physical space. This is advantageous for creating a mutual understanding of knowledge between collaborators.

David, 00:02:31
This is the spare part cut out from the inside. Actually, it's the shape of the internal space.
Rebecca, 00:02:36
I think it looks quite nice. I feel like the internal space looks really good. Don't you think so?
David, 00:08:09
Yes, but this can only be considered as a by-product.
Rebecca, 00:08:39
I think it can be like, during your exhibition, you can display both the negative and positive parts simultaneously. So it's not necessarily the case that this thing is completely a useless by-product. I think you can exhibit both negative and positive together.
David, 00:09:07
Right. Actually, at first glance, the positive parts seems better than the negative.

(Rebecca & David, Meeting Time Code: 2021.11.04 00:02:31 – 00:09:07)

Through the process of laser cutting acrylic, the ‘spare parts' that were deleted in the digital model were preserved in the physical model, uncovering new possibilities. This method of developing design ideas and possibilities through interaction with actual models and materials is a common working approach and characteristic within the field of jewellery. As shown in Figures 5.3-35 and 5.3-36, the 'positive parts' displayed in Figure 5.3-36 were considered spare parts in the digital 3D model (Figure 5.3-35) and thus were not retained or further developed during the digital modelling process. However, in the creation of the physical model (as seen in Figure 5.3-36), the 'positive parts' were not directly deleted as in the digital modelling software, but rather accumulated on the table (as shown in Figure 5.3-38). This led to contemplation of their potential development and further experimentation (As the testing model shown in Figure 5.3-39).

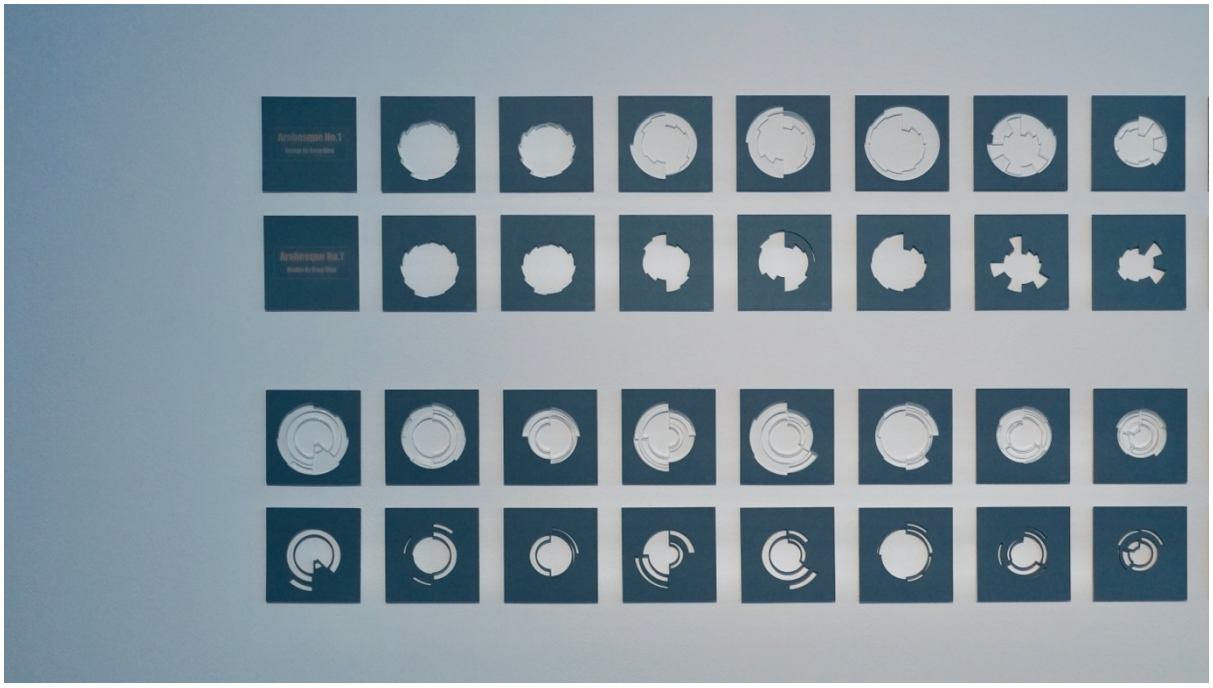


Figure 5.3-40: Part of the Final Outcome

This development was further affirmed in communication with Rebecca (as indicated in Figure 5.3-39 and the related meeting records) and evolved further based on discussions with Rebecca in meetings. Ultimately, it became part of the finished product (as shown in Figure 5.3-40) - both positive and negative parts were retained and arranged in a corresponding display. This highlights the unique and irreplaceable

role of physical models in the jewellery field, demonstrating their ability to reveal unforeseen design possibilities that digital models may overlook.

This case demonstrates the unique role of the physical model as a distinctive boundary object within the context of this practice, illustrating its special function in the deconstruction and reconstruction of certain specific knowledge during its flow across fields. The physical model carries information that other boundary objects cannot represent – the potential of the development process based on tangible materials - the retention and development of 'spare parts' (specific fragmented knowledge deconstructed and revealed through the sharing of the physical model) were captured by both collaborators. Through the mutual feedback process and interaction development, these retained elements expanded the potential of the design and further influenced the final product (reconstructed fragmented knowledge). In this process, the physical model, serving as a semantic boundary object, played a crucial role in the creation of new knowledge during the collaborators' interaction.

5.4 Concept development – a process perspective through the integrated framework based on the emerging boundary object concept

In this section's analysis, we will continue using the integrated analytical framework based on different boundary object concepts, as utilised in the previous section 5.3. This approach will be combined with the concepts of emerging boundary objects and boundary zones proposed by Dalsgaard et al. (2014), which were mentioned in the earlier literature review (section 3.4) to frame a new integrated framework, which provides a process perspective for the development of concepts in practice. It means that in this section will observe the interactions of concepts as emerging boundary objects with other boundary objects within the boundary zone by this new integrated framework. This approach will further track the development of concepts to observe the emergence and evolution of cross-disciplinary jewellery.

In the unique context of this study, two types of concept development are involved. One is similar to what Dalsgaard et al. (2014) focused on: the development of collaborative concepts born within the boundary zone. In their study, the emerging boundary objects proposed are conceptual constructs for the development of

collaboration-related concepts, focusing on the dynamic changes of concepts that all stakeholders in the collaborative environment work towards.

In the unique context of this project, when focusing on the emergence of cross-disciplinary jewellery in the boundary zone, the scenario where both collaborators work towards the same final outcome is not the only pathway for the emergence of cross-disciplinary jewellery. The independent design process based on the mutual feedback discussion in the boundary zone is also a pathway for its emergence. Therefore, in this project's context, there are discussions and developments of concepts that are related only to one collaborator's independent design process. Specifically, this refers to concepts based on the independent design process being pulled into the boundary zone, undergoing development through the mutual feedback process of both collaborators, but ultimately returning to their original independent design field.

The integrated framework used in this section attempts to extend the concept of emerging boundary objects to include developments based on the mutual feedback process in the boundary zone, ultimately extending to concepts in the independent design process. This provides a process perspective for the dynamic changes of independent design concepts as they traverse the boundary zone. In this section, I will discuss the development of independent design concepts through several cases. To facilitate the connection and referencing of different cases for comparative discussions during the process, these cases will be numbered in the subtitles.

5.4.1 Development of the Independent design concepts – concepts traverse the boundary zone and return to their original field

Firstly, focusing on the development of independent design concepts. In the unique environment of this practice, the development of the independent design concepts in the first phase occurs not only within the individual fields of the collaborators but also moves into the boundary zone through online meetings. Here, they undergo development via the mutual feedback process of both collaborators, with the future of these concepts ultimately decided by the collaborator from the original field – whether to end their professional life, return to the original field for future development, or remain in the boundary zone awaiting future development.

5.4.1.1 Case 1

Initially, in the first meeting of the project, the construction of potential concepts (emerging boundary objects) in the boundary zone was addressed. The purpose of this first meeting between us was to establish the topics for collaboration and to initiate preliminary discussions about them. During this meeting, four potential collaborative topics were proposed, all representing potential emerging boundary objects. In this process, I initially showed interest in the topics related to music visualisation. At this point, the topic of music visualisation, as a concept, was temporarily stabilised and established as a new boundary object in the boundary zone, although it remained vague and needed further development.

Subsequently, Rebecca suggested two possible pieces for the music theme: a piano piece called *'Arabesque No.1'* and an electronic music piece themed around *'Black Lives Matter'*. After initial thought of the two different types of music, I found the piano piece *'Arabesque No.1'* more engaging. Therefore, based on my own experience and immediate response, I proposed initial points of potential collaboration ideas, which also drew Rebecca's attention and interests. Thus, the visualisation of music based on *'Arabesque No.1'* was established as the topic of collaboration, the newly emerged boundary object began to develop and stabilise. Following this, both collaborators discussed the newly established theme and proposed some potential ideas for future development around it. During the process, the discussions initiated by both collaborators based on the two contextual examples proposed by Rebecca preliminarily demonstrated the development process of a potential independent concept in the boundary zone:

Rebecca, 00:15:52
As you just described to me, you are going to hammering or forming something.
In our field, what you're doing would be considered as a performance art. The whole process of your making is part of the piece. Your final outcome is not just the final physical piece. The whole process is connected. And on the other hand, are you familiar with John Cage's work?
David, 00:16:51
No.
Rebecca, 00:16:52
Okay, you can look him up. He is a contemporary composer, a very famous one. His most famous piece involves using his music performance. He has a lot of this kind of performance. So, there are many similarities with your idea, where you can turn music into something else. It becomes about how you produce this work, and it may not necessarily be a 'perfect' work in the end.

(Rebecca and David, Meeting time code: 2020.10.09 00:15:52 - 00:16:52)

Here, through the example of John Cage, Rebecca illustrated how the same mode of expression or design technique could have different potentialities in different fields. When we consider this process through the perspective offered by emerging boundary objects, it becomes apparent that through the use of contextual examples (functioning as semantic boundary objects), Rebecca demonstrated that the process of making in the jewellery field has the potential to become performance art in the visual field (fragmented knowledge). This helped me to understand that in the field of jewellery, actions like hammering and forming which only considered as techniques or process towards the final product, can be seen from the visual field as integral parts of an artwork (the fragmented knowledge I assimilated and restructured based on my own knowledge structure, forming a new understanding connected to my experience). In this process, the use of contextual examples as semantic boundary objects facilitated mutual understanding and the reconstruction of new knowledge. The deconstruction and reconstruction of knowledge in turn led to the emergence of new potential concepts. This suggests that the appearance of new potential emerging boundary objects is a result of interacting with contextual examples that function as semantic boundary objects, whose roles foster and assist in the construction of emerging boundary objects.

5.4.1.2 Case 2

In the following second meeting, also based on interactions with contextual examples, Rebecca introduced her thoughts on space and character using, through the use of James Turrell and Erick Oh, as well as a game called 'Flow' as contextual examples. This provided a more detailed perspective on the process by which independent concepts evolve and develop as they traverse the boundary zone.

Rebecca, 00:18:25
James Turrell, he's most famous for using light to structure space. This is similar to the feel I want to achieve. When you enter such a space, because we're currently looking at a picture, you can see the boundaries, but when you're actually in the middle of it, you can't see the boundaries. You're completely surrounded by colour. The colour in this space will slowly changing, but you're really enveloped in it. Some people might even feel uncomfortable because it's entirely 360 degrees."
David, 00:20:46
It gives a sense of solitude.
Rebecca, 00:20:48
Yes.
David, 00:21:08
Because you're surrounded by space, it feels like the space is compressing you.
Rebecca, 00:21:17
Right, that's the feeling. And then there's also a sense of suspension. You're in this space, but the only help is the sensation of your feet on the ground. That's the only point of reference; otherwise, it's very similar to a VR environment."
David, 00:21:44
Because your feet have tactile sensation, you feel like you're standing on the ground, but what your eyes see is an infinite space of light.
Rebecca, 00:21:53
Right, so I want to connect these two feelings.
David, 00:25:00
So, your idea is that in the VR space, there will be some patterns or lights that change with the rhythm of the music, possibly compressing or relaxing and expanding you.
Rebecca, 00:25:16
Right. And for the music, I want to show you an older piece by Erick Oh, called Symphony.
Rebecca, 00:27:51
It has many characters in it, but I don't want that many characters in my piece. However, I do want some movement that corresponds to the music, not too specific, but some elements that correlate. The form will also be more abstract, similar to the environment I have in mind.
David, 00:29:29
This piece gives me the feeling of exploring an unknown space, like an adventure. During the process, sometimes triggering mechanisms or things chasing it, but essentially exploring the space. In the end, the world is zoomed out, like exploring the Earth, then realizing it's part of a solar system, and even further, a universe.
Rebecca, 00:30:14
Yes, that's one way to interpret it. Of course, the character traces in this piece are very strong, which I might not need.
David, 00:30:34
But it has a strong sense of story and narrative.

Rebecca, 00:30:36
Yes. Let me show you another, a game called Flow. It has many characters, but I'm not focusing on that part. I'm looking at the flow, the motion. That's what I want to create, as it's a link between the music and my visuals. My mind is currently filled with these ideas. I'm not sure if this helps you understand my thoughts.
Primarily, it will be an immersive environment, 360 degrees surrounding you. The fluidity of the music must be expressed. For me, Arabesque is a perfect example of good flow. The difference between the two pieces I showed is that the 'Flow' game is freer, you can move to any corner, but Erick Oh's piece is more 2D in movement. In terms of movement, I haven't figured it out yet, because if there are too much movement, if you control its direction, can become random, which goes against the flow of the music. So, my idea is it still needs some control, maybe I'll start simple, pushing in one direction and then changing midway.

David, 00:34:15
Listening to this, I have an idea. If I'm in such a space, my eyes will focus on a point, like a character. If it moves with the music, my eyes will follow it, moving through the space.
Rebecca, 00:34:42
I think in some moments, it can be like that, but I don't want the overall to be like this.
David, 00:35:02
You want the entire space to have an impact on people.
Rebecca, 00:35:11
Right, so I haven't thought it through completely. I'm sure there will be elements in motion, corresponding with certain points in the music. That's what I want to create.
David, 00:35:34
Or I'm thinking, like the spatial lighting and size changes could give a sense of compression or release. For example, when the space compressed to an extreme, something suddenly breaks through the space, and my eyes follow it, leading to a release, then at the peak of release, there's a slow pullback. I think it would be interesting to have this kind of physical impact, pushing in and out with the music's flow.
Rebecca, 00:36:20
Exactly. Finding the balance among these elements is a place to experiment, especially in this environment. I don't want it to be too dramatic, but there needs to be something to keep people's attention. To maintain that meditated feel while keeping everyone interested.

(Rebecca and David, Meeting time code: 2021.06.09 00:18:25 – 00:36:20)

Here we can see that, first, Rebecca used the works of James Turrell to express her concept of 'creating a boundless colour light space.' Drawing on Turrell's work, Rebecca visualised her own concept. The characteristics of the boundless colour space, such as the solitude it can provide for viewers, the visual envelopment, the spatial compression, among others (fragmented knowledge that has been deconstructed), were picked up by me and thus flowed into my field, blending with my understanding. From this, I constructed a new concept: *'Use the change of the lights and space with the rhythm of the music, to compress and relax the viewer'* (a new emerging boundary object). This concept once again moved into the boundary zone,

becoming a new emerging boundary object, and traversed back into Rebecca's field, awaiting further development.

Next, Rebecca showcased her idea to involve small characters in her design, visualising the characteristics of the characters she wanted to use by Erick Oh's work and the game 'Flow'. In this dialogue, through these two examples, Rebecca's understanding of character-related elements was expanded:

The dynamic narrativity and sense of story contained in the abstract elements in Erick Oh's work 'Symphony', as well as the echoing music in their flow and movement (fragmented knowledge deconstructed). Combined with the flow and motion of elements shown in the game 'Flow' (fragmented knowledge), deconstructed Rebecca's understanding of how to integrate character-based elements with music (as Rebecca said, "Arabesque No.1 has a very good flow") and colour space environments. Based on this fragmented knowledge, I proposed the concept *'To use characters and lights change with the rhythm of the music, as well as the change of space to compress and relax the viewer'*. This was a new potential concept developed in response to Rebecca's independent design, creating a new potential emerging boundary object.

In this process of mutual feedback, the concept shuttled between Rebecca's design field, the boundary zone, and my design field:

Initially, the concept related to the use of characters, as a part of Rebecca's independent design, was introduced into the boundary zone. At the moment it entered into the boundary zone, this concept, along with the two contextual examples used by Rebecca, performed the function of semantic boundary objects, participating in the deconstruction of Rebecca's knowledge. At the moment of participating in knowledge deconstruction, the concept was stable and unchanged.

Next, as the deconstructed fragmented knowledge was picked up by myself, the concept entered into my field. The process of knowledge reconstruction occurred in my field, and with the integration of my understanding, a new concept was formed. At this point, the concept underwent iteration and development in my field.

Then, the newly formed concept returned to the boundary zone, once again acting as a semantic boundary object to foster Rebecca's understanding. Upon its return to the boundary zone, this concept evolves into a new emerging boundary object, driven by its developing journey within my field.

Finally, the new concept was brought back to its original (Rebecca's) independent design field, where its fate - whether to be discarded, further developed, or executed - would be decided by Rebecca.

During this process, the state of the concept experienced a transition from stable to developed and back to stable. Its identity shifted from *'elements related to Rebecca's independent design process'* to *'a semantic boundary object in the collaborative environment'* to *'a new emerging boundary object in the collaborative environment'* (also serving as a new semantic boundary object at the same time).

This process suggests that a concept, at its moments of stability, can function as a semantic boundary object, but in its unstable state, it transforms into an emerging boundary object. Specifically, when the concept moved from Rebecca's field into the boundary zone, its state was stable. In collaboration with the two contextual examples, it played the role of a semantic boundary object and facilitated my (the other collaborator's) understanding. However, it was precisely the function of the semantic boundary object that facilitated the deconstruction of knowledge and its reconstruction in my field, leading to the development and transformation of the concept. When the newly constructed concept returned to the boundary zone, its identity was multifaceted - from the perspective of the boundary zone, the concept was unstable due to its transformation, which made it become a new emerging boundary object; but from the perspective of the concept itself, since it had already completed its transformation before returning to the boundary zone, it was stable, thus once again functioning as a semantic boundary object, fostering new understanding for Rebecca and being taken back to its original field.

Additionally, since Rebecca introduced the concept into the collaborative field based on the use of contextual examples, we can observe a kind of 'symbiotic' interaction between the emerging boundary objects and contextual examples. Before entering the

boundary zone, the concept, as a potential future emerging boundary object, was first guided into the boundary zone based on the role played by the contextual example as a semantic boundary object. Then, through the fragmented knowledge deconstructed by the contextual example, it was picked up and flowed into my field for reconstruction. In this process, the concept as an emerging boundary object and the contextual example as a semantic boundary object worked together, benefiting each other. This symbiotic interaction triggered and promoted the concept's transition from elements related to Rebecca's independent design process to an emerging boundary object.

Furthermore, from the mutual feedback process, we can see that the multiple concepts I proposed are continuously evolving, and their evolution is related to the amount of fragmented knowledge captured by myself from the boundary zone. As Rebecca deconstructs more and more fragmented knowledge based on contextual examples, the more fragmented knowledge and information I acquire. Based on the example of James Turrell, an understanding related to the light space, which shaped the concept of '*To use characters and lights change with the rhythm of the music, as well as the change of space to compress and relax the viewer'*. Next, as Erick Oh's work and the game 'Flow' deconstructed knowledge related to characteristics of characters, the concept I constructed began to become more specific, with elements of character starting to appear in my proposed concepts. As the discussion deepened, eventually, the concept *'Compressed the light space to a peak, then break and then open the space by using small characters to capture attention, leading viewers' eye and then retracts space, to create dynamic experience with the music flow'* – which merged both the light space, and the character was built. This process shows that the extent of a concept's development, as it transforms from elements related to the independent design process into an emerging boundary object, is related to the amount of deconstructed, fragmented knowledge and the volume of information captured within the symbiotic interactive process.

5.4.1.3 Case 3

The development process of the concept that relates to the expression and display of my physical outcome (originally rooted in my independent design process) through discussions between both collaborators also provides a good perspective on the

process of independent design concepts continuously developing through shuttling back and forth between both fields and the boundary zone:

David 00:11:16
What I'm thinking now is if I want to keep this tunnel shape, I hope to make it like, I don't know, layers of acrylic stacked together. I can see the interlacing structure in the middle, and some of the pieces can be detached, without fastening them all together.
Rebecca 00:11:37
Right, I was just thinking about the issue of how to place this thing.
David 00:11:46
We could make a stand and place them piece by piece on it.
David 00:13:01
Then I can cut out the shapes based on this, because you see each bottom is different. This way, each piece can have a fixed position to stay on top, and it can be secured in a certain position. Or I could make the stand a bit taller, so it in itself would have half of the shape. You could see the sculpture's outline on the stand.
Rebecca 00:13:57
I understand your idea, but I feel the stand might be taking up too much importance if done that way.
David 00:14:09
Yes, so maybe I was thinking of making it about this tall, then they would be fixed on top.
Rebecca 00:14:21
Right, I think that would be better, it should be like that.

(Rebecca & David, Meeting time code: 2021.09.23 00:11:16 – 00:14:21)

Here, based on the use of digital models, a concept related to display was initially established and developed. Unlike the previous discussion (case 2), here, the initial establishment of the concept took place within the boundary zone. First, based on the details shown in the digital model, the idea of *'Making a shelf to support the sculpture and arrange each single piece sculpture in order on the shelf*' was preliminarily proposed. However, it is worth noting that this idea was raised during the online meeting; although it was a potential idea related to my independent design process, it was an unformed potential idea proposed within the boundary zone based on the shape of the channel form model I created, rather than an idea pulled into the boundary zone from my independent design process (like Rebecca's concept in case 2).

Next, as shown in the figure 5.4-1 and 5.4-2, when we used Rhino software and digital models for the real-time visualization of this idea, we found that although the tunnel form sculpture enhanced the overall spatial sense of the model through multiple layers, but the details carried by individual sculptures would lose because of the overlap caused by the stacking of multiple layers. To enhance the overall spatial sense while retaining more details of the individual sculptures, the concept of *'To adopt a separated*

arrangement form - instead of placing them tightly together, make space in between pieces on the shelf' was raised by Rebecca. This new concept was proposed as both collaborators iterated and developed a new concept from the original one based on the discussion process of the digital model.

In this process, first, the establishment of the concept for display was based on the sharing of the digital model, taking place in the boundary zone. At this time, the flow of fragmented knowledge (deconstructed by the digital model functioned as semantic boundary object) in the boundary zone led to the birth of an unstable potential concept (potential emerging boundary object). This potential concept then became preliminarily stabilized as it was captured by both collaborators, transforming from a potential emerging boundary object into a formed emerging boundary object in the boundary zone.

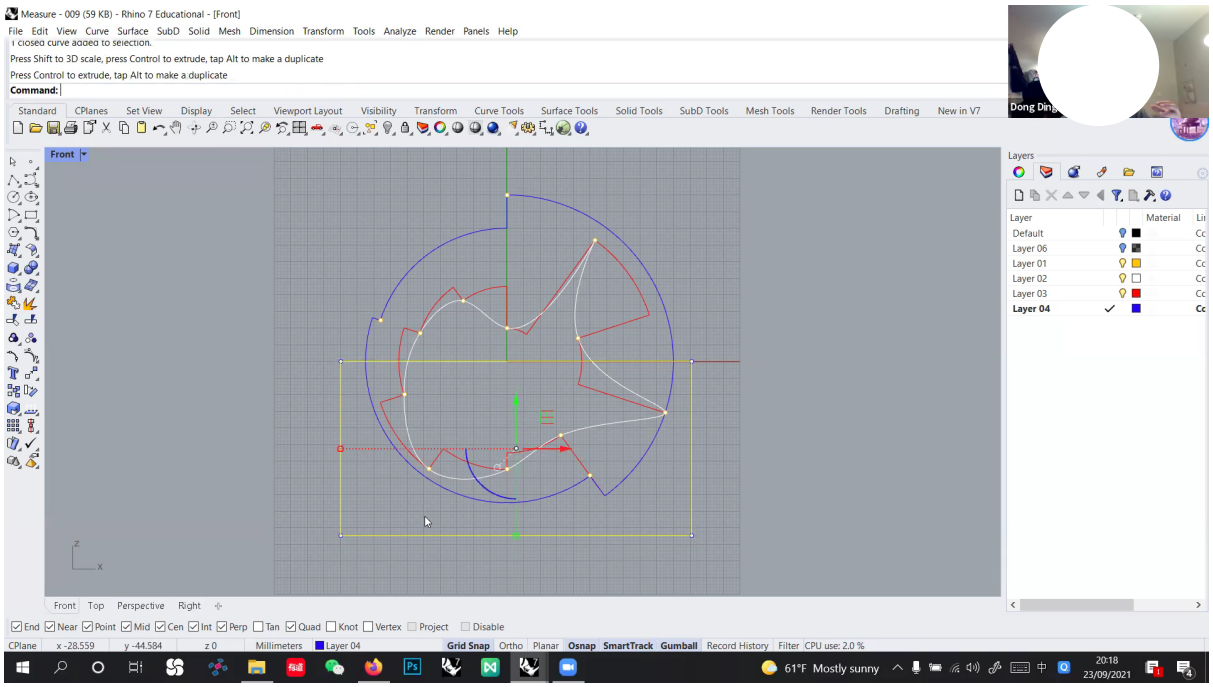


Figure 5.4-1: Myself using Rhino software to build shelf model during online meeting

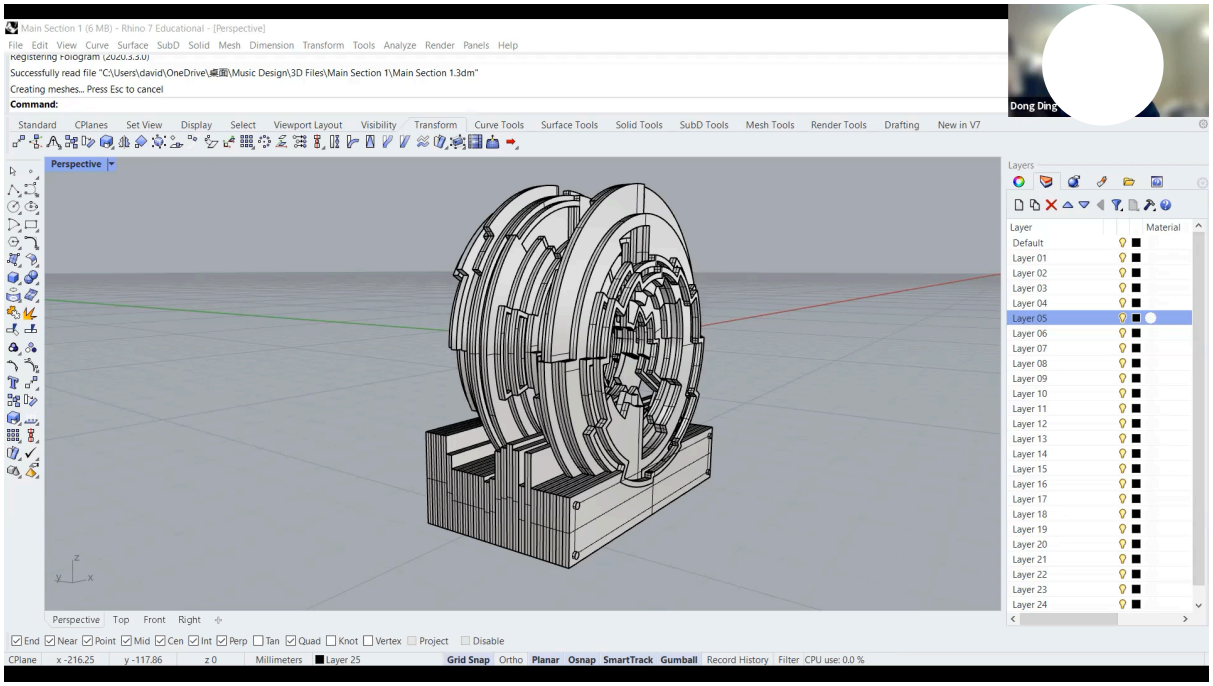


Figure 5.4-2: Rebecca and myself discuss display-related concepts based on the digital model during an online meeting

Next, based on its interaction with the Rhino software and digital model (functioning as a semantic boundary object), this concept developed and formed a more specific new concept (a more stable new emerging boundary object). However, since the digital model at this moment could not provide more information, and there were no other interactive boundary objects carrying relevant information in the boundary zone for this concept to further develop, this concept (which is temporarily stable) receded into the background and was left in the boundary zone, waiting to be mentioned again, or waiting for new boundary objects which carrying relevant information to enter the boundary zone and interact with it, leading to its further development.

5.4.1.4 Case 4

The next development of the concept related to display was triggered by the entry of a new boundary object (physical model) carrying relevant information into the boundary zone, reviving this concept, which had been dormant in the boundary zone, bringing it back to the forefront for renewed interaction:

David 00:04:06
The shelf has a problem that I am currently trying to solve. Many pieces of the sculpture have round bases, and when placed on the stand, they move and can't stay in their original position.
Rebecca 00:04:24
I see.
David 00:04:29
I thought about adding a small notch at the bottom to lock it in place, but that would actually ruin its original shape, which I don't really want to do. I'm considering if there's another way to do it.
Rebecca 00:04:41
Okay, also another problem here is. Because now its stand is also transparent, and I know the stand needs to be transparent so we can see through. But I think now the base and the main body of your piece are blurry. I think there needs to be a distinction, so everyone knows this is a stand.
David 00:05:07
What if we use frosted acrylic for the base, like with a frosted surface?
Rebecca 00:05:15
I was thinking about that too, I think it might be good.

(Rebecca & David, Meeting time code: 2021.11.04 00:04:06 – 00:05:15)

Rebecca 00:10:02
I'm wondering if we can use some sort of soft material at the bottom, so when you insert it, it won't roll.
David 00:10:19
I understand what you mean, but it feels like it would be very difficult to do.

(Rebecca & David, Meeting time code: 2021.11.04 00:10:02 – 00:10:19)

In this feedback process, we can see that based on the physical model serving as a semantic boundary object, the information it carried (based on the structural forms and material characteristics of the physical model) led us to identify two major issues with the shelf as a display method: firstly, the circular form of the sculpture made it difficult for individual pieces to stay properly on the shelf, and secondly, the use of the same transparent acrylic material for both the shelf and sculptures resulted in a blurred distinction between the two. Subsequently, in response to these issues, both collaborators proposed different solutions based on their experience and knowledge, as demonstrated in the mutual feedback process shown in the figure. The concept, revolving around ‘using a shelf to support tunnel sculptures’ (an old emerging boundary object that had remained in the boundary zone since the last discussion), developed into several different new concepts, including:

1. Adding a small extra part at the bottom to click the sculpture piece on the shelf. (Proposed by myself)
2. Using soft material like silicone to fill in the base to secure the sculpture piece sets on it. (Proposed by Rebecca)
3. Creating contrast by using acrylic with different finishes. (Proposed by Rebecca)
4. Keeping the sculpture in transparent acrylic and making the shelf using frosted acrylic. (Proposed by myself)

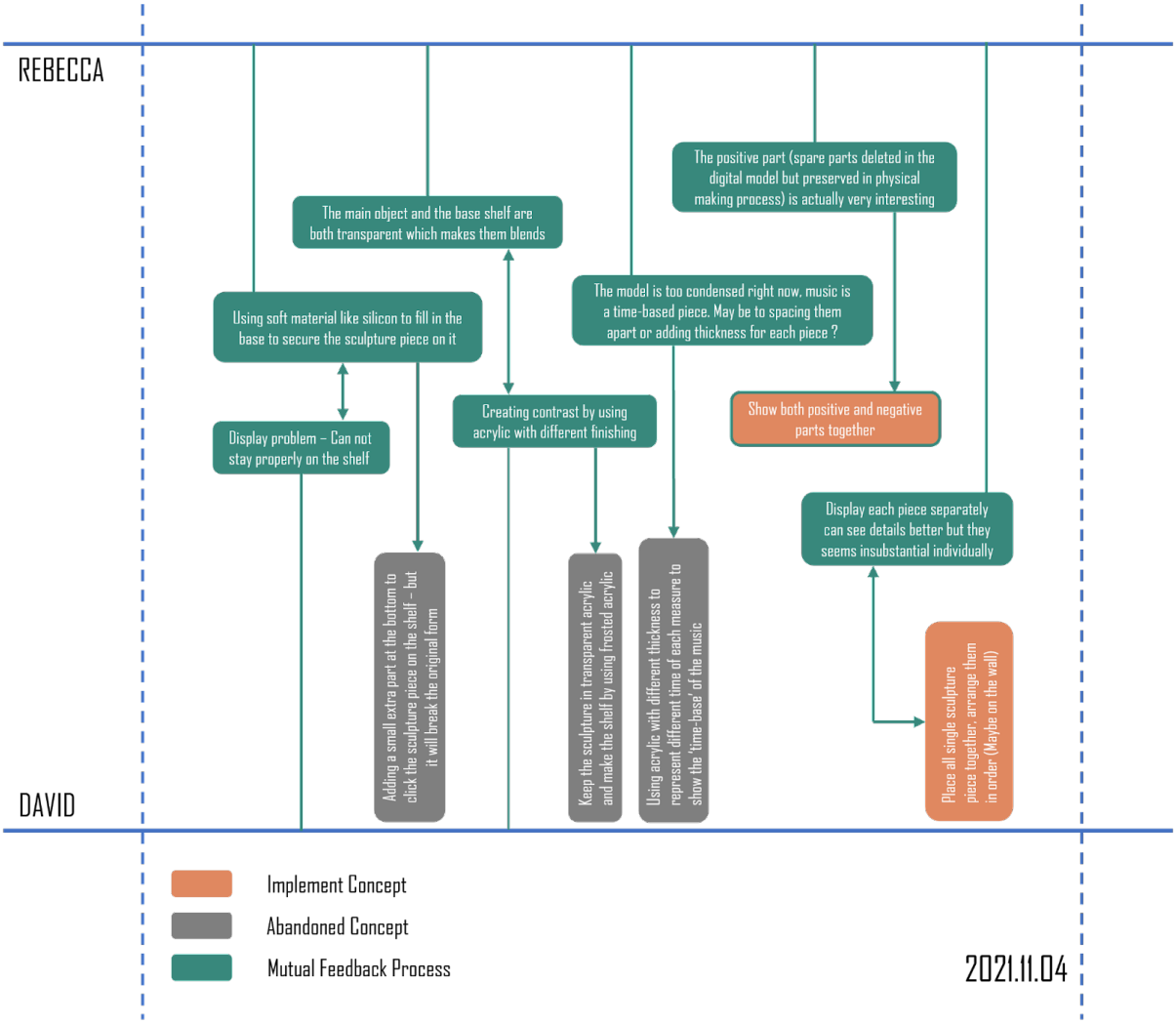


Figure 5.4-3: Mutual feedback process of meeting 2021.11.04

Here, the reason of the concept related to display was reawakened and brought back to the stage was due to the physical model as a boundary object entering the boundary zone. Compared to the digital model, the physical model carried and displayed information related to this concept, yet with slightly different details, thereby leading to

the further development of the concept. The physical characteristics and acrylic material features of the physical model displayed were new information not provided by the digital model. The concept underwent the development process shown in Figure 5.4-3.

Firstly, as the fragmented knowledge deconstructed by the physical model (acting here as a semantic boundary object) was picked up by both collaborators, imperfections in the old concept (established previously and remained in the boundary zone) were identified. Both collaborators, based on their experience and the combination of the fragmented knowledge they gathered, created a new understanding of this concept (new knowledge, which is also a new emerging boundary object, in this case, concepts 1, 2, 3).

Next, the new concepts created by both collaborators were again brought into the boundary zone. At this point, as the concepts were already stabilised in their respective fields, the stable concepts (new emerging boundary objects) began to function as semantic boundary objects, facilitating understanding between both collaborators. During this process, new concepts (new emerging boundary objects) from both sides began to interact (as shown in the mutual feedback process in Figure 5.4-3), and simultaneously interacted with the physical model that remained in the boundary zone. The interaction of these three parties promoted the further development of the concept within the boundary zone, resulting in the creation of a new emerging boundary object (concept 4).

In this case, the discussions around the display idea and the development of related concepts demonstrate the varied developmental processes that arise from the interactions between the concepts (as emerging boundary objects) and different boundary objects. This variation in the development and evolution into different emerging boundary objects is due to the distinct information and knowledge carried by different boundary objects, and the differences in the fragmented knowledge generated by their deconstruction job as semantic boundary objects.

5.4.1.5 Case 5

In the discussions presented in cases 3 and 4, the concept related to display developed different versions centred around the tunnel-shaped forms. However, as discussions up to that point had not resulted in an acknowledged concept for display, the discussion on the display-related concept continued in subsequent meetings, but with a shift in the core of the concept:

> ***David 00:15:53***
> *Then you see, if it's just a single piece, it will look like this.*
> ***Rebecca 00:16:19***
> *I think there are a lot of details in the middle of this thing, particularly the internal details. So, I'm thinking in this case, if it's just a single piece, you really need to put all the pieces together, otherwise it feels a bit thin, like spreading it all out.*
> ***David 00:16:52***
> *Yes, a single piece arrangement can be a good choice, just like you said before, spreading it all out, for example, on a wall."*
>
> *(Rebecca & David, Meeting time code: 2021.11.04 00:15:53 – 00:16:52)*

In the above discussions, following Rebecca's suggestion, a display solution that preserves the details of individual sculptures was proposed: *'to show each of the single sculptures separately instead of layering them together'*.

Due to this shift in the core of the concept, a brand-new potential concept (a new potential emerging boundary object) was established. Through discussions between both collaborators, this potential concept gradually stabilised in the boundary zone, and a more specific plan, *'Place all single sculpture pieces together, arrange them in order on the wall'* (a new emerging boundary object), was born in the boundary zone. As it gained my approval, this concept was captured and flowed into my field, becoming the final concept to be implemented.

Additionally, during data review, it was discovered that this concept of *'spreading out the piece on the wall in exhibition space'* echoed Rebecca's initial suggestion in the first meeting of the physical pieces can be *'wrapping around the space or being mounted on walls.'* (At that time, the project had just started, only the theme was determined, and Rebecca, based on her experience and knowledge, proposed potential possibilities for the physical visualisation of music):

This suggests that, in the discussion of this example, the visual relation created by the physical model working as a semantic boundary object triggered Rebecca's relevant experiential knowledge. This awakened experiential knowledge formed a concrete concept in Rebecca's field and entered the boundary zone. Since it was already stable before entering the boundary zone, it began to function as a semantic boundary object upon entry, deconstructing Rebecca's related experiential knowledge. The deconstructed fragmented knowledge interacted with the latest concept in the boundary zone (the most recently developed emerging boundary object in the boundary zone), facilitating its transformation into a completely new concept (entirely different from the original latest concept based on tunnel-shaped display; the new concept's core shifted to a concept based on the separated display of individual sculptures), forming the concept *of 'Place all single sculpture pieces together, arrange them in order on the wall'* (A completely different new emerging boundary object from the previous one).

Although in this case we see that this concept's development did not refer to Rebecca's initial idea, the connection to the idea she proposed before the project suggests that the relevant idea was embedded in her experiential knowledge. This related experiential knowledge, awakened by the sharing and discussion process based on the physical model (functioning as a semantic boundary object), and interacting with the emerging boundary object, participated in the construction of the concept. This highlights how the interaction process of boundary objects can evoke, deconstruct, and reconstruct the tacit knowledge of collaborators.

5.4.1.6 Case 6

In the examples above, except for case 5, the concepts in the other cases, whether remaining in the boundary zone or returning to their original fields, ultimately did not develop into executable, finalised concepts. Even in the discussions of case 5, there was also no focus on the development of concepts after returning to their original fields. Therefore, the following example will illustrate more detail about the process of a concept traversing the boundary zone and then further developing into a final concept after returning to its original field:

David, 00:02:31
This is the spare part cut out from the inside. Actually, it's the shape of the internal space. It is actually very interesting.
Rebecca, 00:02:36
I think it looks very nice. I feel like the internal space looks really good. Don't you think so?
David, 00:08:09
Yes, it actually looks very attractive, but this can only be considered as a by-product.
Rebecca, 00:08:39
I think it can be like, during your exhibition, you can display both the negative and positive parts simultaneously. So, it's not necessarily the case that this thing is completely a useless by-product. I think you can exhibit both negative and positive together.
David, 00:09:07
Right. Actually, at first glance, the positive parts seems better than the negative.

(Rebecca & David, Meeting Time Code: 2021.11.04 00:02:31 – 00:09:07)

In this case, as we have already touched upon in section 5.6.6 regarding the physical model as a boundary object, the ‘spare part’ discarded in the digital model was discovered to have new potential and eventually developed into part of the final product. Here, we will revisit this development process from the perspective of the process provided by the concept of emerging boundary objects.

Initially, due to the making method of the physical model, the internal ‘spare part’ was retained. As it was considered ‘interesting’ and ‘attractive’ (as I stated in the meeting), it was motioned and shown in our online meeting, which was overlooked in the digital modelling process, and it received affirmation from Rebecca during the meeting. At this point, a potential but unformed concept was guided into the boundary zone with the help of the physical model. Compared to the previous cases discussed, this situation differed from case 2, where Rebecca pulled a partially formed concept into the boundary zone and from case 3, where an unformed idea was initially shaped in the boundary zone based on the digital model. Here, the ‘spare part’ had already been evaluated in the independent design process as a potentially developable object, but no formed or partially formed concept around the ‘spare part’ was established at that time. It was introduced into the boundary zone for discussion only for its potential to develop into a concept. Upon entering the boundary zone, it served as a semantic boundary object, helping to display my value judgement of it, and after receiving affirmation from Rebecca, this ‘evaluation’ was initially stabilised, becoming a potential concept (a potential emerging boundary object). However, as mentioned in the discussion, I considered the ‘spare part’ only as ‘by-product’ at that time.



Figure 5.4-4: ‘Spare Part’ in design process and final piece (Measure 4 as example)

Subsequently, the ‘spare part,’ affirmed by both collaborators, gradually transformed into a concept during our discussions. Until Rebecca proposed the concept of *‘displaying both positive and negative aspects simultaneously’*, with this more tangible possibility suggested, the transformation of the concept was preliminarily completed and began to stabilise. The positioning of the ‘spare part’ shifted from a ‘by-product’ to ‘a part of the final product’, and a new emerging boundary object was born in the boundary zone. (From the perspective of the birth of emerging boundary objects, compared to previous examples, it is different form case 2 as the first iterative development of the concept in case 2 occurred after crossing the boundary zone and being picked up into my field, it was originating in my field; but similar to case 3, it was born within the boundary zone.)

Next, as the concept (now an emerging boundary object) became provisionally stable, it got the basis to function as a semantic boundary object and began to operate as

such. Due to its role as a semantic boundary object, this idea was picked up and re-entered my field (its original field). In my field, during the subsequent independent development process, this idea underwent further development based on my experiential knowledge, becoming a part of the final product. As shown in Figure 5.4-4, in the final product, the ‘spare part’ did not appear in the positive form as in this example but developed based on its form, creating a form that echoed both positive and negative aspects. This is the result of its interaction in my field with other concepts and my own experiential knowledge.

Unlike case 2, which also showed a concept moving from its original field through the boundary zone and back again, in this example, the concept, upon returning to its original field, did not get discarded but underwent further development and eventually became one of the implemented concepts. This process involved crucial interaction with the physical model, mainly in two stages:

Firstly, guided into the boundary zone based on interaction with the physical model (similar to case 2), it entered the boundary zone by deconstructing knowledge through the semantic boundary object function of the physical model.

Secondly, in the boundary zone, Rebecca, using the physical model (functioning as semantic boundary object), proposed a specific plan based on her understanding of this potential concept, thereby establishing a new concept. Here, unlike case 2, where the concept entered my field and interacted with my experiential knowledge, leading to changes (this involved building new knowledge, the iteration of the concept related to the construction of new knowledge), here in this case did not involve the construction of new knowledge. Rebecca proposed a future development possibility for this concept based on her preliminary understanding, without combining it with her own experiential knowledge. It only involved enhancing the understanding of design decisions.

In this example, the reason I believe this case does not involve the construction of new knowledge because although Rebecca's idea of *'exhibiting both positive and negative aspects simultaneously'* is mentioned as an emerging boundary object. Here, I consider this is only a 'potential future idea', slightly different from a 'concept'. This is

because both the 'positive' and 'negative' aspects involved in this idea are quite vague and formless, subject to future change. In the context of this meeting, we only knew that 'positive' and 'negative' referred to *'forms involving only internal space shape'* and *'forms with both internal and external space shapes'*, but their specific forms and presentation are yet to be developed. Therefore, I believe that what Rebecca proposed here is just a potential direction for future development, not a specific concept.

Although a similar situation can be found in other examples, such as in the previously discussed case 2, with the concept of *'Using characters and lights to change with the rhythm of the music, as well as the change of space to compress and relax the viewer.'* In this concept, the 'character' here is also undefined and vague. Should it also be defined as an idea rather than a concept in the context of case 2? This is a thought worth exploring.

My understanding is that the concept in case 2, although the final form of the character was also undefined and subject to development, but it was proposed based on the fragmented knowledge generated by Rebecca's deconstruction of knowledge (her understanding of characters and their characteristics, and how they combine with music) combined with my own experiential knowledge, which involved a more complex and specific process of knowledge flow and creation. The proposed idea was more concrete, it is a partially formed concept.

On the other hand, in case 6, the idea of *'exhibiting both positive and negative aspects simultaneously'* seems more like a direct response to the notion that *'positive is also interesting'* (similar to the direct feedback of *'since both are interesting, why not display both'*). The knowledge deconstruction involved in this, the combination with Rebecca's own experiential knowledge, and the process of new knowledge construction are very limited (especially when compared to case 2). Although this direct feedback was based on Rebecca's experiential knowledge, the process lacked sufficient evidence related to knowledge construction.

5.4.2 Development of co-creation ideas – concept originally built within the boundary zone

In the previous examples, the focus was primarily on the independent design concept interacting with other boundary objects in the boundary zone, leading to further developments and forming new concepts that return to their original field. This section will concentrate on co-design ideas originating within the boundary zone, interacting with other boundary objects in the same environment, and undergoing development changes to become new concepts (new emerging boundary objects).

5.4.2.1 Case 7

This chapter will continue to analyse several examples, starting with one similar to case 2, involving interaction with contextual examples. However, this example involves a concept as an emerging boundary object interacting with multiple contextual examples:

> ***David 00:12:28***
> *In the project I saw, they started from a music score. They redesigned the music score and transformed it into a graphic and colours. Then they had musicians play this score again. The approach in the first half is somewhat similar to mine.*
> ***Rebecca 00:12:42***
> *I know. I think I've seen a similar project. Do you remember the sculpture by Natalie I mentioned to you? Even though her sculpture didn't start with music, it resembles the latter part of this method. The data formed by her sculpture was converted back into a music score...*
> ***David 00:27:12***
> *Like those two people we just talked about, they transformed the music score into a graphic, then the graphic was transformed back into music by musicians. For our piece, especially my part which is a physical sculpture, could we possibly transform it back into music from its physical form? Because as a sculpture, mine is 3D, which contains much more information than their 2D graphics. Suppose we find a musician and I explain how to read the sculpture. If he can try to reinterpret it back into music based on what I've told him, there will be a change on the recreated music, result in something entirely different.*
> ***Rebecca 00:27:56***
> *Right, we could definitely try that.*
>
> (*Rebecca & David, Meeting timecode： 2021.11.17 00:12:28 - 00:27:56*)

In this case, as already addressed in section 5.3.1, my example of 'silent music and seeing sound' and Rebecca's example of Natalie Miebach’s work served as contextual examples performing the function of semantic boundary objects. They facilitated mutual understanding and knowledge flow between both collaborators. However, here

we shift our focus from the function of contextual examples as semantic boundary objects to re-examining the mutual feedback process within the framework of emerging boundary objects.

During the process, initially, the emerging boundary object established in the boundary zone was *'Creating a cycle from music to other art forms and back to music'* (concept No.1), based on my example of silent music and seeing sound. This concept was relatively vague at the time.

Subsequently, Rebecca, drawing on the fragmented knowledge deconstructed by the silent music and seeing sound example (used as a contextual example) and her own understanding, introduced Natalie Miebach's example as a new contextual example. This new contextual example interacted with the existing silent music and seeing sound example in the boundary zone. Simultaneously, the original emerging boundary object in the boundary zone (concept No.1) also interacted with the new contextual example (Natalie Miebach's example). This interaction led to the combination and reconstruction of fragmented knowledge from the two contextual examples and the original concept (concept No.1), resulting in development and evolution into a more concrete new concept - 'Use the transformed spatial or visual patterns as new scores and collaborate with musicians or composers to convert the model back into new musical works' (concept no.2). A new emerging boundary object was born in the boundary zone. Compared to concept no.1, this developed concept incorporated fragmented knowledge ('unique expression methods will be guided by personal factors') deconstructed in the boundary zone based on interactions with the two contextual examples. Based on this fragmented knowledge, we integrated elements ('spatial or visual patterns as new scores') rooted in both collaborators' independent design processes into concept no.1 and transformed it into concept no.2.

As analysed in case 3, since there were no more boundary objects in the boundary zone to interact with to further develop this newly born concept, concept no.2 receded into the background and stayed in the boundary zone. It will, in the future, be either implemented as a mature co-design idea based on both collaborators' judgment, picked up for further development, or completely replaced by other newly emerging concepts.

Throughout this process, the state of the Concept (emerging boundary object) evolved from being born (stabilised) in the boundary zone, to interacting (developing and unstable) with actively functioning semantic boundary objects (contextual examples), and finally to forming a new concept (development completed, stabilised). The birth of the new emerging boundary object (concept no.2) occurred within the boundary zone, during the interaction between the original emerging boundary object (concept no.1) and two interacting contextual examples. The interacting contextual examples laid the foundation for the iterative development of the concept, with the fragmented knowledge generated from their interaction nourishing the construction of the new emerging boundary object.

5.4.2.2 Case 8

From all the examples above, it is evident that concepts, as emerging boundary objects, are unstable during communication processes, fluctuating or evolving based on the dynamic feedback process between collaborators. Focusing on how the process of concept variation dynamically changes based on the flow of knowledge in the boundary zone, our discussion on the potential use of AR technology in the meeting on 2022.05.01 provides an excellent example:

> ***David, 00:26:12***
> *If VR is very difficult, is AR also a possibility? For example, if I create such a space and then display it on a mobile phone, as I walk forward, I can at least see the changes in the space on the screen.*
> ***Rebecca, 00:26:48***
> *We can consider it, because I deal with VR and AR stuff a lot. The problem with AR is that if we deal this kind of model, it's better for static things, but if you do time-based pieces, it's more difficult. The thing we want to do involves music, so it's more of a time-based thing. The form of AR, although it can be real-time, it's very difficult to do a 3 or 4-minute piece. It's quite limited.*
> ***David, 00:27:40***
> *But I have another idea. Do you remember our previous discussion about turning this into a physical thing, like a huge tunnel, right? If this is put inside as a physical piece, it is not limited by time. You just wear headphones and walk forward with the music. If we build such a model and put it in AR, you can use your phone to walk forward while listening to music, kind of replacing its function in reality, but without being so huge.*

Rebecca, 00:28:15
Your idea is good, but what's the limitation? With AR, unless you use HoloLens, you can't do a large scale. Nowadays, the biggest AR things are based on iPad size. With phone or iPad size, your 3D model can't be too big.
David, 00:28:39
But I've tried to look at a very large model on a phone, like a model of a house. It's huge, but as you get closer to it, it's like walking through walls into the room. You can see all the structures inside, lift it to see the roof, look down to see the floor, and to the left to see a mirror.
Rebecca, 00:29:20
The thing is, you go in, you're seeing the content, but now you need to detach yourself from it and thinking it form the perspective of a creator. Because you go in, you see it as huge, but from the creator's perspective, you're only seeing it as huge through a screen. In reality, it's not that big; you're just looking through your phone, which is small in your hand. So, it's in a small place, and you're looking into it, so it's basically a screen-based understanding."
David, 00:30:08
Yes, because in reality, I can't build something so big, so I can kind of get it through a screen, although it's definitely not ideal.
Rebecca, 00:30:24
I think it's worth considering, but both AR and VR have their weaknesses. In this case, the weakness of AR is that it really struggles to support time-based things. You can let users walk into this model, but in this way, the control is largely on the user's side. How to advance the music, and what the combination of this music and your piece.
David, 00:31:02
It's actually not that strong.
Rebecca, 00:31:04
Right, because if your camera is moving, you have no control at all, you can only rely on the user. In VR, there's better control over the camera and environment.

(Rebecca and David, Meeting time code: 2022.05.01 00:26:12 – 00:31:04)

In the conversation, we observed that during the co-design concept discussion about digital models and audience interaction, both collaborators had different understandings of 'interaction between the piece and people'. I usually deal with physical formats, where the nature of physical forms means that the initiative for interaction lies with the audience, requiring them to initiate the interaction, which influenced my approach. This habitual thinking led me to transfer the initiative to the audience even when dealing with digital media.

However, Rebecca's frequent dealings with digital media formats allow for interactions initiated by the digital piece itself, in addition to those initiated by the audience. Digital pieces can actively interact with the audience and even guide how they interact. Therefore, Rebecca preferred to give some initiative to the work to guide the audience. This difference in thinking about the interactivity of the work and the audience led to divergences in our application of design elements and decision-making.

The direct manifestation of this difference in the communication process is the proposal and transformation of concepts. During this example, we observed the following developments:

Initially, I proposed the concept of 'using AR as an alternative technological method'. Immediately after, Rebecca, based on her understanding of AR technology, presented the viewpoint that 'AR technology struggles with time-based works' (a preliminary deconstructed fragment of knowledge regarding Rebecca's experiential knowledge of AR technology use).

Next, I further explained on the concept of 'using AR as an alternative technological method', expanding it into a more concrete plan: 'creating digital avatars in AR virtual space based on physical models' and 'accessing human-sized sculpture models through mobile devices' (concretely deconstructed fragments of my understanding of digital format models). In response, Rebecca further argued that 'accessing large-scale models through AR-based mobile applications is still screen-based understanding' (further deconstructed fragments of knowledge about Rebecca's understanding of AR technology) and that 'the complete control freedom given to users by AR technology could weaken the connection between the artwork and the music' (further deconstructed fragments of knowledge about audience interaction with digital format pieces from Rebecca's perspective).

Although the concept did not further stabilise or form into an agreed concept during the discussion, its iterative and changing process effectively showcased the dynamic nature of concepts as emerging boundary objects and the flow of knowledge between collaborators mediated by emerging boundary objects.

In this process, both collaborators' understandings of how digital format models interact with the audience were continuously deconstructed and picked up. While no new reconstructed knowledge was generated, the process enhanced mutual understanding, laying the foundation for further development of the concept. In the mutual feedback process between collaborators, the changes in the concept were an indication of knowledge being deconstructed and picked up, with the essence of these changes being the process of knowledge deconstruction and reconstruction.

5.4.2.3 Case 9

When we step back from observing the dynamic changes of concepts as a whole and focus on a specific moment of their development, we find that their identity is also dynamically changing. This is demonstrated in the following discussion (occurring immediately after the discussion in case 8 during the same meeting):

> ***David, 00:31:35***
> *In my opinion, AR is just a substitute of the physical model. Suppose I actually build up a huge physical tunnel, then in that form, it's completely dependent on the audience in the tunnel. The audience moves at their own pace, fast or slow, and there's no time-based control as you mentioned, because it's really just a physical thing in that place. So, from this perspective, AR can serve as a substitute for this.*
> ***Rebecca, 00:32:09***
> *Right, I understand what you mean. But actually, it's because the media we deal with are different, so your perspective is different.*
> ***David, 00:32:19***
> *Yes, my idea is to digitalize the physical piece, not to think about it from a digital mindset, which is quite different.*
> ***Rebecca, 00:32:30***
> *But for me, because my media is originally more time-based, I would hope that there's more change over time in the user's experience. So, I need to think about this more.*
> ***David, 00:32:52***
> *I'm just suggesting a possibility, because your work, is about controlling the user's experience with your art. My work, being physical, doesn't have control over people. My thinking is more about how to let the user control the work, which is a reverse logic.*
> ***Rebecca, 00:33:21***
> *Right, of course, it's also interconnected because you present your material, you present the physical thing to your user, and how they experience it is up to time. In my case, I add to that, I also present to them, but my presentation goes over time, constantly feeding them something.*
> ***David, 00:33:52***
> *Yes, you're more of a guide, perhaps through a hint. Your guidance is stronger than mine.*
> ***Rebecca, 00:33:59***
> *Right, I give them a direction to guide. Of course, sometimes, if possible, I will add some elements that allow them to make choices. So, we could add interactivity in an AR or VR environment, giving them more choices, but I'm still not clear about what kind of choices. Another point we can consider is how to involve time again, like how the whole shape transforms according to time, transforms with the music.*
>
> *(Rebecca and David, Meeting time code: 2021.05.01 00:31:35 – 00:33:59)*

In this conversation, based on the discussion of the concept 'creating digital avatars in AR virtual space based on physical models', both collaborators further elaborated on the reasons behind their viewpoints – the difference in thinking methods due to the different media they are accustomed to dealing with:

Both collaborators, as experienced artists dealing with different media, have distinct approaches. Although I am involved with digital media to some extent, I still access digital formats from a craft-based mindset. That is, I think of the digital model in terms of making a physical object, where digital is just used as a tool or a form of model representation, a digital version of a physical piece. My use of digital tools is based on this mindset. How I get involved with digital technology is actually 'digitising the physical piece', as mentioned in the above discussion. My design method is essentially based on the physical, just constructing digital models for it, or representing it digitally.

Rebecca, on the other hand, views digital models from a completely different perspective. She tends to think in digital terms about the models established in the virtual world. Models in the virtual world inherently possess interactive properties, so the way of interacting with the audience is already a part of the design. As Rebecca said, constantly feeding the audience with things to guide them or giving them choices for interactivity is a common approach.

This difference led to a divergence in the use of AR technology between the collaborators and was openly discussed in the above example. The concept here demonstrated a function similar to a semantic boundary object – participating in the flow of knowledge between collaborators, contributing to the deconstruction and capture of knowledge in the boundary zone. Based on the discussion related to audience experience, Rebecca suggested that she is adept at guiding the audience to facilitate interaction, thereby demonstrating the time-based properties of the work (fragmented knowledge about how digital media interacts with the audience). Correspondingly, I proposed that with physical formats, there is more consideration of the audience's control over the artwork (fragmented knowledge about how physical formats interact with the audience).

This fragmented knowledge was picked up by both collaborators, thereby enhancing understanding of each other's design decisions. In this process, the concept's identity related to emerging boundary objects remained stable and did not change, functioning more as a semantic boundary object. This suggests that while concepts as emerging boundary objects, are dynamically changing overall, when we focus on a specific moment of their development, their identity can be multifaceted. In this frozen frame,

their identity can shift to function as a semantic boundary object. They can dynamically shift between being an emerging boundary object and a semantic boundary object, depending on the specific moment and context of the interaction. This duality plays an important role in facilitating the flow and exchange of ideas and knowledge between collaborators, as well as facilitating the development of itself (into different versions of the concept).

5.5 The existing and development of cross-disciplinary jewellery under the emerging boundary object framework perspective

This section will continue to trace the development of the concept based on the integrated boundary object framework used in the previous sections (sections 5.4 and 5.5). However, the focus here will be on my independent design process. More specifically, the establishment and development of the design concept within my independent design process will be observed through the process-oriented perspective provided by the *emerging boundary objects* concept. This section attempts to track the creation and evolution of cross-disciplinary jewellery by examining the dynamic changes of the concept.

The dataset underpinning this research is the mutual feedback process between collaborators. It can only track data that is brought into the boundary zone, but it does not have access to each collaborator's independent design processes. Therefore, due to the inability to precisely track every moment of the independent design process, this section will analyse the creation and development of cross-disciplinary jewellery through only the independent design processes reported during online meetings (mutual feedback). Although online meetings do not provide real-time feedback and records of the independent design process, they contain the main development data of the independent design process. Hence, the tracking and analysis of the creation and evolution of cross-disciplinary jewellery in this section do not involve real-time data related to the design development, focusing instead on the development process of the cross-disciplinary jewellery, rather than the specific time points at which events occur.

During the data reviewing process, to clearly observe the evolution of the concept from the data, the independent design processes showcased during the online meetings are visually organised. This involves mapping out the concept development and the mutual feedback process, as illustrated in Figure 5.5-0. (Given the extensive timespan and complexity of the *'Data-Music-Jewellery'* project, this is a long illustration; please try to zoom in to read the contents of this chart.)

In this diagram, the upper section (when the figure is placed portrait, will be the right section) shows the development of concepts related to Rebecca's independent design process, the lower section (when the figure is placed portrait, will be the left section) shows the development of concepts related to my own independent design process, and the middle section displays the mutual feedback process. All grey blocks indicate concepts that were proposed and ultimately abandoned during the development process, blue blocks represent concepts that were deemed to have potential for further development, orange blocks signify concepts that were taken forward and involved in the final outcome development, and green blocks show the mutual feedback process. Some of the orange blocks with green borders represent concepts developed during the mutual feedback process and adopted in the final outcome. This chapter will analyse the creation process of cross-disciplinary jewellery based on this illustration (will take screenshots of sections of this long figure for detailed discussion).

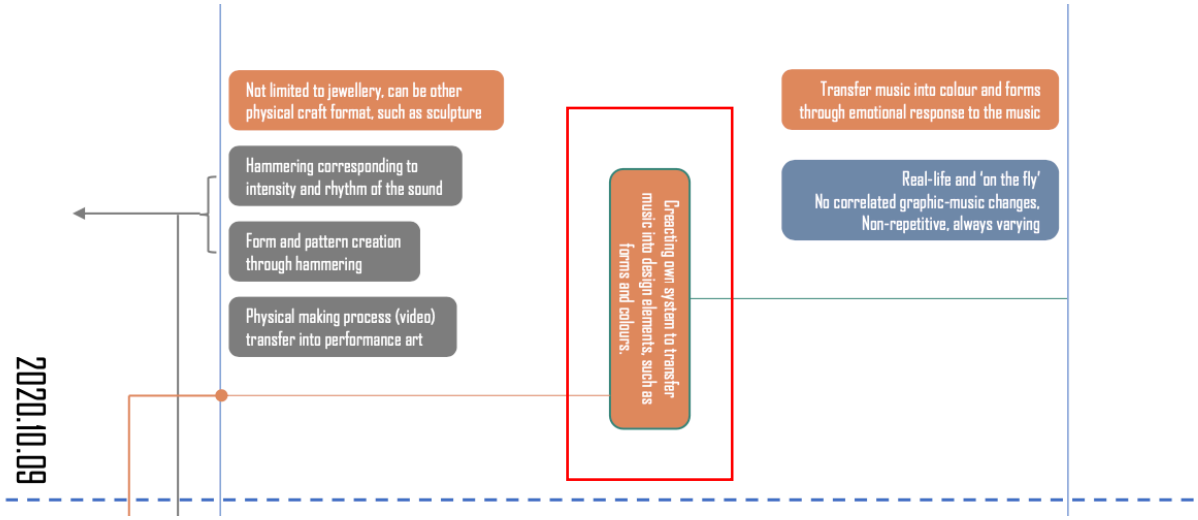


Figure 5.5-1: Concept development and mutual feedback process of meeting 2020.10.09

Firstly, during the meeting on 09 October 2020, as mentioned in the previous Section 5.5.1.1, this meeting took place during the initial establishment phase of the project, aimed at defining the collaborative theme and conducting preliminary discussions about it. During these discussions, as referred to in Sections 5.4 and 5.5, a concept based on the contextual example, 'Creating own system to transfer music into design elements', was established within the boundary zone and captured by me, entering my independent design area.

In this dialogue, initially, based on the works of Natalie Miebach, Rebecca deconstructed her understanding of working methods in the visual field into fragmented knowledge pieces like 'correspondence transformations between musical elements and colours or shapes', and 'conversion of music to visual elements based on a self-built system'. From this fragmented knowledge, a potential concept in development was established within the boundary zone as 'using a self-created mapping system (for Rebecca, based on emotional feedback from music) to achieve transformations between music, colours, and shapes'. At this point, this concept functioned both as a semantic boundary object and an emerging boundary object.

Following this, these pieces of fragmented knowledge and the newly created potential emerging boundary object were captured by me in the boundary zone, flowing into my independent design area. Here, they integrated with my experiential knowledge to form a concept relevant to my independent design process, 'using a self-created mapping system (for me, based on the arrangement of notes in a musical score to create patterns) to facilitate transformations between music, patterns, and space'.

Here, the introduction of this concept influenced the design method I later adopted, potentially shaping the design approach I used in my independent design process. Additionally, as analysed in the contextual example section, the creation of the new concept was based on a distinctive reinterpretation that merged the visually oriented design methods demonstrated by Rebecca with my own experiential knowledge.

The development of this concept through the distinctive reinterpretation suggests the cross-disciplinary flow of Rebecca’s experiential knowledge (related to the visual field), and the restructuring of this knowledge within my own independent design process

(related to the jewellery field). This process of knowledge restructuring led to the formation of concepts related to cross-disciplinary jewellery, establishing the foundation for the creation of cross-disciplinary jewellery within my independent design process in this project.

Building on the concept of 'Creating own system to transfer music into design elements', cross-disciplinary jewellery began to evolve and stabilise within my independent design area and the boundary zone. More specific concepts started to be proposed and tested. The changes and developments related to these concepts are diverse in form and changing dynamically.

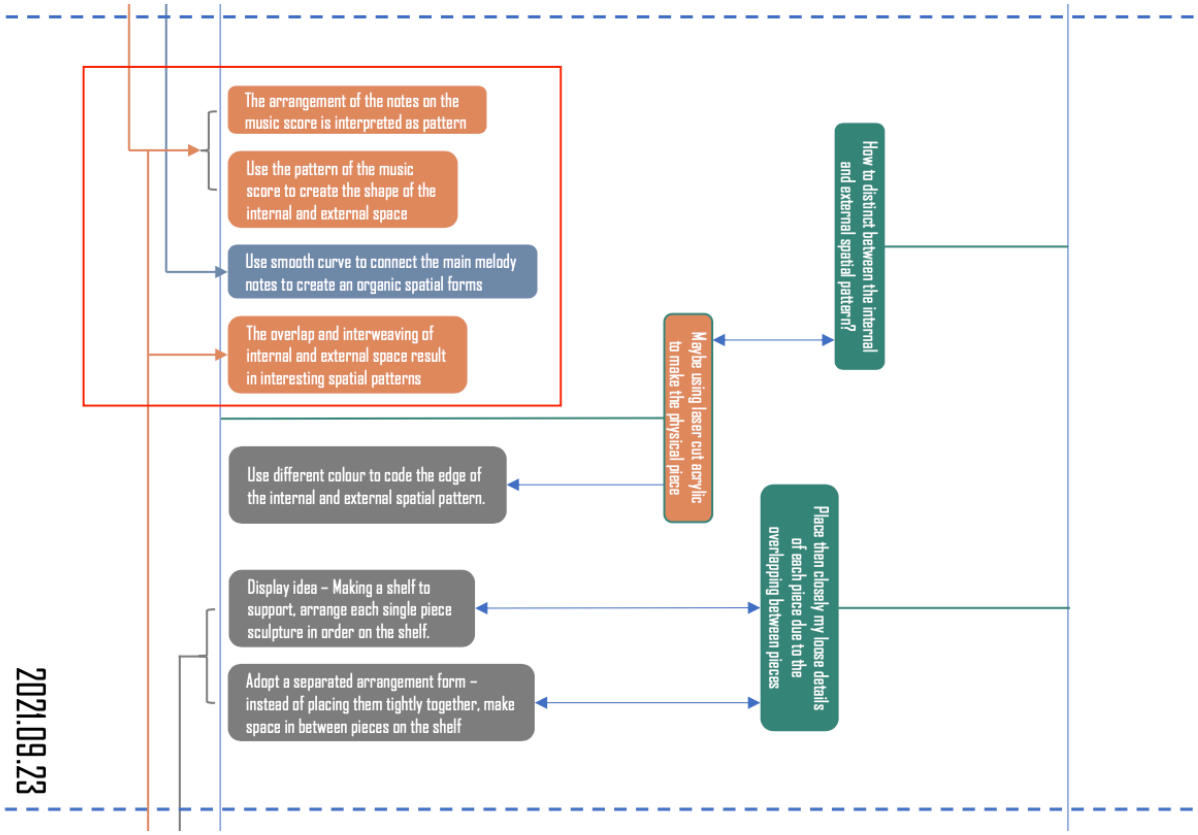


Figure 5.5-2: Concept development and mutual feedback process of meeting 2021.09.23

As shown in Figure 5.5-2, during the meeting on 2021.09.23, it suggests that the cross-disciplinary jewellery's journey from its establishment (proposal of the potential concept) to its progressive development. Based on the concept of 'Using a self-built system to transform music into design elements', more tangible and actionable

concepts were proposed and tested. Based on the fragmented knowledge I captured (which, in Rebecca's understanding, is based on the sound of music and 'transforms music into colours and characters based on emotional feedback'), I proposed design methods that use musical scores as a basis, viewing them as patterns, and creating correspondences between flat patterns and spatial patterns. This includes sub-concepts like 'The arrangement of the notes on the music score is interpreted as patterns', 'Use the pattern of the music score to create the shape of the internal and external space', 'Use smooth curves to connect the main melody notes to create organic spatial forms', and 'The overlap and interweaving of internal and external space result in interesting spatial patterns', all tested through digital modelling.

Furthermore, the development of cross-disciplinary jewellery, in addition to being based on the iterative transformation of concepts within the independent design field, is also influenced by the interactions between collaborators and the evolution of concepts within the boundary zone as they cross these borders, affecting the establishment and stabilisation of the cross-disciplinary jewellery.

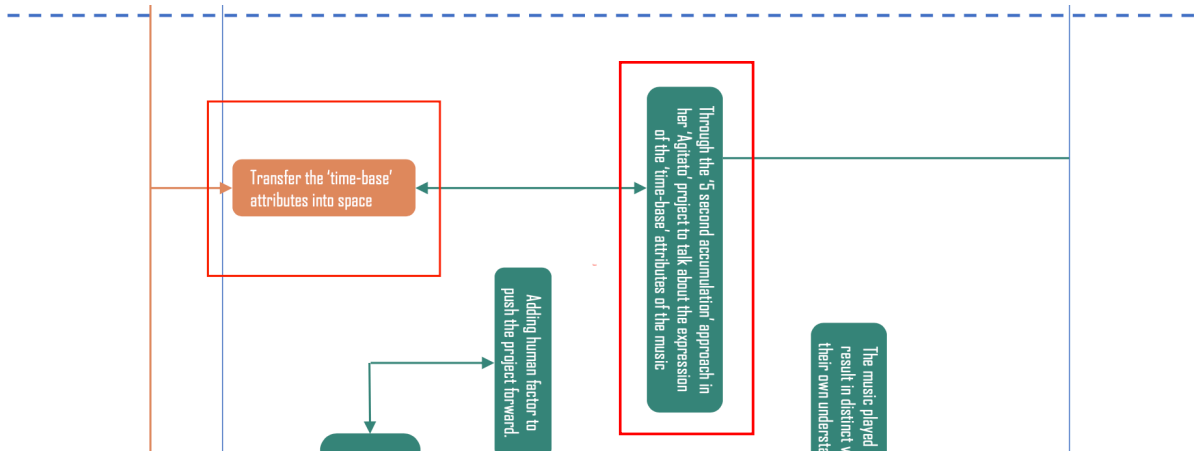


Figure 5.5-3: Concept development and mutual feedback process of meeting 2020.11.04

During the meeting on 2021.11.04, as discussed in the analysis of contextual examples in Section 5.4, Rebecca built upon her previous work to create a comparative understanding of the 'time-based' attribute of music between the two individuals.

Using her prior work 'Agitato' as a foundation, Rebecca linked the different expressive forms adopted by both parties in representing the 'time-based' attribute of music. Through a discussion on her design method of '5 seconds accumulation' and its relation to my design methods in this project, she presented her understanding of my expression of music's 'time-based' attribute – 'Transfer the ‘time-based’ attributes into space’. Based on this comparative understanding, the design approach I adopted was further defined and understood, making the development of concepts related to cross-disciplinary jewellery more stable.

Additionally, when relevant concepts are brought into the boundary zone, they sometimes face challenges from the collaborating partner. The process of questioning, explaining, and discussing these concepts within the boundary zone also serves to review and further stabilise them.

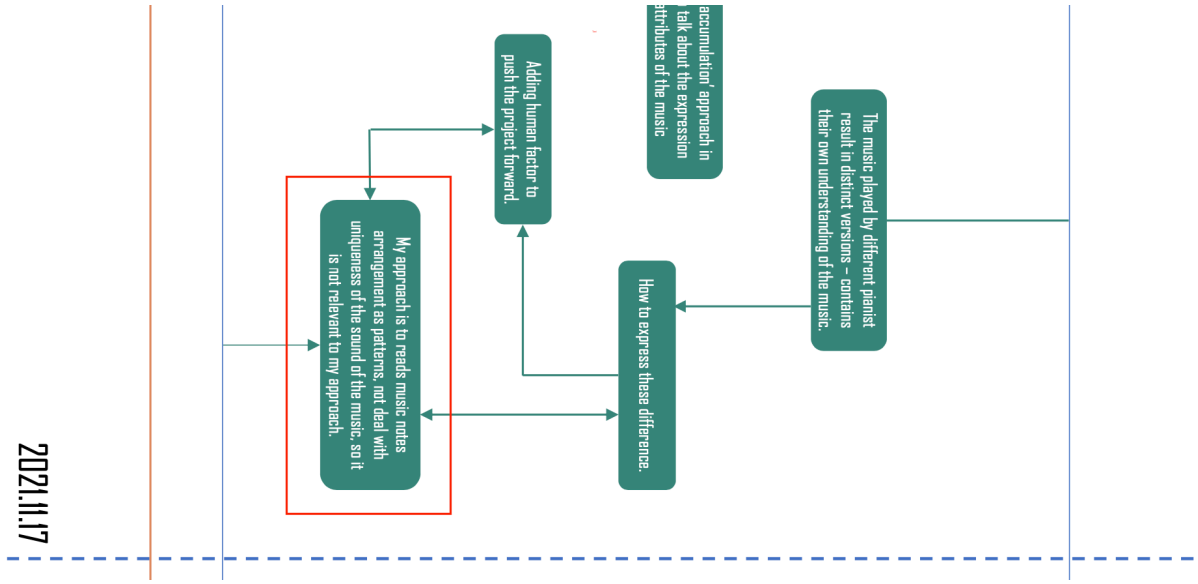


Figure 5.5-4: Concept development and mutual feedback process of meeting 2020.11.17

As shown in the mutual feedback process diagram, during the meeting on 2021.11.17, Rebecca drew on her experiential knowledge and understanding of the 'music-to-visual elements' transformation design process to propose the idea that 'The music played by different pianists results in distinct versions – each containing their own understanding of the music.' Based on this notion, Rebecca attempted to bring the

question of 'How to express these differences' into the discussion, exploring how to physically represent the 'uniqueness' of musical sounds. However, I countered with the perspective that 'My approach is to read music notes arrangement as patterns, not to deal with the uniqueness of the sound of the music, so it is not relevant to my approach.'

Here, initially, Rebecca demonstrated her understanding of the 'uniqueness of music' - 'The pianist's own understanding of the music.' (deconstructed into fragmented knowledge). Following this understanding, Rebecca questioned my adopted design method—specifically, how it could express this uniqueness. Guided by this question, the fragmented knowledge related to 'musical uniqueness' was captured by me into my independent design field and interacted with the design method I adopted (rooted in the concepts of my independent design field). During this interaction, I recognised that while Rebecca's understanding of 'musical uniqueness' represented a potentially valuable direction for concept development, it contradicted the design method I had adopted in my independent design process. Thus, in response to Rebecca's question, I clarified: 'My approach is to read music notes arrangement as patterns, not to deal with the uniqueness of the sound of the music, so it is not relevant to my approach.'

Through this interaction process with the concept and fragmented knowledge (involving reviewing the established concept's information, comparing incoming information with it, resulting here in a negation), the approach used in my independent design process, dealing with information and elements, became clearer and more definitive. This further stabilised my independent design concept (the development of cross-disciplinary jewellery).

This process suggests that the questioning and explaining occurring within the boundary zone can facilitate cross-disciplinary knowledge flow. When captured knowledge enters the new field, its interaction with concepts rooted in the original field can dynamically change - either becoming more stable through review or evolving with the integration of new fragmented knowledge.

This interaction process also suggests that the development and stabilisation of concepts do not necessarily rely on both parties reaching consensus or affirmation on

the concept. During the discussion, by defining the scope of information a concept or design approach handles through 'negation', one can also clarify the characteristics of the concept (cross-disciplinary jewellery) from another perspective, thus fostering its stable development.

The formation and development of cross-disciplinary jewellery are not the result of a single concept developing linearly; rather, it often involves the development and integration of many branching concepts. As concepts continue to develop in my independent design field, they form various sub-concepts. These branches are occasionally introduced and discussed separately within the boundary zone, so the mutual feedback process often involves the establishment and development of these branch concepts. Through continuous development via mutual feedback with Rebecca, these concepts then flow back into my independent design field, waiting for further evolution. In this process, the development of concepts across collaborative fields also constitutes the establishment process of cross-disciplinary jewellery.

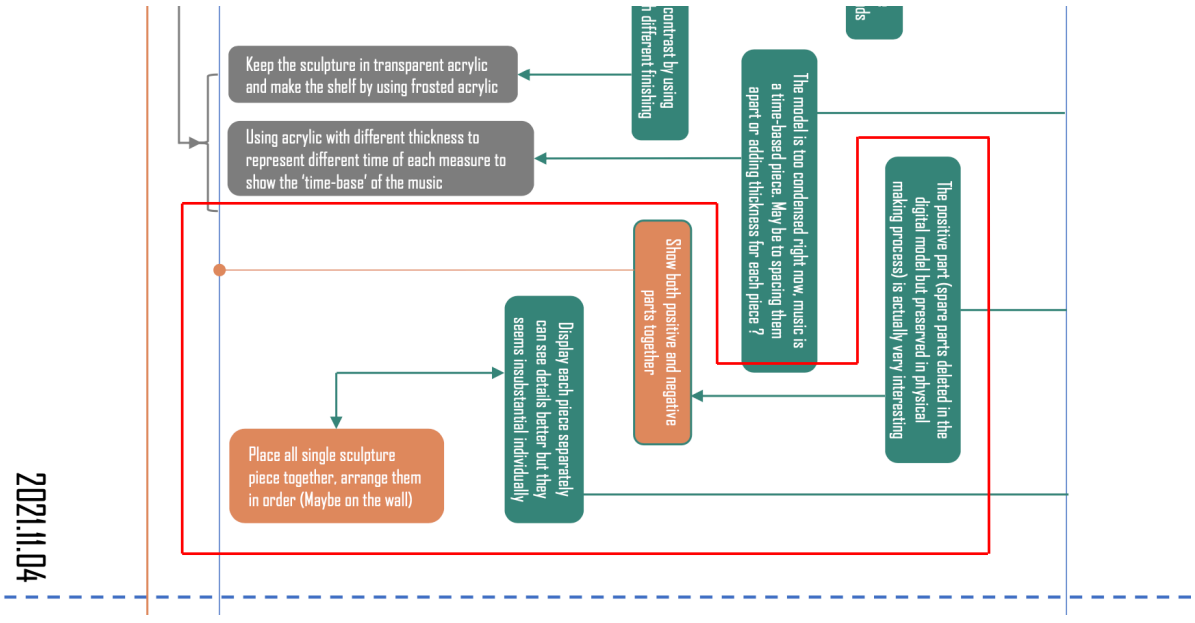


Figure 5.5-5: Concept development and mutual feedback process of meeting 2020.11.04

During the meeting on 2021.11.04, as shown in the mutual feedback process in figure (add figure number) above, the establishment and partial development of branch concepts related to the display and the final form of the work were demonstrated.

This mutual feedback process, as discussed in Case 6 in Section 5.5.1.6, revolved around the use of physical models in the online meeting. 'Spare parts' that were neglected during the digital model testing process but considered 'attractive' and 'interesting' by me were brought into the boundary zone. With Rebecca's affirmation - as shown, where Rebecca considers the positive part (spare parts deleted in the digital model but preserved in physical making process) to be very interesting, the potential value of the 'spare parts' began to garner attention and discussion from both collaborators. Subsequently, based on the idea Rebecca proposed, 'Show both positive and negative parts together', the 'spare parts' began to transform. At this moment, a new concept within the boundary zone started to form and stabilise.

Subsequently, this concept ultimately flowed back into my independent design field, where it developed and eventually manifested in the final product as 'forms that correspond positively and negatively'. This final form of the concept is related to the final product, focusing solely on the exhibition form of the work as a sub-concept. This sub-concept was created within the boundary zone based on the mutual feedback process and did not previously exist.

Similar sub-concepts include those related to the development of patterns previously mentioned in the analysis (this concept was further developed into more sub-concepts, such as those mentioned in the meeting on 2021.02.17, including 'idea of the melody notes', 'idea of the floating notes', 'the reverse space'), as well as the application and combination of these spatial patterns, all forming parts of the final form of the cross-disciplinary jewellery.

The process of sub-concept development suggests that the creation of cross-disciplinary jewellery is not merely the result of a single concept undergoing linear development, but rather a dynamic interplay, selection, and integration of multiple sub-concepts. These sub-concepts do not appear and develop concurrently; instead, they are created and encountered at different stages and in various contexts throughout the development process.

This section reveals the dynamic evolution of concepts within the cross-disciplinary jewellery design process. From the perspective of the integrated boundary object

framework, it is evident that the design concepts related to the cross-disciplinary jewellery were established through multiple stages of evolution, undergo interaction and integration of cross-disciplinary knowledge, continuous feedback and an iteration process, and the mediating role of boundary objects. Starting from initial vague ideas, these concepts gradually develop into stable design concepts and decisions. Through the process of knowledge flow based on mutual feedback, concepts shuttle between the independent design field and the boundary zone, interacting with cross-disciplinary knowledge, forming transformative expressions of this knowledge, and ultimately establishing cross-disciplinary jewellery during the collaborative process. The features of this process of cross-disciplinary jewellery creation, the features of related concept development process, and the contributions of boundary objects to the creation process will be detailed and discussed in Section 6.5.

Chapter 6 - Conclusion

This research aimed to establish a heuristic definition for a to date poorly defined category of jewellery called ‘Cross-disciplinary Jewellery’ within the framework of contemporary jewellery. The discussion to achieve this aim is threaded throughout the thesis: a provisional definition for cross-disciplinary jewellery was established in Chapter 2, based on the historical development of contemporary jewellery and existing cross-disciplinary practices within the contemporary jewellery field. Subsequently, in Chapter 5, additional candidate features and the creative processes of cross-disciplinary jewellery were identified through an analysis of cross-disciplinary collaborative projects, further informing the definition. The knowledge flows involved in the collaborative process, as well as the relationship between these knowledge flows and the creation of cross-disciplinary jewellery outputs is also unpacked through this research (in Chapter 5). This chapter now presents the conclusions (sections 6.1 to 6.4) of the research, which are:

1. A definition for cross-disciplinary jewellery, which encompasses the features and modes of creation of cross-disciplinary jewellery. (section 6.1)
2. The knowledge flows involved in the creation of cross-disciplinary jewellery in a distributed collaboration, comprising the processes of deconstruction, transformation, and reconstruction of knowledge. (section 6.4)
3. The features and roles of eight types of 'boundary objects' which play significant roles in the cross-disciplinary flow of knowledge, and their contributions to the creation of cross-disciplinary jewellery. (section 6.2 and 6.3)

This is followed by a discussion of the contribution to knowledge (section 6.5) and contribution to practice (section 6.6) made by this research. Section 6.7 then presents a critical reflection on methodology and findings, alongside potential directions for future research.

6.1 Definition of Cross-disciplinary Jewellery

The principal contribution resulting from this research is the establishment of the heuristic definition for cross-disciplinary jewellery (as a category of objects that

involves particular patterns of practice and knowledge) within the contemporary jewellery field. This definition is laid out as follows:

> Cross-disciplinary jewellery goes beyond the basic definition of contemporary jewellery by merging knowledge and skills from different professional fields, resulting in a specific type of jewellery that enriches traditional jewellery in terms of form, material, and expressiveness. Its features are as follows:
>
> - Cross-disciplinary jewellery often involves the innovative expression of knowledge and skills from other professional fields within the field of jewellery.
> - Cross-disciplinary jewellery often integrates features from other fields, including the use of specific materials and techniques, or the incorporation of elements characteristic of other fields, or it may consider or interpret the qualities or principles of a specific field through the creation process.
> - The creation of cross-disciplinary jewellery relies on the cross-disciplinary flow and transformation of knowledge, resulting in a tangible outcome of the innovative expressions formed through the deconstruction of knowledge from other fields and its reconstruction within the jewellery field.

The other features of cross-disciplinary jewellery identified in this research are intimately related to the processes of knowledge flow, rooted in the ways that cross-disciplinary jewellery is created. The identified approaches to creating cross-disciplinary jewellery seem to rely on one of two different modes of creation – by individuals or through collaboration:

- The creation of cross-disciplinary jewellery by individuals requires the jewellery practitioner to possess deep knowledge and expertise in two or more distinct areas, with the ability to apply this knowledge cross-disciplinarily (such as the pi-shaped jeweller described in Chapter 2).

- The creation of cross-disciplinary jewellery through collaboration can occur in three distinct scenarios:
    - A jeweller aims to better express their concept using certain specific materials or techniques but lacks the requisite knowledge and skills, thus seeking collaboration with professionals from other fields.

- Collaboration with individuals from other professional fields with the specific goal of creating cross-disciplinary jewellery.
- Cross-disciplinary collaboration that does not initially aim to create cross-disciplinary jewellery, but where such creations naturally emerge due to the flow of knowledge across disciplines during the collaboration process.

These four distinct approaches to creating cross-disciplinary jewellery involve different processes of cross-disciplinary collaboration (as discussed in Chapter 3 as multidisciplinary, interdisciplinary, and transdisciplinary) (Muratovski, 2017: 11-12; Barry et al., 2008:22; Szostak, 2017:20) and diverse processes of knowledge creation:

- The creation of cross-disciplinary jewellery by individuals is indicative of an interdisciplinary process, where knowledge flow is mediated by the individual. This often involves the innovative expression of knowledge and skills from other fields within the jewellery field (i.e., knowledge reconstruction/new knowledge creation). Knowledge from different fields is flexibly applied by an individual who can proficiently master and utilise this knowledge, based on their own experience in the jewellery field to form new expressions.

- Cross-disciplinary jewellery creation based on seeking technical assistance from other fields points to a multidisciplinary process. This process does not necessarily involve the innovative expression of knowledge and skills from other fields within the jewellery field and does not always involve knowledge reconstruction or new knowledge creation. As Barry et al. (2008: 27) noted, multidisciplinary processes often involve multiple disciplines collaborating while maintaining their standard disciplinary frameworks, which aligns with many cross-disciplinary practices seeking technical assistance from other fields. This process typically only requires technical assistance from another field to use specific materials or achieve certain visual and form effects, where knowledge from the jewellery field and other fields is juxtaposed without involving a reconstruction process.

- Cross-disciplinary jewellery creation aimed at creating cross-disciplinary jewellery often requires deep collaboration and cross-disciplinary knowledge flow, pointing to an interdisciplinary process. As explained by Darbellay et al. (2017: 11-12), the interdisciplinary process attempts to synthesise and integrate perspectives from multiple disciplines, thus often involving the innovative expression of knowledge and skills from other fields within the jewellery field, as well as knowledge reconstruction and new knowledge creation.

- Cross-disciplinary jewellery creation based on the collaborative process suggests that cross-disciplinary jewellery can emerge naturally from the flow of knowledge without requiring a purposeful collaboration. This also points to a process of deep collaboration and knowledge exchange across different fields, which its characteristics will be detailed in the following section.

6.2 Boundary Objects in the cross-disciplinary jewellery creation process through a distributed collaborative environment：

Eight categories of boundary objects were identified that played an important role in the collaborative process: Contextual Example, (Process and Reflective) Journal, Process Image, Process Video, Digital Model (Rhino 3D Model), Digital Model (Rendered Image), Digital Model (Rendered Video), and Physical Model. These eight categories of boundary objects occurred in the process of creating cross-disciplinary jewellery within a distributed collaborative environment.

In Chapter 5, these eight boundary objects were analysed using data and specific cases, but their features were not summarised and synthesised; instead, this task is reserved for this chapter. This is because: Concentrating the discussion of the features and functions of these boundary objects all in this chapter facilitates a more focused discussion. Subsequent sections of this chapter will summarise how design concepts evolve based on the roles of these boundary objects (section 6.3) and how they can be involved in the creation of cross-disciplinary jewellery (section 6.4). Positioning the summary of the individual boundary objects before these sections, rather than in Chapter 5, can lay the foundation for discussions and effectively link these discussions.

For the reader, avoiding the need to jump back and forth between Chapter 5 and this chapter also makes the flow of the thesis smoother and more organised in this structure.

6.2.1 Boundary Object 1: Contextual Example

Contextual examples serve as effective boundary objects that facilitate communication and foster mutual understanding between collaborators. In the cross-disciplinary collaborative environment, contextual examples bridge knowledge gaps between collaborators, promoting the flow and transformation of knowledge across fields, and facilitating the construction of cross-disciplinary jewellery through the deconstruction and reconstruction of knowledge.

Contextual examples can function as tools for introducing and exploring potential collaboration themes in the early stage of the project. They established a consensus among collaborators by fostering a fundamental understanding, laying the groundwork for creative exploration. By introducing different artworks and artists as contextual examples, collaborators were able to explore potential themes and approaches beyond their direct professional knowledge, creating a rich environment for ideation.

As the project progressed, the role of these contextual examples evolved. They transformed into semantic boundary objects, providing a medium for complex knowledge transformation and integration and playing a crucial role in deconstructing complex field-specific knowledge into manageable and discussable segments.

Contextual examples, through their capacity as semantic boundary objects, facilitate the deconstruction of knowledge and its cross-disciplinary flow, helping these fragmented pieces of knowledge to interact with the jewellery field as they enter it, participating in the concept and design development process, and promoting the construction of cross-disciplinary jewellery.

Moreover, contextual examples habitually integrate into and emerge from different contexts, gaining new meanings and scaffolding collaborative dialogue. This dynamism underscores the fluidity of contextual examples as boundary objects and

their evolution within a collaborative environment. Each role adjustment not only fosters communication but also drives innovation - as new ideas are introduced, these examples help highlight the connections and differences between existing and emerging project elements, enabling collaborators to explore new interpretations and thus enriching the development process and outcomes. Furthermore, this continuous role adjustment not only supports communication but also actively enhances the innovative collaborative synergy within the team. By encouraging continuous dialogue and inspiring collaborators to reinterpret the contextual examples, their thinking is effectively integrated into the evolving project narrative, thereby advancing the development of concepts and the construction of cross-disciplinary jewellery within a collaborative environment.

6.2.2 Boundary Object 2: Journal

Journals serve as multifaceted boundary objects that are crucial for managing project progress and facilitating knowledge sharing among collaborators. These journals are categorised into process journal and reflection journal, playing multiple roles in the project from recording the progress of design development to reflecting on the impact of collaborative interactions.

Initially in the "Data – Music - Jewellery" project, journals from the "Viral Making" project were introduced into the collaborative environment to help establish standardized data recording and collection methods. They aimed to structure the recording of the design process and negotiate and reconcile differences in working methods among collaborators.

Subsequently, based on discussions, the recording method evolved from journals into online meeting-based records that focused on mutual feedback processes, forming another type of ‘journal’. This method expanded the function of the journals to the sharing of individual design processes and the reflection on collaborative interactions, providing records of immediate feedback between collaborators and enriching data recording of the mutual feedback processes in collaboration. This transformed the journals into both syntactic and pragmatic boundary objects, achieving standardisation of information storage and sharing, and also semantic boundary objects that promote

mutual understanding by detailed recording of thought processes and design evolution. For example, during meetings, the display of process journals provided a visual and textual recap of design steps, enhancing the collective understanding of project direction and decision-making.

Moreover, journals communicated external perspectives by documenting data from different projects to guide the transition and adjustment of design elements and concepts between projects. For instance, introducing ideas from the *"Viral Making"* project into the *"Data-Music-Jewellery"* project demonstrated the journals' ability to integrate external viewpoints with the current project context. This functionality highlights the journals' contribution in cross-disciplinary collaborative processes - not only maintaining the continuity of creativity across different contexts but also introducing innovative perspectives, sparking new design developments. The dynamic application of journals underscores their vital role in transforming complex knowledge, standardising communication, and fostering a creative collaborative environment. By building a stable and structured collaborative setting, and establishing effective and standardised pathways for information sharing, journals provide a conducive foundation for the creation of cross-disciplinary jewellery.

6.2.3 Boundary Object 3 & 4: Process image and video

Process images and videos served as effective semantic boundary objects that visualised and communicated design decisions. In the *"Data-Music-Jewellery"* project, these selectively preserved and displayed visual images enabled Rebecca to share her interpretations of the transformation from music to visual elements (such as colour choices and the dynamic flow of visual elements) in a tangible form, facilitating discussions about design concepts and development.

The use of process images and videos not only promoted the flow of knowledge during communication but also organised knowledge fragments considered valuable for further conceptual and design development. During online meetings, these visual elements not only provided a record of the creative journey but also laid the groundwork for further design exploration and decision-making. The mutual feedback process based on these images and videos allowed complex design decisions to be

deconstructed into more concrete elements. Discussions centred around the process images and videos facilitated a shared understanding and provided a visual reference point, offering a clear guide for further design exploration, thereby not only enhancing mutual understanding but also guiding the collaborative development of new ideas.

The work with process images and videos also shows how boundary objects dynamically influence knowledge construction within a collaborative environment. They support the deconstruction of existing knowledge and guide the reconstruction of new ideas and interpretations based on the collaborators' personal experiences and creativity. This interplay between visual elements and collaborative interpretation underscores the significant contribution of process images and videos to the creative and iterative processes in cross-disciplinary collaboration.

6.2.4 Boundary Object 5: Digital 3D Models and Rhino Software

The use of Digital 3D Models and the application of Rhino Software during the mutual feedback process were crucial for facilitating detailed design discussions and iterative development. As semantic boundary objects, Digital 3D Models help to deconstruct complex design concepts, allowing for a detailed examination and discussion of each design element and its development at various stages of the project. As a modelling tool, Rhino enables the modification and display of various aspects of models, allowing for the real-time visualisation and manipulation of design elements during online meetings. The ability to scale, rotate, and dissect models in Rhino provides a dynamic platform for exploring design solutions and expressing detailed feedback, not only enhancing understanding and communication among collaborators but also serving as a vital medium for deconstructing complex design ideas and exploring new design possibilities in a remote collaboration environment, demonstrating its flexibility and effectiveness in managing complex design processes within a distributed collaborative setting.

In the *"Data – Music - Jewellery"* project, the shift from physical to digital model production was necessary because of the distributed collaborative environment. Given the complexity of the project and the need for frequent adjustments, this shift enabled continuous iterative development based on remote collaboration. Digital models serve

not only as digital representations of physical models but also as a medium for simulating potential real-world interactions within the design, such as walking through a virtual model after the structures being designed to get an idea of the internal space of the model.

Rhino's support for a shared design language allows it to function as a syntactic boundary object when necessary, standardising communication around the project's 3D modelling aspects.

6.2.5 Boundary Object 6 & 7: Digital 3D Models (Rendering images and videos)

Rendered images and videos of digital 3D models have expanded the functionality of Digital 3D Models, highlighting visual and material simulations of design ideas. Unlike Digital 3D Models, which primarily focus on form and structure, rendering provides a virtual testing ground for material selection and texture effects, simulating the potential visual qualities of models. Utilising Keyshot software for the simulation of material properties and visual effects offers realistic previews of material effects and potential exhibition settings, playing an important role in the development and discussion of design decisions within the collaborative environment.

By effectively simulating various material choices and their spatial effects, rendered images and videos can explore how different materials and their characteristics affect the perception of the design object. For example, the choice of transparent acrylic material was made because it intuitively displays the complex internal structure of the design. This design decision was visually presented through rendered videos, which provide specific previews of potential exhibitions and spatial arrangements, fostering a shared understanding and collaborative discussion of display strategies.

These rendered images and videos partly replace the complex processes of physical model production and material testing, offering solutions for design development and collaborative discussion in a distributed collaborative environment. This approach, through clear and visual presentations of material effects and design outcomes, enhances collaborative interaction, supporting and augmenting design discussions and decision-making processes within the distributed collaborative setting.

6.2.6 Boundary Object 8: Physical Models

Physical models are unique boundary objects rooted in the jewellery field within the *"Data-Music-Jewellery"* project. Unlike digital models, physical models are physical representations of design concepts, offering sensory experiences that digital formats cannot replicate and tangible insights into material and spatial factors that digital models do not provide. The use of physical models allows for a deeper exploration of material properties and spatial relationships, which is crucial for fields (for this research, jewellery field) where tangible outcomes are the final formats.

Physical models are particularly important during the mid-development phase as actual tests of proposed design concepts. These models enable collaborators to evaluate the spatial form and material properties of designs, thereby influencing further iterations and refinements. For example, interacting with physical models helps to validate the choice of materials such as acrylic, whose transparent properties effectively showcase internal structures.

Physical models also aid collaborators in gaining a more intuitive understanding of the design. They provide a direct, hands-on experience with materials and shapes, enabling effective discussions about the development of the final outcome. Being able to physically manipulate these models and observe their interaction with light and space enhances the design process in ways digital models cannot.

Direct interaction with materials and forms through physical models strengthens the collaborative process, deepens understanding, and often leads to unexpected progress in projects. Additionally, physical models reveal unexpected design possibilities unseen in the digital realm. For instance, 'spare parts' produced during laser cutting processes were initially considered by-products, but their value was recognised using physical models and incorporated into the final display. Such 'happy accident' highlights the unique contribution of physical models to the creative process, demonstrating their capacity to explore and realise complex design concepts and guide the ongoing development of concepts and designs in a collaborative environment.

6.3 Concept Development Through Boundary Objects within the collaborative framework of cross-disciplinary jewellery creation

In addition to the individual features of the eight identified boundary objects and their contributions to the cross-disciplinary jewellery creation process, this research also focuses on the dynamic interactions among these boundary objects and their contributions to the development of concepts within the collaborative framework of cross-disciplinary jewellery creation. The boundary objects identified in the practical process of this research influence and transform the conceptual development process based on principles of interaction. Through interactions with various boundary objects and the dynamic interactions between them, concepts related to cross-disciplinary jewellery are continually built and reshaped. For instance, physical models provide tangible insights into materials and space, enhancing sensory understanding, while digital models offer flexibility for exploration and iteration. Contextual examples expand the conceptual development by integrating various existing contexts, enriching the design process. This dynamic process of interaction demonstrates the positive contributions of different types of boundary objects to the cross-disciplinary jewellery creation process, especially in the development of concepts.

Chapter 5 of this thesis provided a detailed analysis of how independent and collaborative design concepts evolve based on the dynamic interactions within boundary zones and between boundary objects. The dynamic interplay of boundary objects within boundary zones facilitates the evolution and stabilisation of design concepts, significantly impacting the creation of cross-disciplinary jewellery.

Initially, when focusing on the development of independent design concepts, it is noted that these concepts often originate from one collaborator but travel into boundary zones based on interactions with boundary objects. Once independent design concepts enter the boundary zone, they gradually integrate feedback from collaborative interactions. For example, references to physical models in online meetings can spark discussions, generate new insights, and then feedback into the digital modelling process, enriching the original concept. After crossing boundary zones, these enriched concepts typically return to their original fields for further development, carrying collaborative insights gained during the crossing process.

These concepts undergo a process of gradual stabilisation based on a mutual feedback process with boundary objects and collaborators, being continuously built and reshaped through interactions with other boundary objects, integrating different insights and evolving from a singular to a multidimensional perspective.

Concepts related to co-creation typically originate within the boundary zone, stemming right from the start of collaborative interactions between partners (from different disciplinary perspectives). These concepts are naturally cross-disciplinary, formed through the dynamic exchange of ideas and techniques within the boundary zone.

These design concepts often remain within the boundary zone for extended periods, being continuously shaped and rebuilt through ongoing interactions. The boundary zone serves as a testing ground where ideas are continuously feedback and iteratively through interactions with boundary objects (such as digital models or physical models), ultimately shaping the iteration of concepts and the construction of potential new knowledge.

During the conceptual development process, the mutual feedback between collaborators is central to the evolution of concepts, while boundary objects act as catalysts and facilitators, bridging gaps between different knowledge fields and collaborative environments. Their primary function is to provide a shared language or medium through which perspectives from both collaborators can interact. For example, physical models provide a tangible sensory experience that digital models cannot replicate, making them invaluable for assessing material visual qualities and visual spatial characteristics. Conversely, digital models and renderings can be rapidly iterated and adjusted, supporting quick and effective exploration of complex forms and structures.

In these interactions, boundary objects play an important role in deconstructing field-specific knowledge and personal experiential knowledge into fragmented pieces, but their contribution extends beyond transmitting existing knowledge. They also challenge and expand original concepts by introducing new information and perspectives. This expansion is based on the interaction between the fragmented knowledge guided by boundary objects and the original field knowledge. The

transformative capability of boundary objects in these interactions provides a foundation for the construction of new concepts and knowledge.

Boundary objects help concepts evolve from vague ideas into concrete outcomes. They serve as repositories and channels for both explicit and tacit knowledge, providing the necessary practical and conceptual insights to advance projects. For example, using contextual examples helps anchor abstract concepts within specific artistic practices, enabling collaborators to visualise complex concepts and design decisions, thereby enhancing understanding. Boundary objects such as contextual examples and digital tools also support real-time collaboration and simulation during the collaborative process, responding to inputs from multiple different fields. For instance, through real-time simulations in Rhino, collaborators can promptly discuss the impact of form changes on spatial perception, thus facilitating communication and iterative development of concepts.

Boundary objects in a collaborative environment, interacting dynamically with concepts and knowledge from different fields, highlight their significant role in the process of creating cross-disciplinary jewellery:

- **Supporting Conceptual Development:** Boundary objects provide a platform for the maturation of design concepts, allowing concepts to be exposed to diverse perspectives and expert feedback. Through boundary objects, collaborators can test, critique, and refine concepts within the collaborative environment, leading to effective conceptual iterations.

- **Enhancing Interdisciplinary Integration:** By facilitating the exchange of ideas across disciplinary boundaries, boundary objects help integrate different knowledge bases. They aid in deconstructing the knowledge of the users of the boundary objects and guide the interaction between the deconstructed, fragmented knowledge and knowledge from other fields, fostering the construction of new knowledge and the development of concepts.

- **Dynamic Adaptation and Innovation:** The dynamic nature of boundary objects allows design concepts to continuously evolve and develop through

interactions with various boundary objects and between boundary objects themselves.

This research then suggests that the process of building cross-disciplinary jewellery, especially the development of its concepts within a distributed collaborative environment, is inseparably linked to the support provided by boundary objects and the dynamic interactions guided by them.

6.4 Creation of cross-disciplinary jewellery in a collaborative environment

Based on the analysis of the development of concepts of cross-disciplinary jewellery at various stages during the collaborative process, this research suggests that the establishment of cross-disciplinary jewellery involves multi-stage conceptual evolution and the integration of cross-disciplinary knowledge. The characteristics of its creation process are as follows:

- The creation of cross-disciplinary jewellery based on collaboration involves a process of cross-disciplinary knowledge flow. The deconstruction of collaborators' own knowledge, the capture of fragmented knowledge in the boundary zone, and the combination of this fragmented knowledge with personal experiential knowledge to produce transformative expressions trigger the development and stabilisation of related design concepts and decisions, ultimately forming the cross-disciplinary jewellery.

- The establishment of cross-disciplinary jewellery is based on dynamic evolution through mutual feedback, resulting from the iteration of concepts and the interaction between different concepts.

- The creation of cross-disciplinary jewellery is not the result of a single concept developing independently and linearly, but rather a collection of related concepts, formed through the integrative interaction of various sub-concepts.

The development of concepts related to cross-disciplinary jewellery involves the following characteristics:

- The unique perspectives and specialized skills brought by different collaborators interact and complement each other during the mutual feedback process, fostering the development of relevant concepts and the establishment of cross-disciplinary jewellery.

- As the project progresses and through the mutual feedback process, design concepts and decisions are continuously reassessed and adjusted at different stages. Feedback and iteration at each stage can trigger new changes and improvements.

- Different sub-concepts are established at various stages, which may appear in the independent design field or arise within the boundary zone based on the mutual feedback process. Established concepts from different fields can interact with each other and may shuttle back and forth between the independent design field and the boundary zone, engaging with fragmented knowledge and experiential knowledge from different collaborators to trigger development.

- The development and stabilisation of different sub-concepts can also occur in both the independent design process and the boundary zone. When a concept from the independent design field enters the boundary zone:

    - The concept may interact with the experiential knowledge of the other collaborator and fragmented knowledge existing in the boundary zone, carrying this knowledge back to the independent design field for further development through interaction with existing knowledge.
    - The concept may undergo iteration and development based on interaction with the other collaborator's experiential knowledge and fragmented knowledge in the boundary zone, tending towards stabilization within the boundary zone. The developed concept may return to the independent design field or remain in the boundary zone awaiting further activation.

- The concept may be subject to challenges from collaborators, providing an opportunity to reassess the concept. Affirmations or rejections of these inquiries can offer opportunities for the concept's stabilisation. By incorporating the collaborator's perspective, the concept may develop further by integrating the collaborator's experiential knowledge (the inquiry is affirmed) or become more stabilised by the concept proponent's rebuttal (the inquiry is negated).

This research also explored the presence and evolution of cross-disciplinary jewellery within the collaborative environment from the perspective of the emerging boundary object framework (see the *'Data-Music-Jewellery'* project, chapter 5.5). The emergence of cross-disciplinary jewellery has gone through multiple stages of development, with boundary objects playing a significant supporting role at each stage:

- **Initial Concept Development:** Within collaborations, the development of concepts begins within specific disciplinary frameworks (within the field of one of the collaborators), for example, transforming an individual's understanding of music into design elements or concepts based on personal experience or field.

- **Capture and Development in the Boundary Zone:** These initial concepts are internal, intuitive ideas, then extend into the boundary zone through mutual feedback processes between collaborators. These ideas are exposed within the collaborative environment and interact with external elements such as knowledge from another field brought into the boundary zone by collaborators and their personal experiences. Boundary objects facilitate this interaction, enabling collaborators to capture and transform concepts through interactions with boundary objects, thus producing development of the ideas.

- **Development through Boundary Objects:** As concepts move within the boundary zone, they are reinterpreted and refined. This development is mediated by boundary objects, which act like interfaces, transferring knowledge across disciplinary boundaries and assisting in the deconstruction and reconstruction of information. For instance, a concept might be influenced by

another collaborator's expertise in visual arts, resulting in a richer and more varied visual representation.

- **Feedback and Iterative Development:** The mutual feedback process between collaborators plays a key role in the evolution of concepts. During online meetings where concepts and design decisions are discussed, these concepts are continually refined. This feedback is not just critique but a constructive process that integrates different perspectives, helping to challenge and expand the initial concepts to incorporate more complex and diverse elements, thus leading to stabilised and matured concepts.

- **Concept Evolution and Stabilisation:** Through ongoing interactions with boundary objects, concepts evolve from vague ideas into a series of design decisions. In this process, concepts undergo feedback and adjustments through different stages, interacting with fragmented knowledge from various fields. This interaction leads to iterative development of concepts, reflecting the influence and integration of knowledge from different fields, such as the dynamism of music, the visual expression of sculpture, understanding of materials, and the craftsmanship related to jewellery practice. These iteratively developed concepts ultimately form a series of stable and innovative design decisions under the influence of interactions between different fields, with cross-disciplinary elements beginning to emerge and further shaping the final outcomes based on interactions between design decisions.

In these stages, the emerging boundary objects' analytical framework provides us with a unique perspective. Defining dynamically changing concepts as emerging boundary objects allows for a clear observation of how concepts interact with various boundary objects and fragmented knowledge within a collaborative environment, continuously evolving to adapt to new insights and challenges presented during the collaboration process. From the perspective of the emerging boundary objects framework, we have better identified the iterative development of concepts during the collaboration process and the construction of cross-disciplinary jewellery.

The observed dynamic collaboration process suggests that the creation of cross-disciplinary jewellery is based on dynamic interactions between different disciplinary practices, facilitated by boundary objects within the collaborative environment. Creating cross-disciplinary jewellery requires the integration of insights from different fields, which is coordinated through boundary objects. These objects help translate and adjust knowledge from different fields and personal experiences from different collaborators, allowing them to express innovation in another field, thus imparting qualities that could not be achieved within a single disciplinary framework.

This process also reveals another potential feature of the cross-disciplinary jewellery creation process - arising from knowledge flows and dynamic interactions during the collaborative process, implying that the creation of cross-disciplinary jewellery does not necessarily target a practice process with a clear goal. A collaborative process explicitly aimed at creating cross-disciplinary jewellery is not required; rather, due to the dynamic interactions and knowledge flows between jewellery and other different field practices, cross-disciplinary jewellery can naturally emerge during the process, pointing to an unintentional creation process - cross-disciplinary jewellery can be created by 'knowledge (flows and interactions)' rather than necessarily by 'people (will and purposeful action)'. This not only suggests a new method of creating cross-disciplinary jewellery - arising naturally from knowledge flows during the collaboration process - but also further reflects the close relationship between cross-disciplinary jewellery and the process of cross-disciplinary flow of knowledge.

6.5 Contributions to knowledge

The theoretical contribution of this PhD research is twofold. Firstly, by proposing a heuristic definition of cross-disciplinary jewellery (as a category of objects that involves particular patterns of practice and knowledge) within the framework of contemporary jewellery, it adds to the contemporary jewellery research literature.

Secondly, the analysis of the distributed collaborative process of the *'Data-Music-Jewellery'* project contributes to the practice of cross-disciplinary jewellery research. Based on the analysis and discussion of a rich dataset, this research not only extends cross-disciplinary perspective into the field related to jewellery but also fills gaps in the

research on the application of cross-disciplinarity research in the craft field, particularly regarding distributed collaborative practices.

The analysis section of this thesis employed an integrated analytical framework (see section 4.6) based on different boundary object concepts. This integrated framework builds upon concepts related to boundary objects: Semantic, Syntactic, and Pragmatic Boundary Objects (Carlile, 2002; 2004); Existing, Built, and Appropriated Boundary Objects (Halpern, 2012); and Dynamics of Boundary Objects (Nicolini et al., 2012). Compared to these single boundary object perspectives, the integrated framework provides a more open and diverse view of the features and roles of boundary objects in distributed collaborations related to the jewellery field.

Through this integrated analytical framework, the thesis highlights the key roles played by a range of boundary objects identified in the 'Data-Music-Jewellery' project within the distributed collaborative environment between the jewellery and visual art practices. The boundary object-related result of the research is also considered as part of the theoretical contribution of this study.

Existing literature on boundary objects primarily focused on collaborative studies related to collaborative teams management (for example, Phelps & Reddy, 2009) or fields associated with design, particularly Interaction Design (for example, Dhaundiyal & Sharma, 2022), Participatory Design (for example, Singh, 2011; Groot & Abma, 2021), User-centred Design (for example, Blomkvist et al., 2015), and HCI (for example, Dalsgaard et al., 2014; Blomkvist et al., 2015). Research on boundary objects within the realm related to craft is very limited. From this perspective, this research contributes by extending the concept of boundary objects to cross-disciplinary collaborations related to the jewellery field.

The findings related to boundary objects in this research not only offer new perspectives on how effective knowledge transfer and generation can be achieved in cross-disciplinary collaborations related to the field of jewellery but also deepen the understanding of the dynamic nature of boundary objects. Moreover, this integrative framework has the potential to be generalised, providing new dimensions and valuable theoretical and practical contributions to the study of boundary objects.

While existing research on boundary objects tends to focus on collaboration within a group context, there has been limited attention given to collaborations between individuals. This research contributes by focusing on collaborations occurring between individual artists, extending the concept of boundary objects to collaborative environments in the individual context, which opens up the creative process in a manner that helps demystify expert design practices.

Most existing research on collaborations in the craft field is focused on a group setting, such as collaborations between craftspeople and designer teams (For example, Suib et al., 2020; Temeltas & Kaya, 2021), or craftspeople and industrial manufacture teams (For example, Yair, 2001). However, there is very limited research exploring cross-disciplinary collaborations between individual artists or craftspeople. As mentioned in Section 4.2.1, I met my collaborator Rebecca from the 'Data-Music-Jewellery' project at a summer event held at Tongji University in Shanghai (the pilot project discussed in Appendix 1 also took place during this event). At this event, several artists involved in cross-disciplinary work gave talks, covering fields such as public art, visual arts, and installation art. During the Q&A session that followed these presentations, when I inquired how individual artists harmonize different working methods and thought processes in cross-disciplinary collaborations against diverse knowledge backgrounds, the responses were often vague, such as "you will work out a common language and working mode during the practice." or "you will find a way when you in that environment." This type of unclear answer was one of the factors that led to the shift in research interest discussed in Chapter 1, suggesting a lack of focus in existing research on cross-disciplinary collaboration between individual artists or craftspeople. Additionally, existing research on boundary objects also mostly focuses on collaborations within collaborative contexts, such as those between craftspeople and design teams (For example, Suib et al., 2020 and others mentioned above), with very limited attention to those occurring in individual contexts.

Therefore, this research's focus on the collaborative processes within an individual context fills this gap - focusing on collaborations that occur between individual artists and craftspeople, it not only opens up the creative process in a way that helps demystify expert design practices but also extends the concept of boundary objects to

individual collaborative environments. This exploration of the collaborative processes between individuals represents one of the contributions of this research.

6.6 Contribution of practice

As a practice-based PhD research, the practice projects not only provide data for the development of theoretical insights in the thesis but also consider the practice itself as a crucial contribution. Although it was mentioned in Section 4.1.2 that this thesis focuses on the process of collaboration and knowledge flow during the mutual feedback process - that the outcomes of the practical projects are not as important as the process - this perspective pertains only to the theoretical development within the thesis. For the practical projects themselves, the practical outcomes should indeed be discussed as contributions of this doctoral research.

The outcomes of the practice, including a large-scale sculpture transformed from a piece of music (from the *'Data-Music-Jewellery'* project) and various co-created, in-progress practical outcomes (from both projects), are recognised as integral parts of the contributions of this PhD research.

6.6.1 Practical contribution of the *'Data-Music-Jewellery'* Project

The practical outcomes of the *'Data-Music-Jewellery'* project (see: https://daviddongdingjewellery.squarespace.com/arabesque-no-1), including a large-scale musical sculpture (figure 6.5-1) and several collaborative (co-authored) in-progress creative outputs (figure 6.5-2), These outcomes enable transformations in my practice:

- Shifting from an outcome-oriented practice to a process-focused practice.
- Shifting the scale of practice outcomes, from small-scale jewellery pieces to large-scale sculpture or installation pieces.
- Shifting the focus of my practice from exploring the structure and functionality of the pieces to exploring visual languages such as pattern arrangements.
- This also illustrates how my practical thinking has evolved: as a jeweller, the working process of my practice has shifted from an independent design

development process that incorporated cross-disciplinary knowledge from myself (working as a Pi-shaped jeweller) to a collaborative design process that involves cross-disciplinary knowledge from other professionals from various design fields.

These changes in my practice, encompassing both process and outcome, are rooted in my existing knowledge structure and have further developed from it.

From the perspective of the final practice outcome, the large-scale sculpture uniquely interprets the musical score from a craft-based viewpoint, views the musical score as a special form of data, considering the arrangement of notes within the score as a distinct pattern, isolating it from emotional interactions with the music's sound. Based on the design of a mapping system and its application, to reshapes the arrangement of the music notes into complex spatial structures through the mapping system and further develops them into physical design elements. This interpretation is rooted in my personal experience, design style, and the physical forms of expression, all of which are based on a unique perspective from the field of Craft. (Ding, 2023)



Figure 6.5-1: Example of outcome – *'Data-Music-Jewellery'* Project

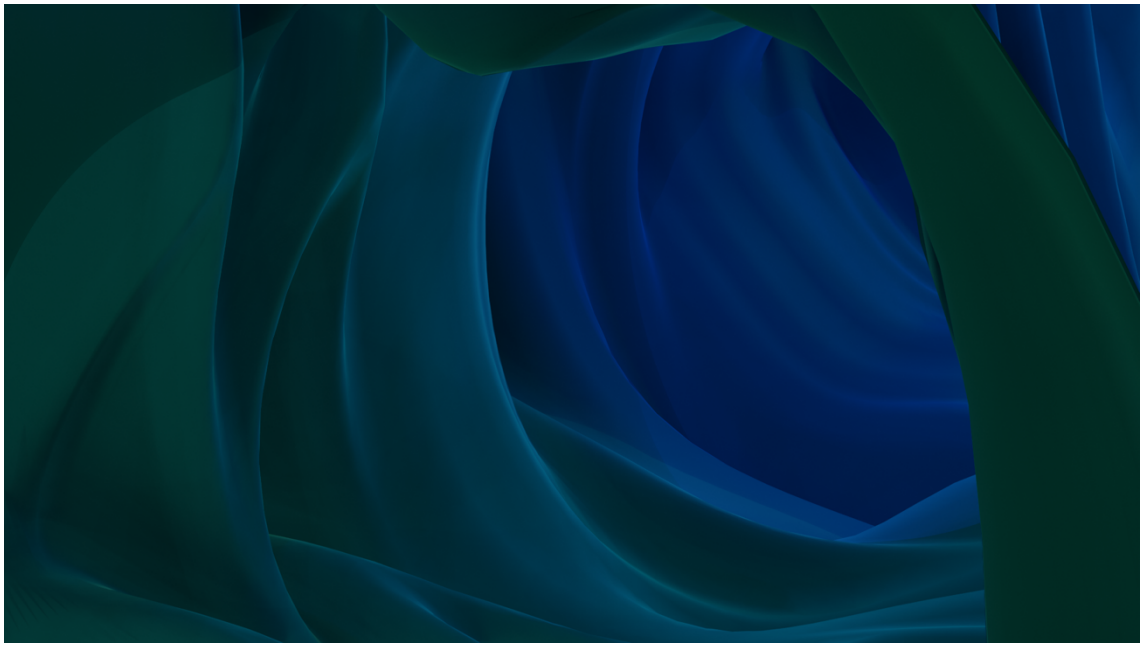


Figure 6.5-2: Example of outcome – *'Data-Music-Jewellery'* Project

The contribution of this large-scale musical sculpture demonstrates a creative method of interpreting music through the lens of craft and translating it into a physical format. This innovative approach has garnered attention and has been featured in peer-reviewed conference publications such as EAD 2023 and VINCI 2023 (see the list of publications and exhibitions in declaration at the beginning of this thesis).

6.6.2 Practical Contribution of the *'Viral Making'* Project

Although in Section 5.1.1 mentions that the process and data of the *'Viral Making'* project were not included in the analysis of this thesis, and therefore do not contribute to the theoretical aspects of this research, the practical process and its outputs - a few collaboratives in-progress creative outputs - remain a part of the practical contributions of this study. (see: https://daviddongdingjewellery.squarespace.com/viral-making) These in-progress creative outputs include several videos captured from different perspectives of the practice process (figure 6.5-3). The practice process of the *'Viral Making'* Project and descriptions of its final output, including considerations on the exhibition methods of the in-progress creative outputs, are detailed in Appendix 5.

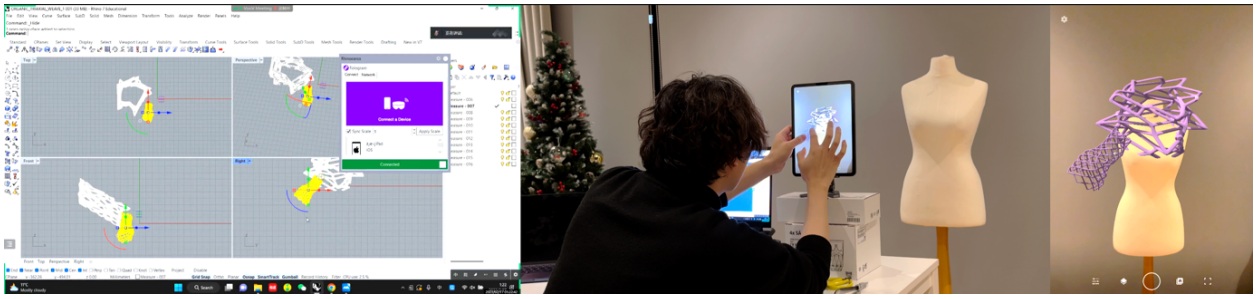


Figure 6.5-3 Example of Outcome – *'Viral Making'* Project

From the perspective of contributions to my personal practice development, the *'Viral Making'* project supported a shift in my practice to a different format of practice outcome. The project focuses on the process rather than the final product, treating the workflow and process as the outcomes themselves. This approach provides a distinct form of practical outcome. The *'Viral Making'* project enabled me to potentially shift my practice from an 'artefact' format to a 'non-artefact' format, which is considered a contribution to my practice development journey.

6.7 Critical reflection on methodology and findings and potential future research

The analysis of the practice of creating cross-disciplinary jewellery in a distributed collaborative environment addressed is an observation of a specific set of interactions between the craft and design fields in a distributed collaborative setting. The boundary objects identified in this case and their features and support for the collaboration process are also rooted in this specific practice context.

The use of the boundary object concept in this research highlights the profound impact of boundary objects in cross-disciplinary practices related to jewellery, from establishing fundamental communication bridges to aiding complex design decisions. However, on the other hand, this research is observed from the perspective of the jewellery field, focusing on a specific set of interactions, and conducted as an objective study. This means that the features of the 8 categories of boundary objects discussed may not necessarily be generalizable. In the future, this research could be explored in other similar cross-disciplinary studies to enhance its generalizability. This would not only help understand the role of the identified boundary objects in cross-disciplinary

collaborative practices but also further test the integrated analytical framework used in this research.

In the practice component of this research, the focus was placed on the collaborative process and the involved knowledge flows, rather than on creating cross-disciplinary jewellery as a final outcome. As a result, the practical outcomes of this research were not confined to wearable jewellery forms. Instead, jewellery was treated as a specific type of knowledge. The focus was on the knowledge flow between two fields and exploring the establishment of cross-disciplinary jewellery based on the knowledge flow process, but the form of the outcomes in this research raises a thought:

Since this research is conducted from the perspective of contemporary jewellery, where jewellery was indeed integrated as a form of knowledge into the creation process, it also shows innovative expressions of knowledge from other fields within the jewellery field. Although the practical outcomes of the *'Data-Music-Jewellery'* project were presented in the form of large sculptures, they did not exceed the framework of cross-disciplinary jewellery defined in this research. (This also does not limit its transformation into wearable jewellery forms; during the practical process, attempts were made to present the outcomes as wearable jewellery forms, but this was not directly related to the research questions focused on in the research, so it was not discussed in the main body of the thesis.) But if we step outside the perspective of the jewellery field, could such outcomes be defined as cross-disciplinary sculptures, or more broadly as cross-disciplinary art?

This consideration raises a discussable question – in the creation process, if jewellery knowledge is applied (integrating jewellery as a form of knowledge in the creation process), or if the qualities or principles of jewellery are considered or interpreted (as with the definition of architectural jewellery by Ward, 2005), but the work is not presented in a wearable jewellery form, how should such pieces be positioned within the framework of cross-disciplinary jewellery? What distinguishes this type of cross-disciplinary jewellery from those that are wearable?

As described in the definition of cross-disciplinary jewellery, as a form of body adornment, the relationship between jewellery, its wearability, and the wearer is an

important element that cannot be ignored. Exploring the wearability and representational forms of cross-disciplinary jewellery, or whether presentation in a wearable form is a necessary condition for cross-disciplinary jewellery, is a topic worth further exploration and also potential future work to refine the definition and framework of cross-disciplinary jewellery.

This research follows a craft-thinking methodology that reflects the characteristics of craft thinking. Rather than adopting predefined methods, the methodology emerged gradually in response to the nature of the practice itself (see chapter 4). Throughout the research process, practice often preceded theory (see Section 4.1.2, Point 3). This means that theory in this study served the needs of practice, rather than being applied to it in a prescriptive or pre-structured manner. There were many moments during the research where decisions were made intuitively—based on the researcher's immediate judgement—and later on, in the stages of thesis writing or theoretical analysis, relevant theoretical frameworks were identified through supplementary literature review to support those earlier decisions.

For example, the three-phase method (see chapter 2) used to define cross-disciplinary jewellery emerged naturally during the research. At the time, this structure felt appropriate and was shaped by the needs of practice. During the writing phase, further literature engagement led me to realise that the three-stage structure I had developed matches the structure for the concept analysis method proposed by Schwartz-Barcott and Kim (1986, 1993, 2000) (see Chapter 2). This staged structure is also embedded within the broader craft-thinking methodology that underpins this research (see Section 4.1).

While this non-linear research process may involve certain risks such as potential uncertainties in structure or theoretical grounding that require extensive subsequent research, it offers an approach that aligns more closely with the mindset and working patterns of craft practitioners. If the research had been confined from the outset to a rigid methodological structure, these risks might have been reduced, but it would also have imposed constraints that could limit the researcher's thinking. Such a prescriptive framework might have led me to act in service of the framework itself, rather than in

response to the specific needs of the research, thereby weakening both the process and the outcomes.

From my perspective, using craft thinking as an epistemological framework to do this practice-based craft research is contextually and methodologically appropriate for this study. Rather than pretending that this research followed a conventional, linear process, I have chosen to frame the open, iterative, and reflective nature of the research journey into the craft-thinking methodology in this study.

This methodology not only reflects how the research actually unfolded but also points toward a sustainable approach for my potential future research. Firstly, there is the discussion in Section 4.4 on how reflexive thematic analysis aligns with the craft-thinking methodology. Braun & Clarke (2018, 2019) discuss the subjective and objective perspectives of researchers in thematic analysis and acknowledge the importance of researcher subjectivity in reflexive thematic analysis. In Section 4.4, I have already touched on this core characteristic of reflexive thematic analysis, which is centred on the researcher's subjectivity, aligning well with the craft-thinking methodological framework followed in this research, as well as the unique perspective of the researcher in this research. However, as this is not the focus of my research, I have not explored it in depth. In the future, based on the characteristics of the researcher's constant shifting between practical and research perspectives in this study, it could provide a unique case for the application of reflexive thematic analysis in craft research, becoming a potential area for future research exploration.

Additionally, the craft-thinking methodology followed in this study could potentially contribute to the practice research discourse - utilizing the 'research onion' model (Saunders, Lewis & Thornhill, 2012), and positioning craft thinking at the outer layer of the research onion as a philosophical layer; it may also incorporate the discussion of the application of thematic analysis in practice-based research as discussed above, as the inner layer of the research onion. Such discussions based on craft thinking could become another future exploration of this study, potentially enriching the practice research discourse.

Figure Reference

Figure 2-1: Klimt02.net, *Friedrich Becker. ring*, *Klimt02 Artworks & Jewels. Friedrich Becker. Ring*. Available at: https://klimt02.net/jewels/friedrich-becker-ring-1958-untitled

Figure 2-2: Berger, M. (2023) *Collection - Michael Berger - kinetic jewellery and objects*, *kineticrings.com*. Available at: https://www.kineticrings.com/collection/

Figure 2-3: Berger, M. (2023) *Collection - Michael Berger - kinetic jewellery and objects*, *kineticrings.com*. Available at: https://www.kineticrings.com/collection/

Figure 2-4: deVille, J. *Sparrow Mouse brooch*, *JULIA deVILLE*. Available at: https://www.juliadeville.com/bespoke/details/7329905475/sparrow-mouse-brooch/

Figure 2-5: Kardouss, L. (2019) *A Jewelry Piece*, *A Jewelry Piece | Lodie Kardouss - Contemporary jewelry*. Available at: https://lodiekardouss.com/work-aJewelryPiece.html

Figure 2-6: LOEWE Foundation The Room, *Rita Soto | Quiltra II Brazalete*, *LOEWE Foundation The Room*. Available at: https://theroom.loewe.com/en/artwork/rita-soto/quiltra-ii-brazalete

Figure 2-7: LOEWE Foundation The Room, *Rita Soto | Parasite No. 8 Brooch*, *LOEWE Foundation The Room*. Available at: https://theroom.loewe.com/en/artwork/rita-soto/parasite-n8-brooch

Figure 2-8: Davern, A. (2012) *Journal: Anna Davern*, *e.g.etal*. Available at: https://egetal.com.au/journal-anna-davern-2/)

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Appendix 1: Pilot Project

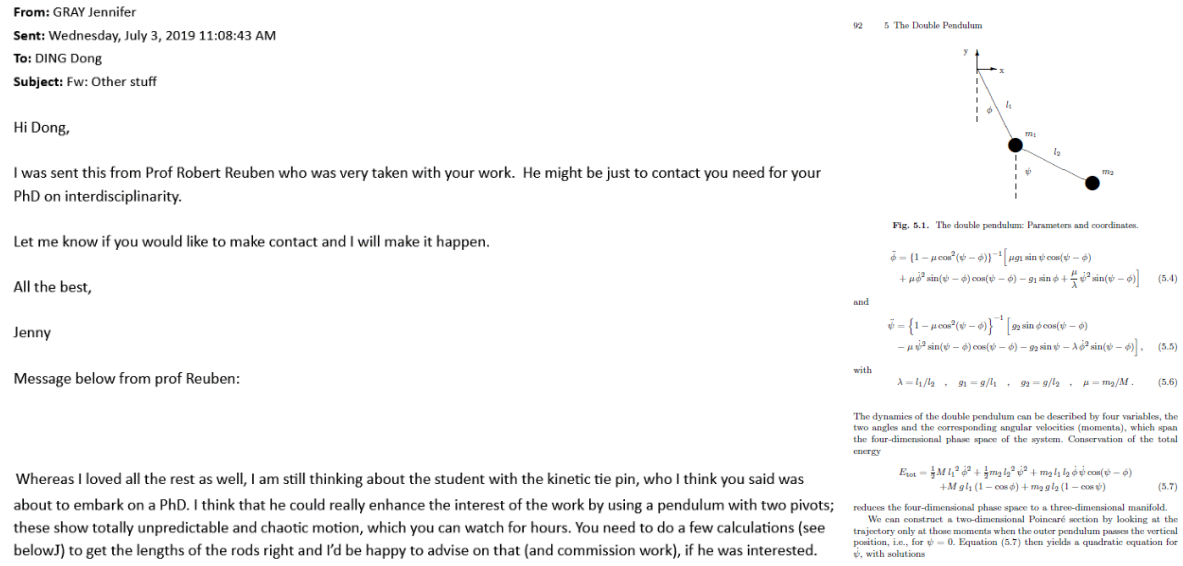
To achieve the aims and objectives of this research, collaboration projects are essential. The plan included starting with a pilot project involving collaboration between myself and an MSc student from Heriot-Watt University, Edinburgh. This project was supervised not only by my supervisory team but also by Professor Robert Lewis Reuben from the School of Engineering and Physical Sciences at Heriot-Watt University. I have been in contact with Professor Reuben since July 2019, with the intention of commencing the project in March 2020. Unfortunately, due to the COVID-19 pandemic, the project was postponed and ultimately cancelled.

The pilot project was designed to identify and address potential issues in the research design. Any problems or necessary modifications could be addressed before starting actual collaboration projects of my research. This pilot project was also intended to help me understand some of the theoretical frameworks I had reviewed the previous year. Although researchers have different working styles and I will encounter various individuals in future collaborative projects, it was hoped that this experience would familiarize me with collaborative work across different fields. Additionally, it was expected that I would begin to grasp the research processes discussed in the first year's literature review. This pilot project aimed to provide insights into the number and types of researchers required for cross-disciplinary research, as well as time limits and parameters, helping to determine the number of collaborative projects feasible within the research timeframe.

Although the pilot project was ultimately cancelled, it highlighted several potential issues, particularly in the initial preparation stage. Problems such as subject setting and communication with the collaborator were identified, contributing to the project's failure and cancellation. These insights are valuable for future collaboration projects, enabling better preparation and execution.

The original intention of the project was to work closely with professionals from various fields. The modes of collaboration included, but were not limited to, co-creation of work, knowledge exchange, and feedback throughout the collaborative process. The trigger for the pilot project occurred when Professor Robert Reuben saw my *"Boundary of Balance"* collection at my MFA graduation exhibition in June 2019. From an

engineering perspective, Professor Reuben believed there was potential to enhance the dynamics and structure of this jewellery collection. He proposed using a physical and engineering concept called "chaotic motion" to improve the visual and dynamic effects of the *"Boundary of Balance"* collection. Facilitated by Jennifer Gray, one of my supervisors, I contacted Professor Reuben to discuss potential collaboration.



From: GRAY Jennifer
Sent: Wednesday, July 3, 2019 11:08:43 AM
To: DING Dong
Subject: Fw: Other stuff

Hi Dong,

I was sent this from Prof Robert Reuben who was very taken with your work. He might be just to contact you need for your PhD on interdisciplinarity.

Let me know if you would like to make contact and I will make it happen.

All the best,

Jenny

Message below from prof Reuben:

Whereas I loved all the rest as well, I am still thinking about the student with the kinetic tie pin, who I think you said was about to embark on a PhD. I think that he could really enhance the interest of the work by using a pendulum with two pivots; these show totally unpredictable and chaotic motion, which you can watch for hours. You need to do a few calculations (see belowJ) to get the lengths of the rods right and I'd be happy to advise on that (and commission work), if he was interested.

92 5 The Double Pendulum

Fig. 5.1. The double pendulum: Parameters and coordinates.

$$\ddot{\phi} = \{1-\mu\cos^2(\psi-\phi)\}^{-1}\Big[\mu g_1 \sin\psi\cos(\psi-\phi) + \mu\dot{\phi}^2\sin(\psi-\phi)\cos(\psi-\phi) - g_1\sin\phi + \frac{\mu}{\lambda}\dot{\psi}^2\sin(\psi-\phi)\Big] \quad (5.4)$$

and

$$\ddot{\psi} = \Big\{1-\mu\cos^2(\psi-\phi)\Big\}^{-1}\Big[g_2\sin\phi\cos(\psi-\phi) - \mu\dot{\psi}^2\sin(\psi-\phi)\cos(\psi-\phi) - g_2\sin\psi - \lambda\dot{\phi}^2\sin(\psi-\phi)\Big], \quad (5.5)$$

with

$$\lambda = l_1/l_2 \quad , \quad g_1 = g/l_1 \quad , \quad g_2 = g/l_2 \quad , \quad \mu = m_2/M\,. \quad (5.6)$$

The dynamics of the double pendulum can be described by four variables, the two angles and the corresponding angular velocities (momenta), which span the four-dimensional phase space of the system. Conservation of the total energy

$$E_{\rm tot} = \tfrac{1}{2}M l_1^2\dot{\phi}^2 + \tfrac{1}{2}m_2 l_2^2\dot{\psi}^2 + m_2 l_1 l_2\dot{\phi}\dot{\psi}\cos(\psi-\phi) + M g l_1(1-\cos\phi) + m_2 g l_2(1-\cos\psi) \quad (5.7)$$

reduces the four-dimensional phase space to a three-dimensional manifold.

We can construct a two-dimensional Poincaré section by looking at the trajectory only at those moments when the outer pendulum passes the vertical position, i.e., for $\psi = 0$. Equation (5.7) then yields a quadratic equation for $\dot{\psi}$, with solutions

Figure 1. Email from Professor Robert Reuben

The initial communication involved me, my supervisory team, and Professor Reuben. During a face-to-face meeting, Professor Reuben brought a model of a chaotic pendulum to demonstrate the dynamics of chaotic motion. We discussed the potential development directions and collaboration points for my "Boundary of Balance" collection. It was anticipated that collaborating with an engineering student whose research focused on chaotic motion could not only advance the "Boundary of Balance" collection but also explore the intersection and development of engineering and art.

At the beginning of the project, my collaborator, Hamish, and I had an online meeting with my supervisory team and Professor Reuben. The aim of this meeting was for Hamish and me to understand each other's topics and expertise, facilitating effective future collaboration.

During online chat, Hamish presented his progress through a PowerPoint presentation (see Figure 2). I also showcased my work and my MFA graduation collection. Hamish, as an engineering student, primarily focused his project on calculating formulas. He

wrote a program in Python that simulated and generated chaotic trajectories by inputting values such as weight, length, and distance (see the next appendix [add number] for details of the program). We attempted to discuss potential collaboration ideas, but it became apparent that neither of us had a clear understanding of the exact outcome or benefit of the collaboration at that time.

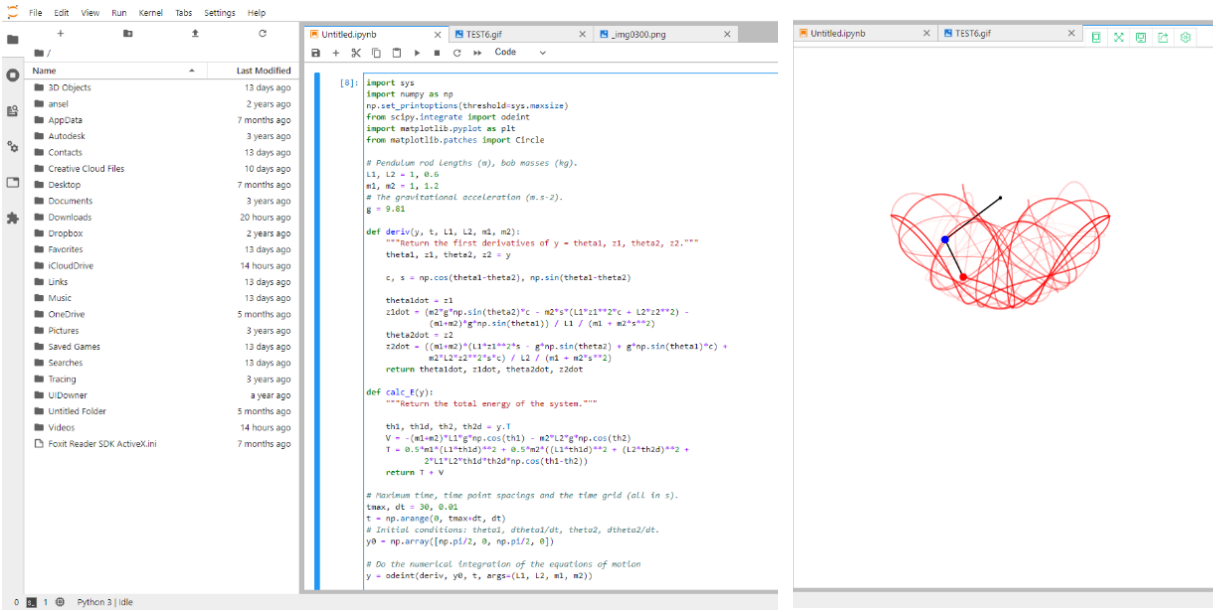


Figure 2. Hamish's program and the chaotic trajectories created by the program, excerpt from his presentation

During this communication, I realized that the original plan for us to co-create an outcome together was not feasible. Hamish was essentially providing his program for me to use, without specific ideas for artistic creation or further project development. To address this issue, I proposed advancing the project through mutual reflection and feedback. This approach meant that I could use Hamish's program to develop my collection, share the process with him, and then receive his feedback. Hamish could then refine his task based on my development process, and we would continue this iterative process to explore the transformation of knowledge between our two fields.

The first opportunity to use Hamish's program for creative development appears during a summer project with Tongji University, Shanghai, in August 2020. This summer school for graduate students, called the 'Shanghai Space Installation and Material Exploration International Exhibition,' spans ten days and focuses on architecture, space, sculpture, installation, and public art in Shanghai. During this

project, I developed details of my “Boundary of Balance” collection using Hamish’s program. I re-scaled and reorganized the structure of the jewellery pieces, integrating the concept of 'chaotic motion' into my design. This work culminated in a new public sculpture and installation piece (see Figure 3). Please refer to appendix [add number] for more details on the outcomes and concept of the ‘Chaos’ project.

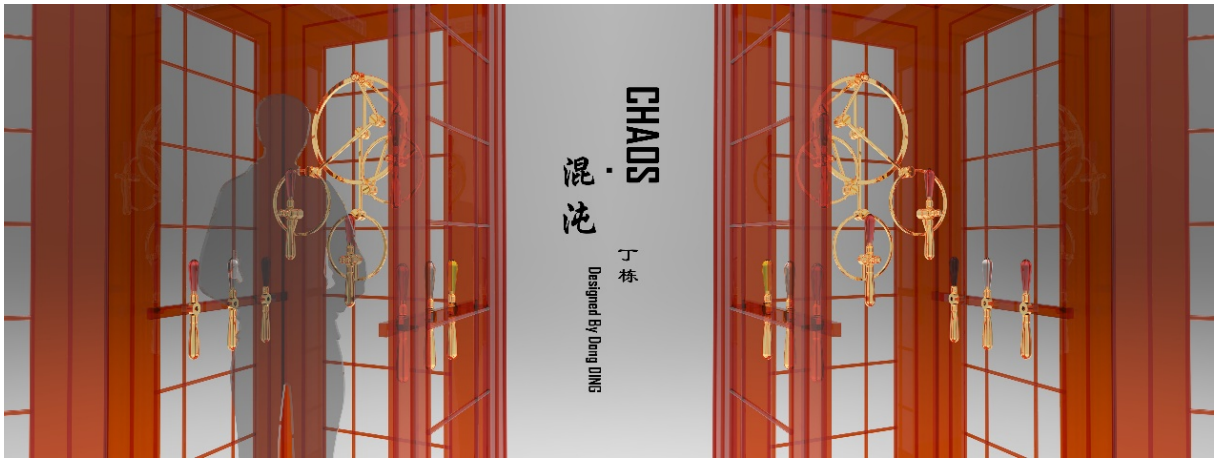


Figure 3. ‘Chaos’ – Public sculpture and installation piece developed form jewellery collection

Throughout the development of the project, I communicated with Hamish online. He further introduced me to the concept of ‘chaotic motion’ and demonstrated how to use the program he created to simulate the trajectory of chaotic motion. During our discussions, I inquired about modifying the shape and size of the points in the program to create more realistic and interesting trajectories. Hamish explained that his primary research interests were in the calculation of formulas and providing a theoretical basis for simulation programs in mathematical and engineering contexts. For additional needs, he suggested seeking assistance from other professionals in the computer programming field.

In subsequent communications, Hamish expressed his willingness to assist with any issues related to the program. However, when I shared feedback after developing my work, he did not provide corresponding feedback or integrate my developments into his own project. It became clear that he was more focused on guiding the use of the tool rather than engaging in reflective and collaborative advancement of the project. Although Hamish did not explicitly explain his lack of engagement, I suspect that as his study program was concluding, his research project had been put on hold, leading

to the absence of feedback or further development. Consequently, this project cannot be considered a true collaboration, as it did not reach completion.

Regarding the roles we played in the collaboration, my earlier literature review discussed how, in collaborations between art and design practitioners and other fields, art is sometimes seen merely as a means of promoting other fields rather than engaging in genuine collaboration. Similarly, other fields may be utilized by artists as providers of tools and skills, resulting in an unbalanced collaboration. In this project, Hamish functioned more as a technician, authoring and providing tools, rather than as a collaborator, which did not align with the expected collaborative role.

At the same time, through analysis, I believe the main problem in the pilot project lay in the early communication of the collaboration. Although both collaborators intended to work together, the project objectives and collaboration methods were not clearly defined. Additionally, the communication between the two collaborators was inadequate in terms of setting clear objectives, outlining the future development timeline, and providing sufficient information. This lack of clarity and poor communication ultimately led to the interruption and cancellation of the project.

To avoid such problems in future collaboration projects and achieve more effective outcomes, early communication is crucial. During the initial stages of communication, it is necessary to clearly agree upon and determine the project's objectives and understand both collaborators' intentions. Merely having the intention to collaborate is insufficient; it only serves as the basis for initiating the project. Before the actual start of the collaboration, clear goal setting and a detailed project plan are essential. This includes writing a project brief and agreeing on a timeline.

The failures of this pilot project provide a valuable model for my future research collaborations and how they should be set up. These improvements include:

- Clearly defining the position and role of each collaborator in the project.
- Enhancing communication between collaborators.
- Establishing a detailed project plan (brief writing).
- Utilizing reflection and feedback on each other’s research methods throughout the project.

These points have been improved and reflected upon when establishing my two subsequent collaboration projects.

Appendix 2: Viral Making - Initial Project brief

Participating Artists	
Dong Ding Contemporary Jewellery PhD in Design Edinburgh college of art The University of Edinburgh, UK	Jo McCallum Digital Craft PhD Candidate School of Architecture The University of Queensland, Australia
Email: daviddingdong@hotmail.com	Email: j.mccallum@uq.edu.au

Project Description

***Key Words**:*

Adaptive Digital Tools, Mixed Reality, Jewellery, Architecture, Fabrication, Craft Research.

Rationale:

Whilst meeting platforms, like Zoom, Microsoft Teams, and Skype offer the opportunity to cross borders and boundaries, practice research is in flux. How can makers, fabricators, and material researchers preserve, harness, and enhance tangible engagement in this new screen-centric era? In this context, researchers in architecture and craft have a unique opportunity to share their tacit knowledge. As such, Viral Making will explore adaptive digital tools (Rhino & Grasshopper) and mixed reality platforms (Fologram), in order to craft connections, deliver novel pedagogy, and share practice research methods.

We are committed to investigating innovative tools and techniques, with a view to informing and enhancing engagement across a range of disciplines.

The research project aims and Objectives:

We will collaborate in order to:

- Preserve, harness, and enhance practice research, utilising adaptive digital tools (Rhino & Grasshopper), alongside mixed reality platforms (Fologram).
- Explore a process of Training & Experimentation by sharing skills, and digital/physical models.
- Craft a process of Growth through Iteration by developing a series of shared models, made
  collaboratively across two continents.

- Document and reflect upon this process to deliver Demonstration & Dissemination, including a Viral Making toolkit (knowledge sharing strategy, process diagrams, workflows, material logs, short films, and opensource files).

Project Description:

- Training & Experimentation: learning to use Fologram; sharing experience of Rhino & Grasshopper; exploring existing precedents across jewellery and architecture; agreeing data sets, materials, scale, workflows, and documentation strategies.
- Growth through Iteration – engaging in shared modelling (jewellery and architecture); exploring adaptation, hybridity, and digital capability; exploring and enhancing material research.
- Demonstration & Dissemination: designing and delivering the Viral Making toolkit (knowledge sharing strategy, process diagrams, workflows, material logs, short films, and opensource files); designing and delivering webpage; designing and delivering the social media campaign.

Pre-award:

In preparation for this project Jo has been accepted into the Digital Futures, Designing for Mixed Reality Fabrication workshop, which will be delivered over four days by Fologram' s Gwyllim Jahn, CCO and Sean Guy, Product Manager. Commencing 27 June 2020, this course will deliver dedicated instruction in the use of the mobile app tool. This training event will also enable us both to network with members of the company with a view to working collaboratively in the months to come. This may extend to additional funding opportunities, and equipment sharing.

Jo is also enrolled in Foundry Skills (Casting and Moulding), TAFE Queensland, a vocational course, aimed at delivering trade qualifications. This training opportunity will enable Jo to gain the skills required to scale-up jewellery making processes. The University of Queensland has a foundry on site, and Jo also has a relationship with UAP (Urban Art Projects), one of the worlds largest artist foundries, based in Brisbane.

As Scotland remains in Lockdown, David is currently advancing his Rhino and Grasshopper skills. This grant seeks to provide him with his own Rhino 6 license, so that he can continue to work remotely if necessary. Should restrictions be lifted, David will make use of local workshops and foundries.

Training & Experimentation (Q.1)

We have agreed to share the Fologram course content and our existing Rhino & Grasshopper workflows. We will source additional training, as and when required, this will come from accredited providers, approved by our supervisors. We will then engage in Design Thinking strategies PACT (people, activities, context, technology/ materials), and SCAMPER (substitute, combine, adjust, modify/magnify/minify, put to other use, eliminate, reverse) to explore how this new technology might inform and enhance practice research. We will collate and explore precedents across jewellery and architecture, which will be housed on an opensource Pinterest page, titled Viral Making. Sharing our respective practice will form an important part of this project, and we have agreed to share 3D modelling files of our existing practice.
During this time we will also introduce the technology to other academics in our respective institutions, to gain their perspective possible applications. We have both identified HoloLens sets in our universities, and will attempt to borrow these for part of the project. If this isn't

possible, we will focus on the mobile application, which is widely accessible and suitable for shared approaches.

We will create a Dropbox folder, where we will design and develop templates aimed at delivering Viral Making, including our knowledge sharing strategy, process diagrams, workflows, material logs, short films, and opensource files. This content be bound by a Creative Commons License: Attribution – Non-Commercial 4.0 International (CC BY-NC 4.0), enabling sharing and adaptation, but limiting commercial use. All modelling tasks will be shared.

Growth through Iteration (Q.2)

During the course of Quarter 2, we will deliver at least three digital models. The physical versions of these will be made using Fologram's mobile application, and HoloLens platform. We will work together in real time to explore skills, processes, scale, materials, form, and pedagogy; one participant in Scotland, the other in Australia; one used to working in intricate detail, the other with structures. This remote, but wholly engaged process will be carried out over three, five-day periods, to allow for documentation, reflection, adaptation, and hybridity (morphing and combining models). It is anticipated that this stage will deliver six separate physical models, which can then be scanned and compared to identify the maker's mark.

Fologram has created a series of short films explaining the capability of their mixed reality platform: https://fologram.com

Outcome & Impact:

This project will build digital capacity via demonstration and dissemination. We will deliver our Viral Making toolkit via a shared paper, webpage, and social media campaign. All assets will be opensource, and users will be encouraged to download and adapt our original models. This process-driven, collaborative approach will add value across science, technology, engineering, the arts, and mathematics (STEAM).

As makers and PhD candidates, we are both acutely aware of the challenges and barriers COVID-19 has brought to bear on our sector. We are dedicated to preserving, harnessing, and enhancing tangible engagement, to deliver novel pedagogy and share practice research methods. However, we also want to maintain wellbeing. Our Viral Making toolkit, will be freely available for others to download, adapt and share. Isolation should not stop us from making, from connecting. Even though we can't be in the same workshop, lab, or lecture theatre, we wish to craft connections – to share our skills and experience with our community, both inside and outside academia, both inside and outside the screen.

Appendix 3: Viral Making - Initial Project structure and process plan

For the *Viral Making project*, throughout the whole project, the 'process journal' will be the method for us to record what we think and what we do, video records and transcriptions will be the method for recording the communications and exchange of thinking and knowledge during the process. The 'Reflection Journal' will be the method for us to feedback on each other's work and to record our thoughts. All of these journals and transcriptions will be used as qualitative data for future analysis and in the conclusion of this project.

The process of the project will be divided into several stages and all stages will be further divided into more detailed steps, diagrams will be used to help explain the process of the project structure.

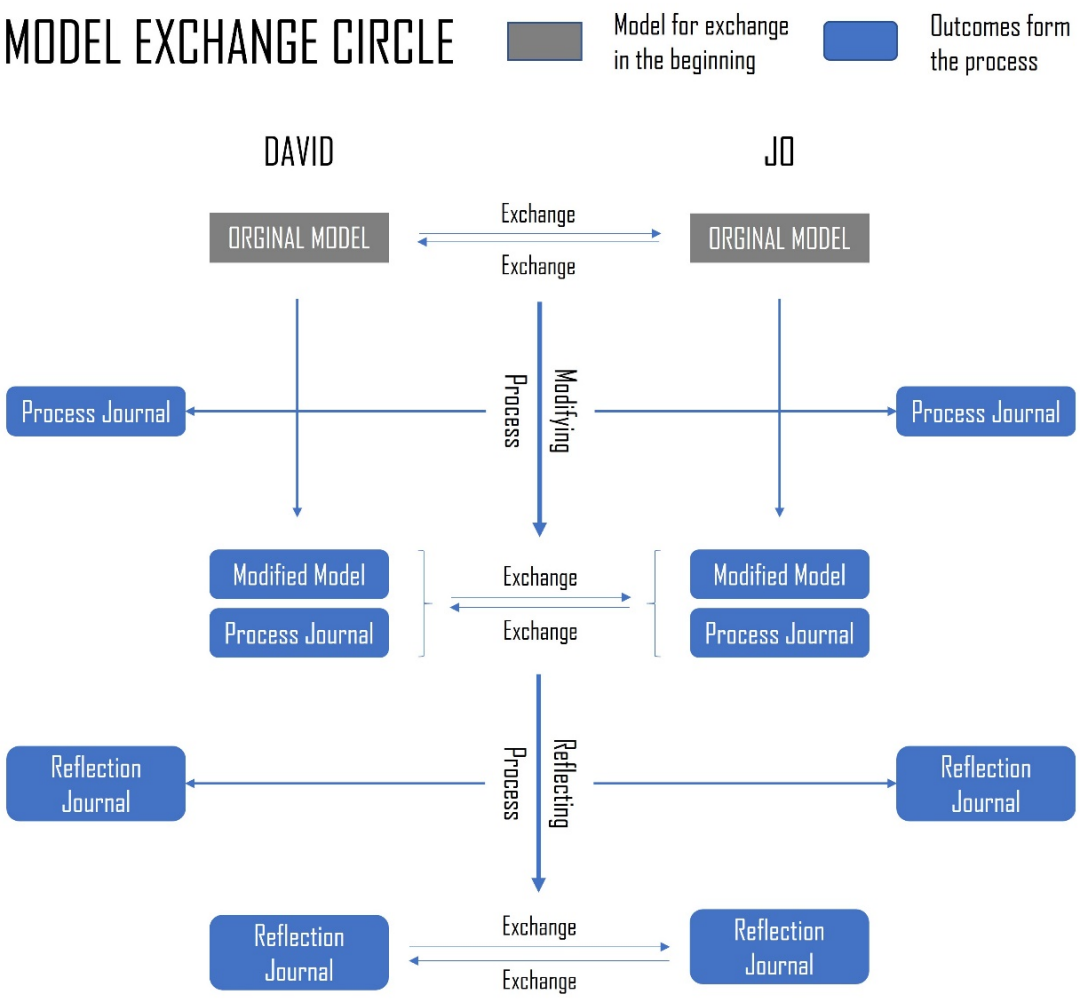


Figure 1: *Viral Making* Stage 1 - Model Exchange Circle Process

The diagram in Figure 1 shows the research process of the 'model exchange circle' during the first stage of the *Viral Making* process, followed by Figure 6 which shows the whole research process of the *Viral Making* Project.

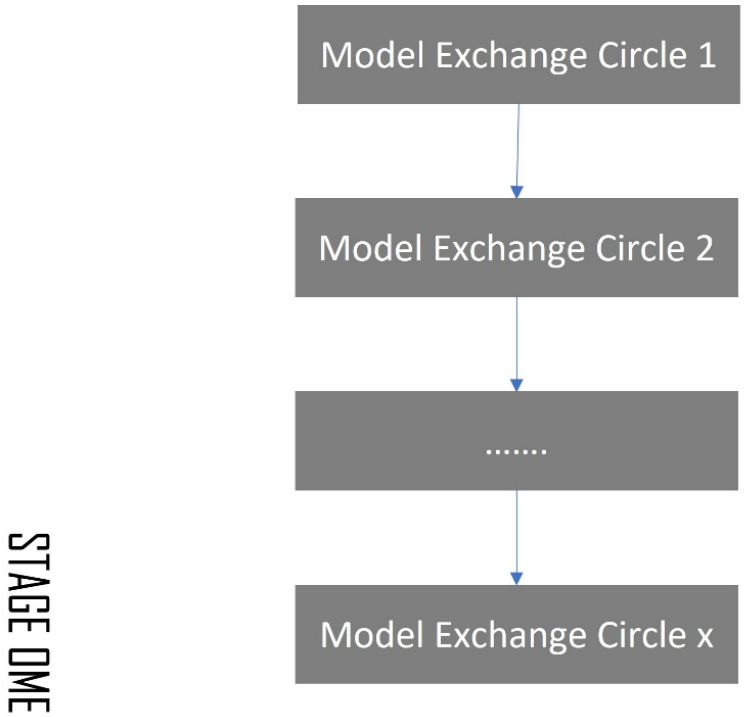
Stage 1: The first stage will be a model exchange process (See Figure 1 for the model exchange circle process), we are going to share digital 3D models with each other (can be existing models or new creations), this stage will be a more independent process and we will work through 3D modelling software that we are most familiar with. (Such as, for myself will be Rhino, and for Jo Grasshopper.) We will feedback on each other's models in this stage.

Step 1 : We will make some changes to each other's models based on our own background. Through this step, we will both write a 'Process Journal' to record what we do and think through the model editing process. We may also write but are not limited to what we do, why we make the changes and other thoughts through the process in our first persons' view.

Step 2: We will send the modified models back to each other. We will look at the modified models and react to them. During this step, we will both write a 'Reflection Journal' to record what we thought about the modified models, including but not limited to what we like and dislike about the changes, what we think is interesting and inspired, and what differences we see from the different background field through the modification.

After each cycle of the model exchange, the research data will comprise the resulting models, and a process journal and a reflection journal from each collaborator.

Because we are undertaking the same process (even using the same software), but are informed by our different background disciplines, it should be possible to use the journals to analyse differences in applications, presentations, knowledge and thought processes resulting from them.



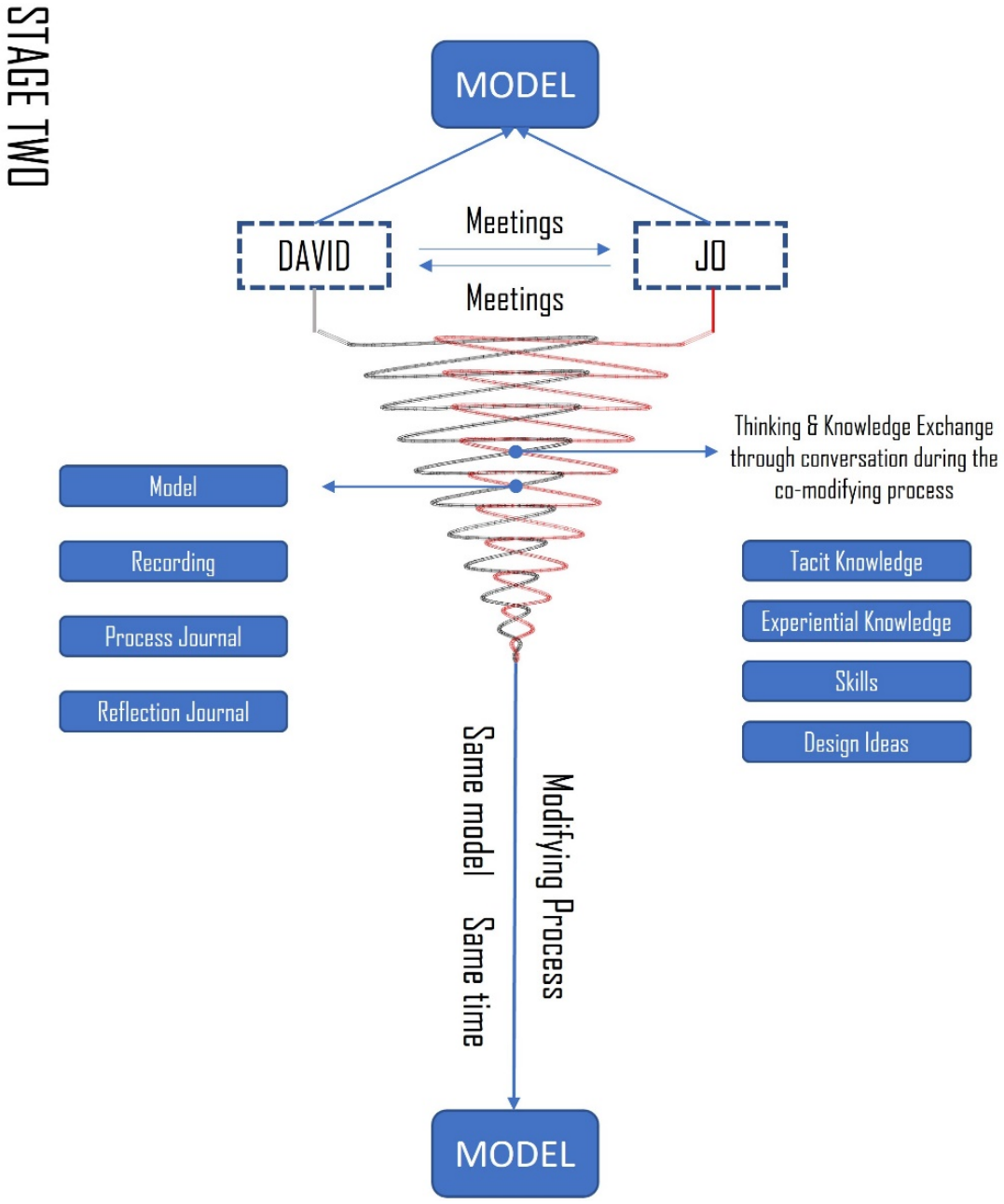


Figure 6: *Viral Making* Process - Stage 1 & 2

Stage 2: The second stage will be the co-working process, we will modify the same model or create new models at the same time through Fologram – a platform that is based on VR technique, we will be able to make changes to the same models at the same time through VR controllers and can communicate and feedback to each other at the same time, the whole process will be recorded and transcribed for future analysis.

Because 'talking is a way of thinking and knowing' (McNiff, 2012:36), communication during the making process is one of the knowledge exchange pathways. We will be able to see the instant exchange of the thinking and knowledge between us from this stage and the recordings and transcription will capture the process as qualitative data and we will use it for further analysis.

Appendix 4: Viral Making – Changes to the project workflow

Similar as the ‘Data-Music-Jewellery’ project, the actual process of the ‘Viral Making’ project also differs from its original plan, in terms of changes to the process and development of the project, and changes to the data collection methods, which are discussed in this section based on the flow chart of the actual project process.

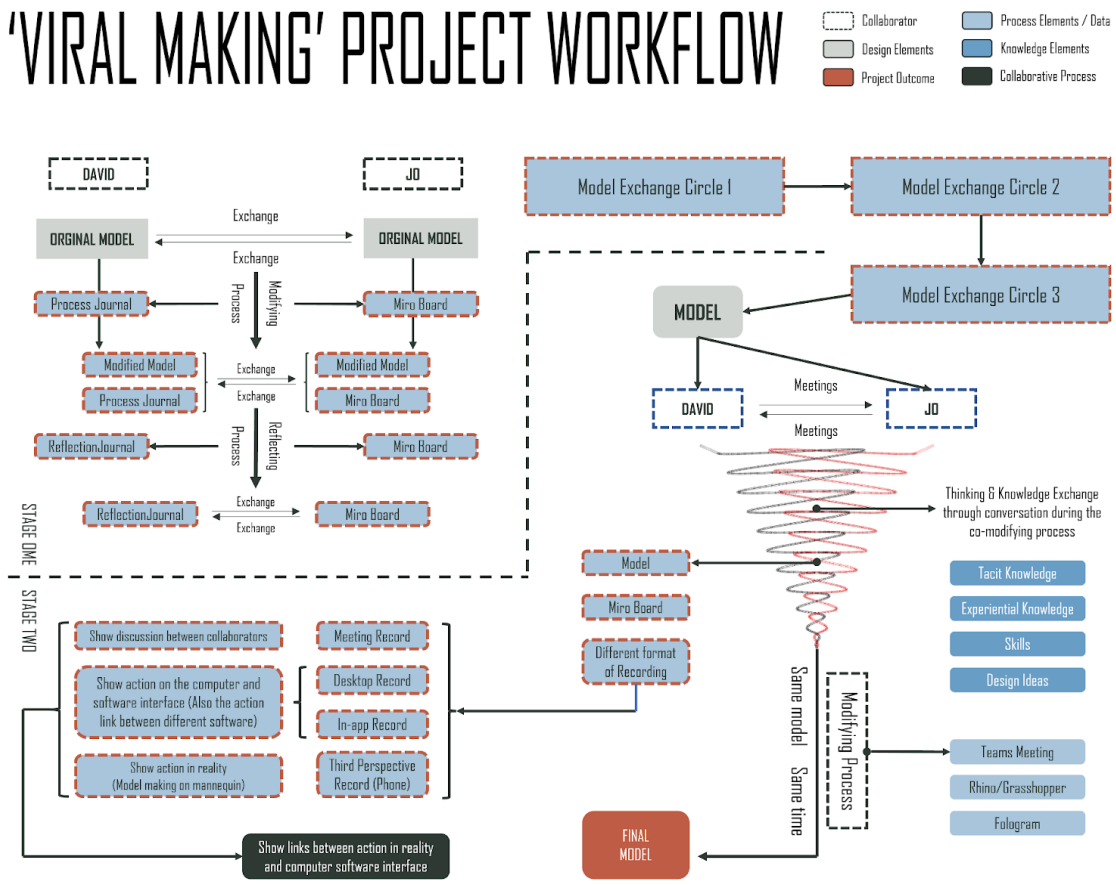


Figure 1: Actual ‘Viral Making’ Project workflow

Actual project process - Changes project methods and process

The first point to discuss is the collaborative process and the changes in methods involved. In the actual practice process, as the flowchart shows, the project still proceeds in the two planned phases - the model exchange phase and the co-design phase. However, the implementation methods and processes have changed depending on the actual collaborative environment.

First Phase

In the first phase (model exchange), in the original plan, the whole process of this phase was combined by several independent model exchange cycles, with no iterative links between each model exchange cycle, and all being allowed to use different models to participate in the exchange process.

As shown in the diagram in figure 1, the first phase of the original plan was subdivided into five steps:

Step 1: Exchange of the original model

Step 2: Modification of the original model (independent process) and creation of the process journal

Step 3: Exchange of modified models and process journals

Step 4: Creation of reflection journals by review of the modified model and process journals

Step 5: Exchange of reflection journals

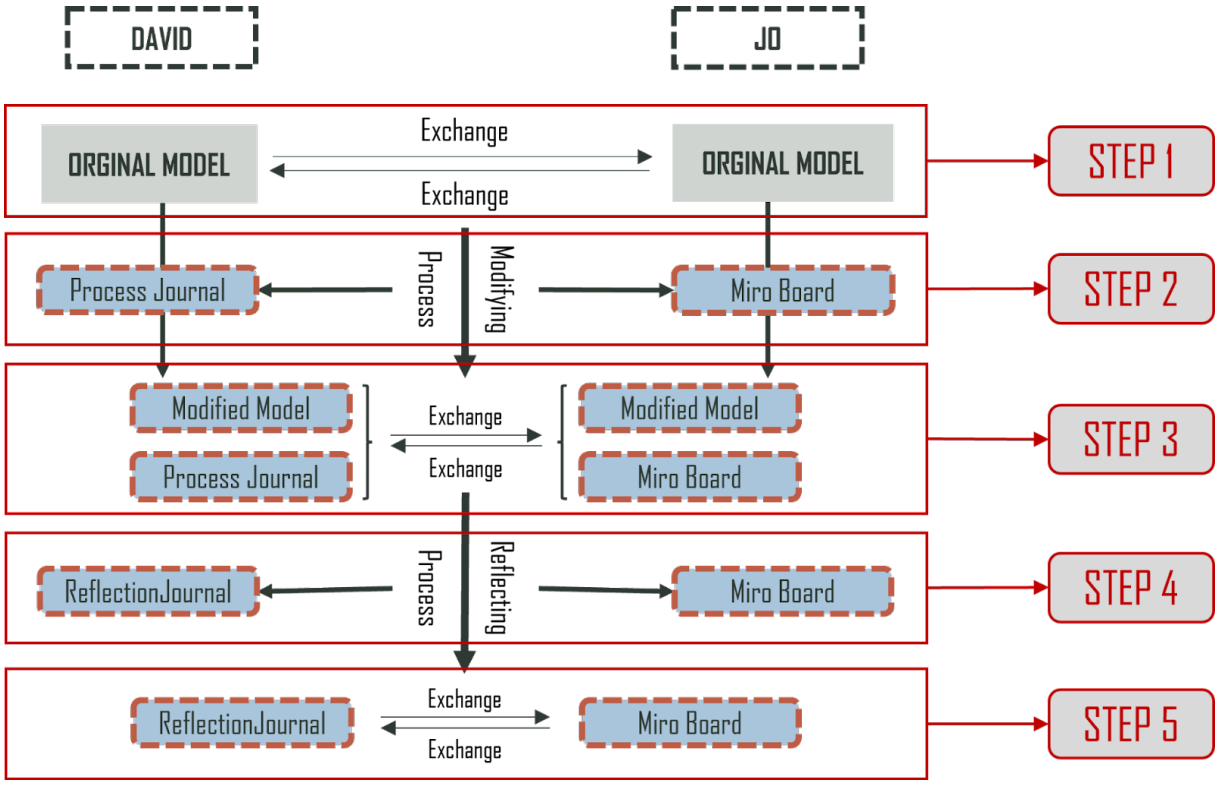


Figure 1: Five Steps in Phase one of the ‘Viral Making’ Project

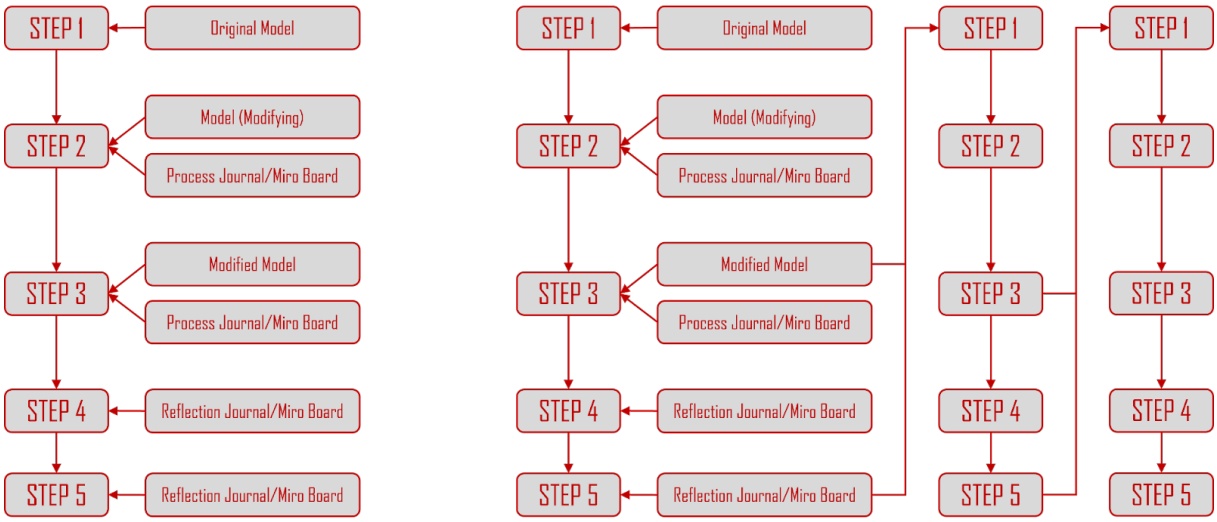


Figure 2: Links between Model exchange cycles in Phase one of the 'Viral Making' Project

In actual practice, four model exchange cycles were carried out. Except the test model exchange (work as a pilot to test the process of model exchange cycle) used models that had already existed, which formed an independent model exchange cycle. Starting from the first formal model exchange, as models from another practical project (the 'Data-Music-Jewellery' project) were brought in to participate in the model exchange process, subsequent model exchange cycles are based on the results of the previous exchange (As shown in the figure above, the modified model acquired in step 3 becomes the original model for the next round of model exchange cycle), which creates iterations and connections between model exchange cycles.

Phase two

In the original plan, there were also no actual links between phase one and phase two, there was no requirement to work with models that had appeared in phase one for phase two. But in the actual practice process, the models used for phase two were derived from the models produced in phase one through three iterative model exchanges. This also creates a link between the phase one and phase two work.

In the original plan, the second phase of the roll-out was based on a VR online interaction platform called 'Fologram'. The role of this online sharing platform is to allow people to work together at the same time from a long distance. By connecting both collaborators' VR devices to this platform, the aim is to allow both collaborators

to manipulate and modify the same model at the same time. The original plan was to use the software developed by Fologram for the Oculus device platform, but due to the Covid-19 and other factors, Fologram cancelled the development of the software for the Oculus platform. So, in the actual practice process, we have to use their mobile device based software (iPhone, iPad) instead to carry our work. Unlike the planned VR device, the mobile software is based on AR technology, which means that we lost the immersive working environment and the ability to work together to manipulate and modify the same model at the same time.

To solve this problem, we developed a method to collaborate based on online meetings and mobile devices based Fologram. As shown in the figure 3, during the collaboration, both collaborators set up a working environment including mobile port (iPhone, iPad), computer port (laptops) and real-life port (real life working environments including mannequin) to work simultaneously and communicate in real time via online meeting.

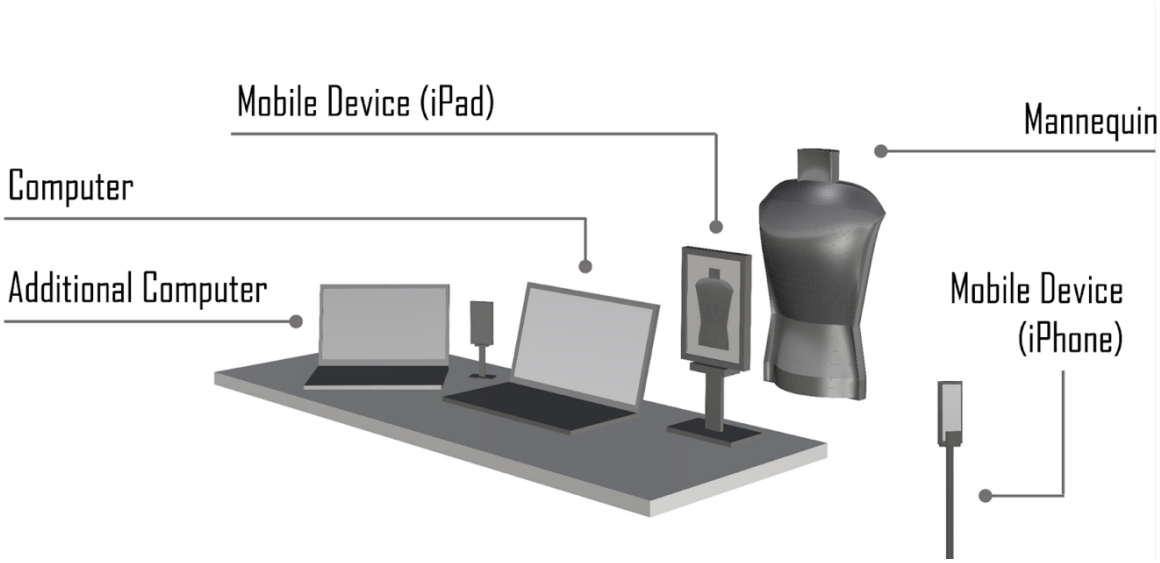


Figure 3: ‘Viral making’ project phase two working environment set up

Computer: To use 3D modelling software’s (Rhino, Grasshopper) and connect to mobile devices (iPad). Based on interaction with the real-life environment, to modify models through 3D modelling software and synchronise changes of the model between computer port and mobile port. The computer port is also used for online meetings, providing the ability for both collaborators to communicate in real time and work together based on screen sharing.

Additional Computer: To implement sharing and working in tandem with collaborators through Miro board. And to be the temporary replacement of the computer side for real-time communication through online meeting in case of network limitations.

Real Life Port (Mannequin): Human size mannequin in real life environment, to interact with 3D models through the Fologram platform on mobile device (iPad).

Mobile Device (iPad): Connects to the computer port, synchronises the changes of the model in the modelling software (Rhino and Grasshopper) in real time and enables interaction with the real life environment based on AR technology through the Fologram platform.

Mobile Device (iPhone): To film the whole practice environment and working process through video recording.

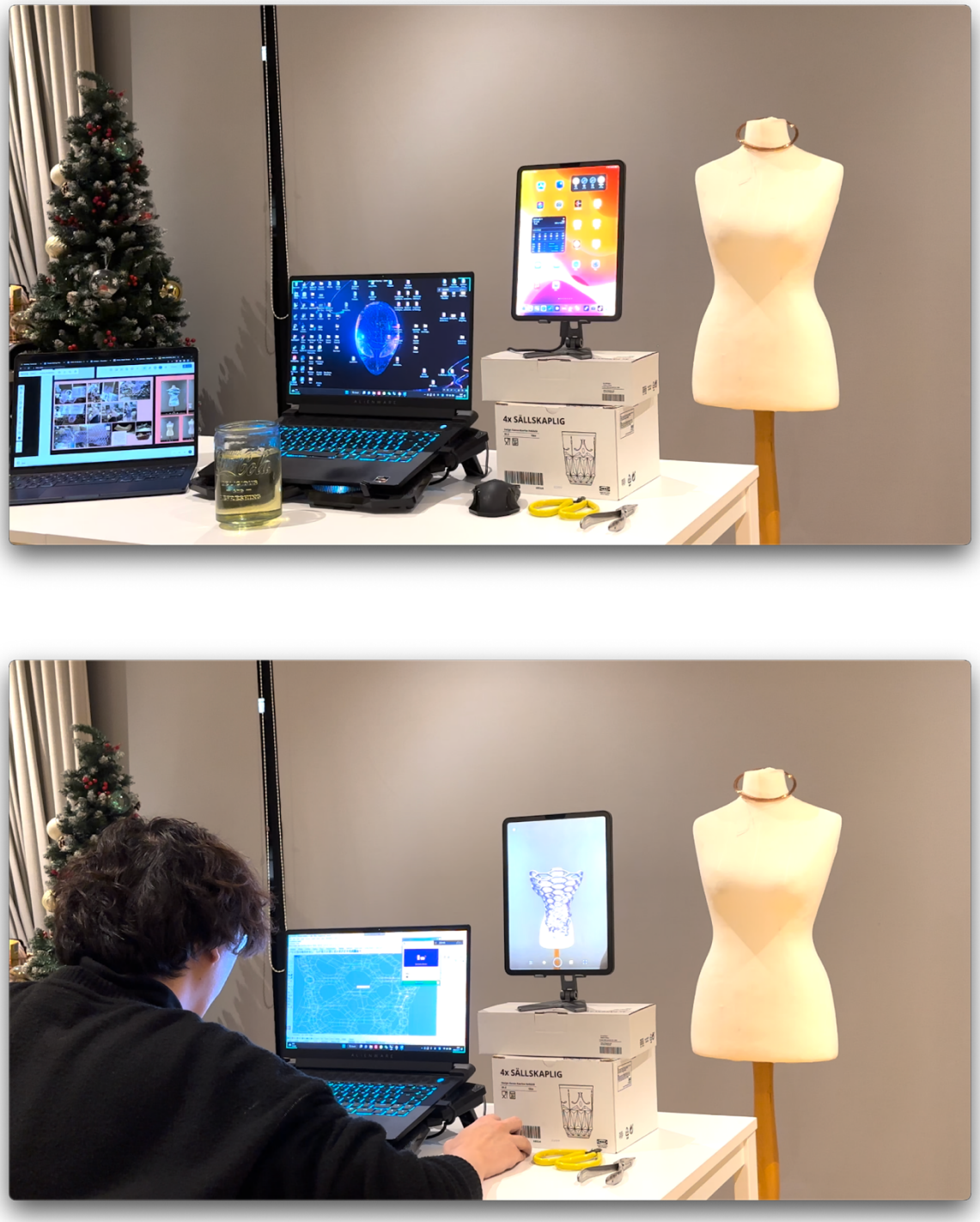


Figure 4: Real working environment (Phase two) of the ‘Viral Making’ Project

Changes to data collection:

Phase one

As mentioned in the previous section, in the original plan, the data collection method of the first phase was through the 'process journal' and ‘reflection journal' created by both collaborators.

In the original plan, both collaborators would record process data by creating a 'process journal' - the 'process journal' was created in parallel with the model modification process after the model exchange between the collaborators to record the process of modifying the received model (see step 2 in figure 3&4). This includes, but is not limited to, the process of modifying the model, ideas and reasons for the modifications, and ideas for further modification of the model in the future. The ‘reflection journal' is planned to be created after receiving the modified model from the collaborator, to record the thinkings and reaction on the modifications and to record further thoughts and feedback on the actions taken by the other collaborator.

In the actual practice process, during the testing round, both collaborators used the planned data recording method - to create and share their 'process journal' and ‘reflection journal'. However, from the first model exchange cycle, I kept the 'process journal' and ‘reflection journal’ as methods of data recording and collection, but Jo proposed and adopted a new method of data recording - the Miro Board.

One of the advantages of using Miro boards is that there is no need to rely on file transfers to obtain ‘journal' data from collaborators at a fixed time. Data from the practice and feedback can be updated and shared in a timely manner, eliminating the delay in data sharing between the ‘modify step (step 2)' and the 'feedback step (step 4)' of the original plan.

Furthermore, the ‘reflection journal' was originally intended to be used only for feedback on model modifications made by collaborators in the current cycle, with the aim of observing the different thoughts and actions of collaborators from different fields in relation to the same model and providing feedback on their actions. But in actual practice, due to the links established between the model exchange cycles, the ‘reflection journal' also contains ideas for further iterations of the model inspired by

each other's modifications. This in a way creates a cycle of feedback and iteration between model exchange cycles and builds up development of the process. Which is something that is not present in the original plan.

Phase two

Due to the complexity of the Phase 2 working environment and process, the data for the collaborative process in Phase 2 is diverse in format and collection methods:

<table>
<tr><th></th><th>Data Type</th><th>Collection Methods</th></tr>
<tr><td>Computer</td><td rowspan="2">Video of screen action (Action on modify model through 3D modelling software)
Video of screen action (interaction with collaborator on Miro board)
Video of communication (interaction with collaborator)</td><td rowspan="2">Meeting Record
Screen Record</td></tr>
<tr><td>Additional Computer</td></tr>
<tr><td>Real Life Port</td><td>Video of real life action (interaction and action among different ports and devices)</td><td>Video Record</td></tr>
<tr><td>Mobile Device (iPad)</td><td>Video of screen action (Interaction between real live ports and Fologram through AR)
Video of screen action (Interaction between Computer 3D modelling software and Fologram)</td><td>Screen Record</td></tr>
<tr><td>Mobile Device (iPhone)</td><td>Video of real life action (interaction and action among different ports and devices)</td><td>Video Record</td></tr>
</table>

It is important to note that the various types of data mentioned above do not exist independently from each other but are interrelated and interactive. The actions and interactions recorded by the different devices occur simultaneously and are later edited together to form a complete, multi-perspective video. It provides the process data for the research part of the research and itself is also considered to be a part of the practical outcomes of this PhD research.

Appendix 5: Viral Making – Notes of thinkings of Project outcome

As shown below are screenshots of videos taken from different perspective by different devices showing one single moment of the practice:

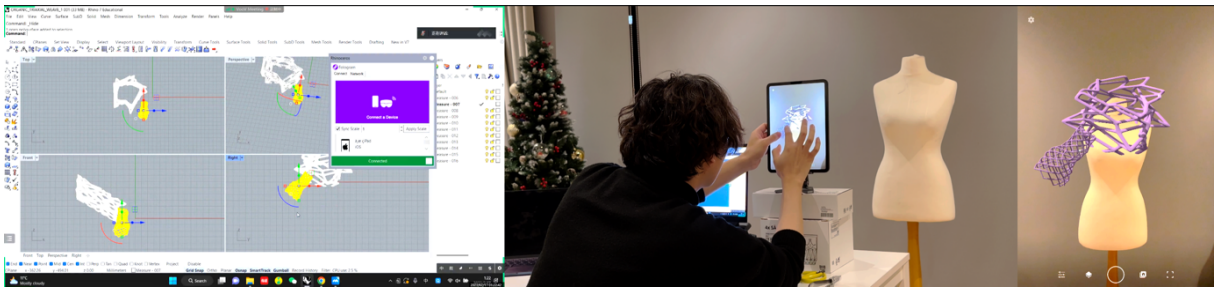


Figure 1 (Left): Computer Perspective (Rhino)

Figure 2 (Middle): iPhone Perspective (Real live interaction)

Figure 3 (Right): iPad Perspective (Fologram Platform)

- Figure 1 is the screen record of the computer showing actions on modifying model on computer software (Rhino)
- Figure 2 is the video record of the real life working environment taking by iPhone showing interaction and actions among different ports and devices (in this particular figure, I am changing the size of the model on the iPad screen to fit the mannequin)
- Figure 3 is the screen record of the iPad showing the interaction between computer modelling software and real-life ports through the Fologram platform

Looking at the different perspective screenshots together, we will be able to see that when I am modifying the model on Rhino, the model on the iPad screen (Fologram platform) is changing by the modifying action at the same time. Also, when I am changing the position and size of the model on iPad screen (Fologram platform), the model in Rhino software is also changing at the same time.

Through this kind of interaction and connection through the Fologram platform, I am able to shift between devices to modify the model by using the mannequin (real life ports) as a guidance, to modify and fit the model on different parts of the mannequin.

Through the reviewing process of the ‘Viral Making’ project, I am thinking about not only using the videos as data to form the discussion of my developed theory but also to form it into a special form of practice outcome. I am confused at this stage on how this form of practice outcome can fit into my theory discussion and contribute to my thesis, as well as how to shape this practice outcome itself to contribute to the practice part of my PhD research. As a special form of practice outcome, this project leaves me a chance to shift my practice between different formats.

My original practice before my PhD journey is a pure craft based physical outcome and consider myself as an independent jeweller. But through the research process, I am now able to shift my practice from a pure independent jewellery designer and maker into a collaborative cross-disciplinary craft designer:

- The ‘Data - Music - Jewellery’ project allows me to shift my practice outcome form small scale jewellery pieces into large scale sculpture/installation piece, the working process of my practice is also able to shift from an independent design develop process involved with cross-disciplinary knowledge from myself into a collaborative design process involves cross-disciplinary knowledge form other professionals from other design field.

- On the other hand, the ‘Viral making’ project supported me with another change to shift my practice into a totally different format of practice outcome. The ‘Viral making’ project is focusing on the process of the project other than the outcome, it considers the process and workflow of the project as the outcome of the project, which offers a different form of practical outcome. The ‘Viral making’ project can be seen as a ‘Boundary mediums’ for my practice development journey which allows me to shift my practice between ‘artefact' and ‘non-artefact’ formats.

I am considered to take this project outcome into a exhibition format and there are a few potential exhibition plans has been thought can form different shape and presentation of this practice:

First, is to line up videos taken from different perspective to show it as a whole:

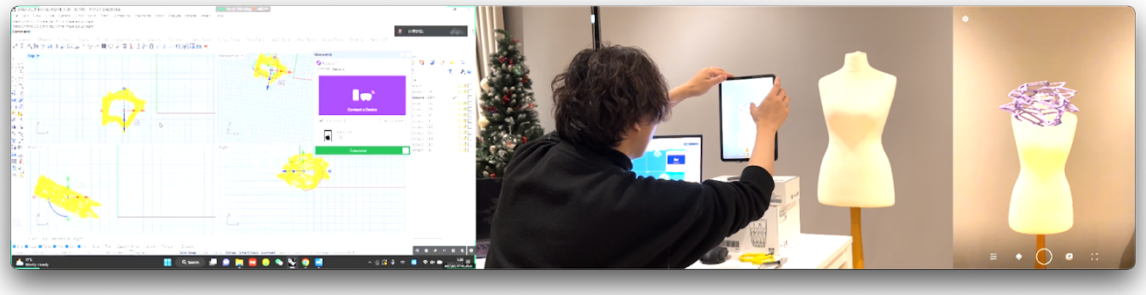


Figure 4: Line up version (long rectangle shape)

As shown in figure 4, this way might be more suitable for an online exhibition format than a real-life exhibition as the video is in a very long rectangle shape and might not be suitable for most of the monitors.

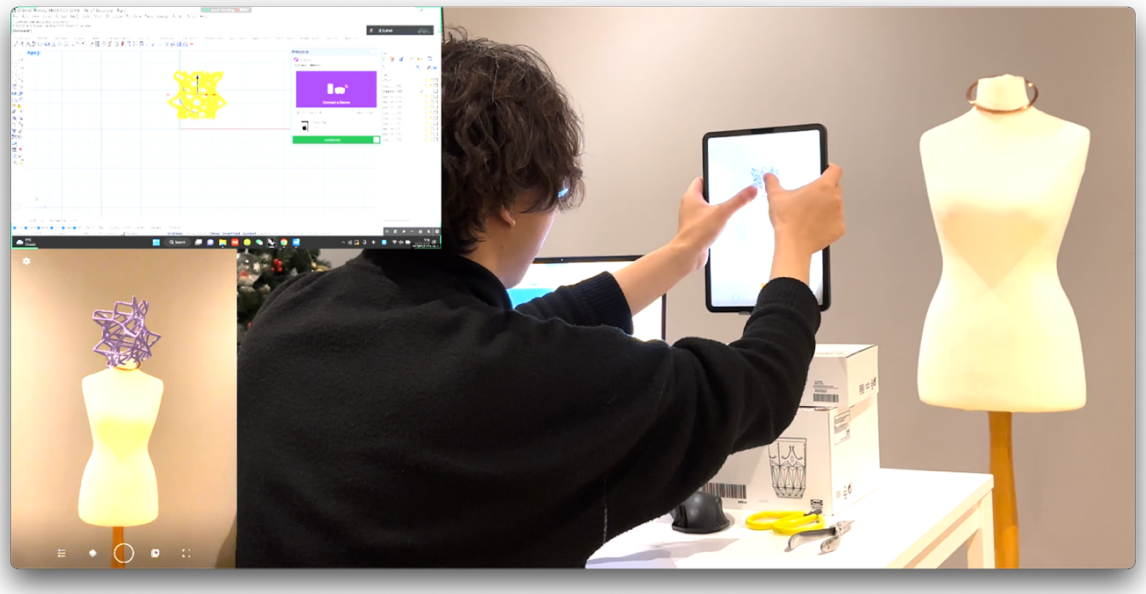


Figure 5: Line up version (16:9 shape)

As the limitation of the devices we will normally use, the video can also be shaped like figure 5 to present different perspective as a whole, the limitations of this way is it may makes the screen view and the iPad view a bit small which makes it bit hard for audience to see the detail (it can be show in a large scale monitor to solve the problem but not so sure about if the resolution of the video is enough for large scale.)

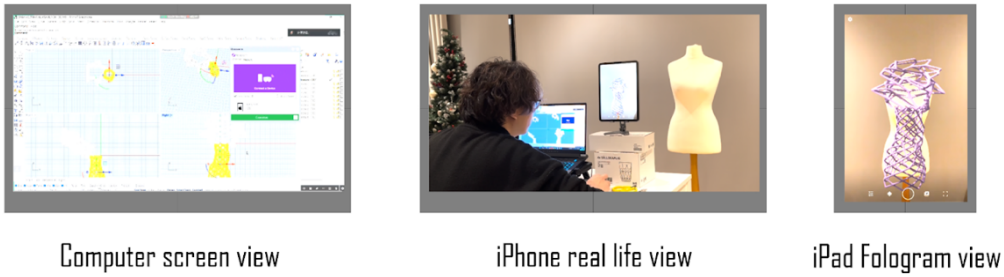


Figure 6: Line up version (On separate devices)

Another way of solving the problem is to play different perspective videos separately on multiple devices/monitors and line them up as figure 6. This will give audience a clearer sight but still weakness of this plan:

- First is this plan will request more monitors and request a larger space of the wall to put up several devices.
- Second is the multiple devices might make the audience a bit confused to figure out the links among the multiple devices and the videos. Whether to place the 3 devices together as a whole or to place them separately, this way of displaying the work still does not give enough information to the audience about what this work is (whether it is a ‘video’ or a ‘experience’ that invites interaction?) and how to engage with it.

But in this way, the practice still remained as kind of an ‘artefact’ format and also lacked the context of the project. It shaped the process and workflow of the project into a ‘video’ and considered the ‘video’ as an outcome of the project which is not what I want.

This practice is more interested in presenting the 'process' and ‘workflow' of the practice as a special form of outcome to the audience, through some form of interaction between the audience and the 'process' to experience the practice. Therefore, creating a sense of 'immersion' in the exhibition space may be one of the potential solutions to achieve the goal.

As figure 7 shows, to recreate the actual practice environment and play each of the videos on the devices that they have originally been taken to can be one of the potential ideas. This way of the exhibition will provide the audience a more immersive

experience of the work by putting them into the actual practice environment which contains more information of the narrative and context of the practice, this will also open to more possibilities for the audience to get their own experience in the environment by creating the atmospheres in the room.

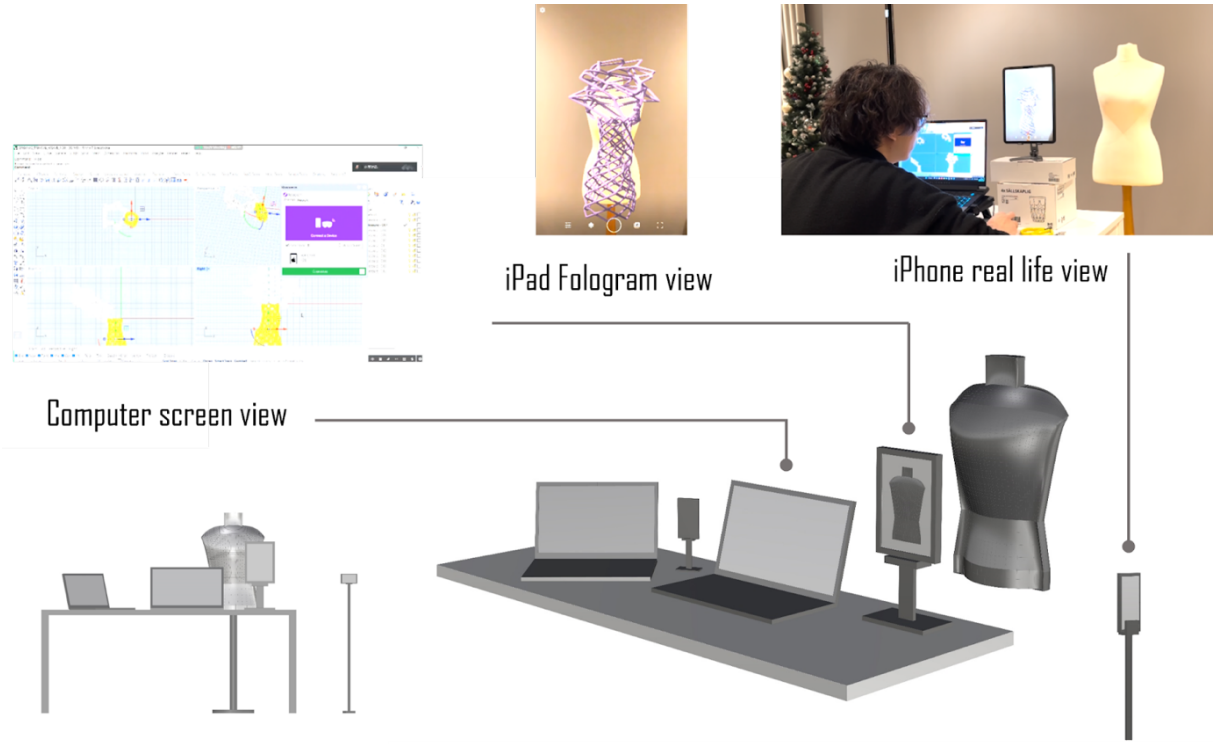


Figure 7: Recreating working environment with videos play on original screen

Of course, there are other ways to provide immersion in the exhibition, such as to project videos of different angles on different walls in the exhibition space. In this way, the visual sense of immersion will rise by eliminating most of the equipment and devices but will also remove the context of the practice environment, which in turn creates an obstacle to the viewer's interpretation of the work. I believe that the context is very important in this practice. A video that isolates the context of the practice, even if the immersion is increased, is not in line with the goal of the work - to share the 'process of practice' with the audience. From this point of view, the exhibition plan that eliminates the device would result in a lack of context, which is detrimental in the context of this practice.

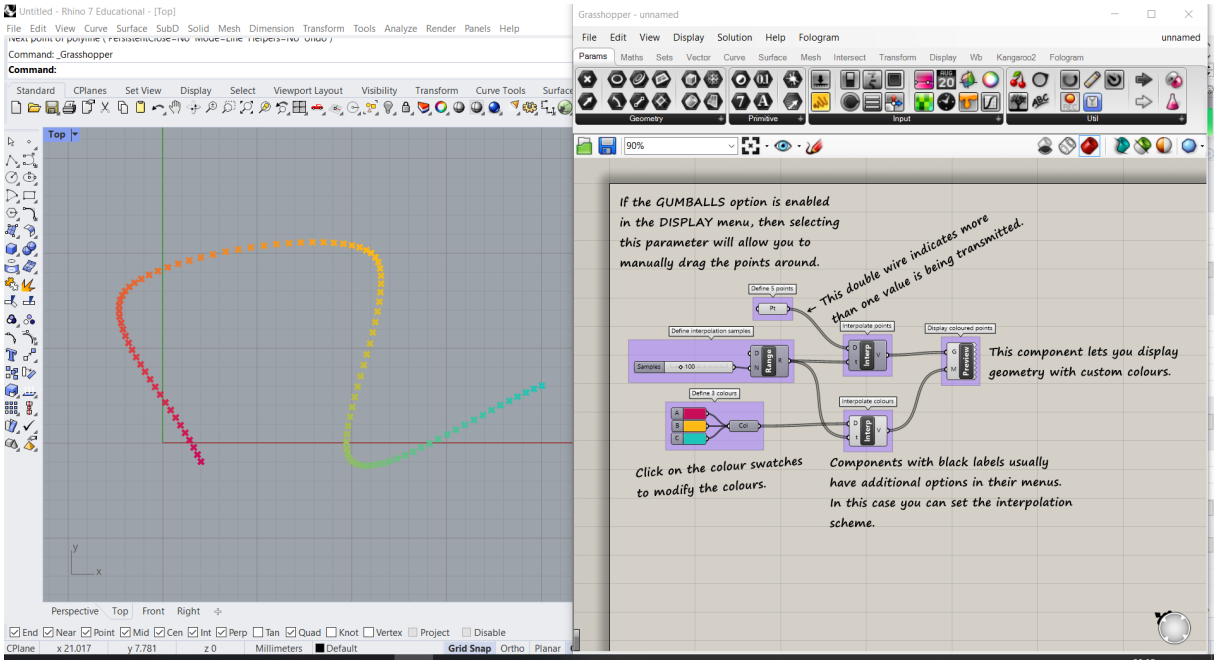
Overall, in these ways of showing the practice, they eliminate the limitation of the 'form', it's not limited and relies on the form of 'video' as a visual format to show the process.

However, recreating the working environment was considered a more appropriate idea. Recreating the working environment will not only provide the audience with a sense of 'immersion', but also provides more narrative and contextual information, which will giving more opportunities and potential for the audience to interact with the work, which is more in line with the goal - to present the 'process' as a form of outcome and to interact with the audience. Furthermore, by recreating the working environment with actual working process video play on the original screen, it provides an ‘experience’ other than an ‘visual’ which I will consider as a different format of practice outcome.

Appendix 6: Viral Making – Example of Reflection Journal from David

Whilst meeting platforms, like Zoom, Microsoft Teams, and Skype offer the opportunity to cross borders and boundaries with ease, practical research, including demonstrations, material engagement, and skills assessment are in flux. How can makers, fabricators, and material researchers preserve, harness, and enhance tangible engagement in this new screen-centric era? In the context of the digital age, the relationship between modelling jewellery and architecture is much closer than it seems. The practitioners on both sides use the same software, materials, and fabrication processes. Digital platform, provide a unique opportunity for craft researchers across both disciplines to share their tacit knowledge. In the Viral Making project, me and Jo, standing in our own fields, although one used to work in intricate detail, the other with structures, but Rhino - the digital modelling platform that both of us are used to, created a common language between us to allowed communicate.

Although we are using the same digital modelling software, we use the software in different ways due to different professional focuses. I'm more accustomed to using Rhino's established tools to create 3D models in the form of visualized form and shapes. But Jo often uses Grasshopper - a plug-in attached to Rhino, to manipulate tools in the way of parametric modelling to build digital models. In order to get better understanding and collaborating with each other, I have been learning Grasshopper's parameterized modelling mode by myself recently. In the process of learning, I start to feel the different ways of expression in different fields of the same knowledge and skills translated by different languages.

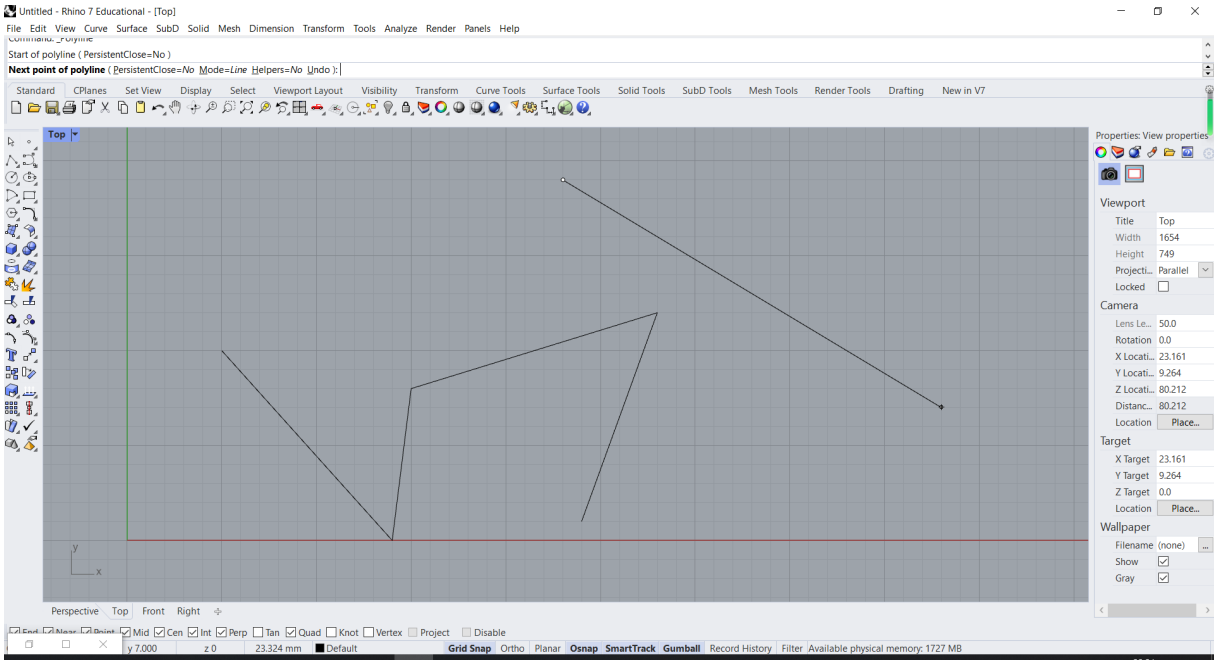


Grasshopper in Rhino

Grasshopper® is a graphical algorithm editor tightly integrated with Rhino's 3D modelling tools for designers who are exploring new shapes using generative algorithms. Grasshopper requires no knowledge of programming or scripting, but still allows designers to build form generators from the simple to the awe-inspiring. Grasshopper is a visual programming language and environment that runs within the Rhinoceros 3D application. Programs are created by dragging components onto a canvas. The outputs to these components are then connected to the inputs of subsequent components. Grasshopper is primarily used to build

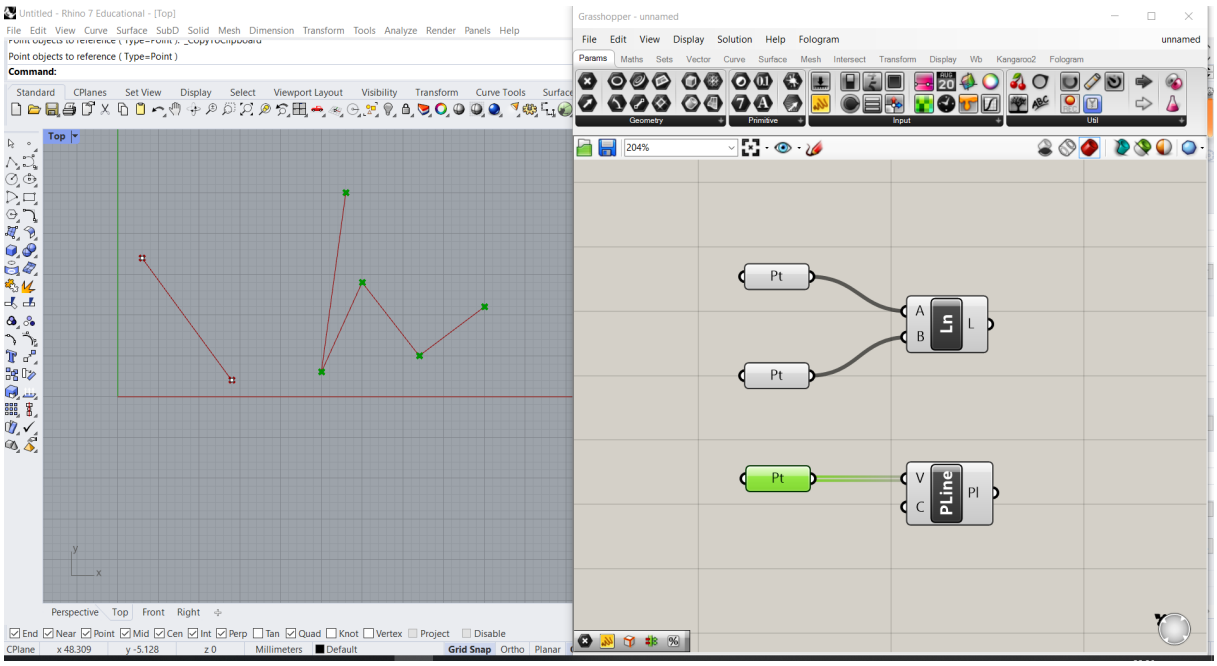
generative algorithms, such as for generative art. Many of Grasshopper's components create 3D geometry. Programs may also contain other types of algorithms including numeric, textual, audio-visual and haptic applications. (Wikipedia)

Below I will show the difference between Rhino and Grasshopper modelling with a few simple examples:



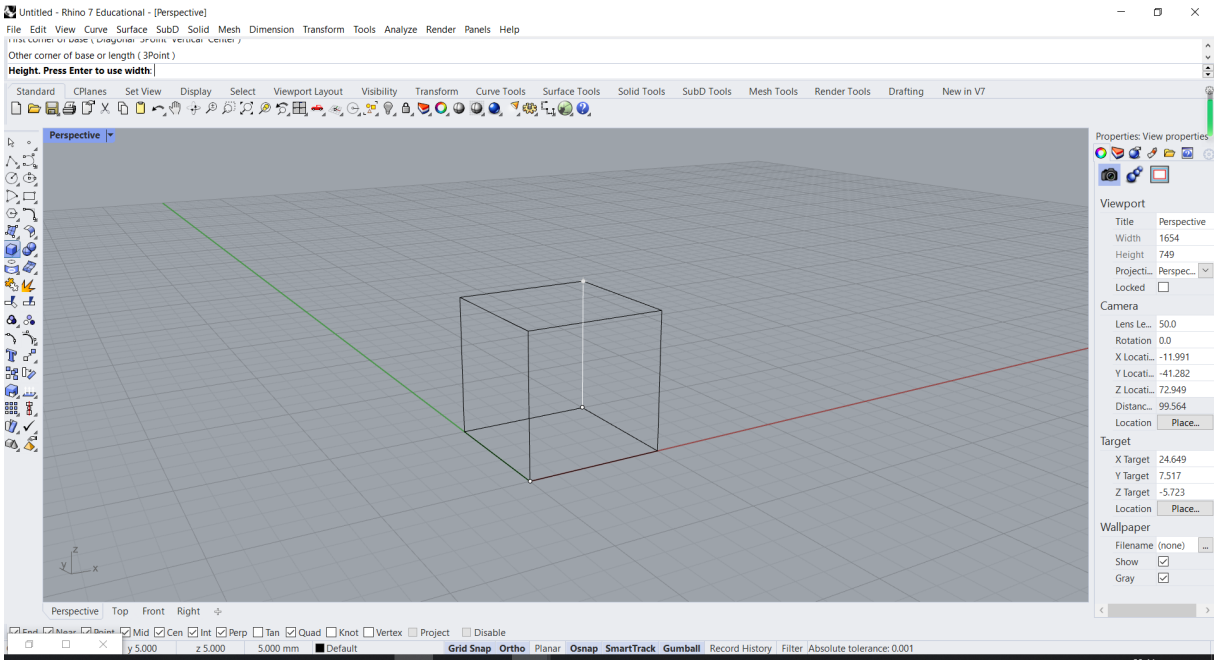
Creating line in Rhino by established ‘Polyline’ tool

First of all, take the simplest example - create a line, in Rhino if we want to create a line, I need to select the ‘Polyline’ tool, then we generate a line by directly clicking in the canvas to select the two endpoints of the line or select multiple endpoints to create polylines.



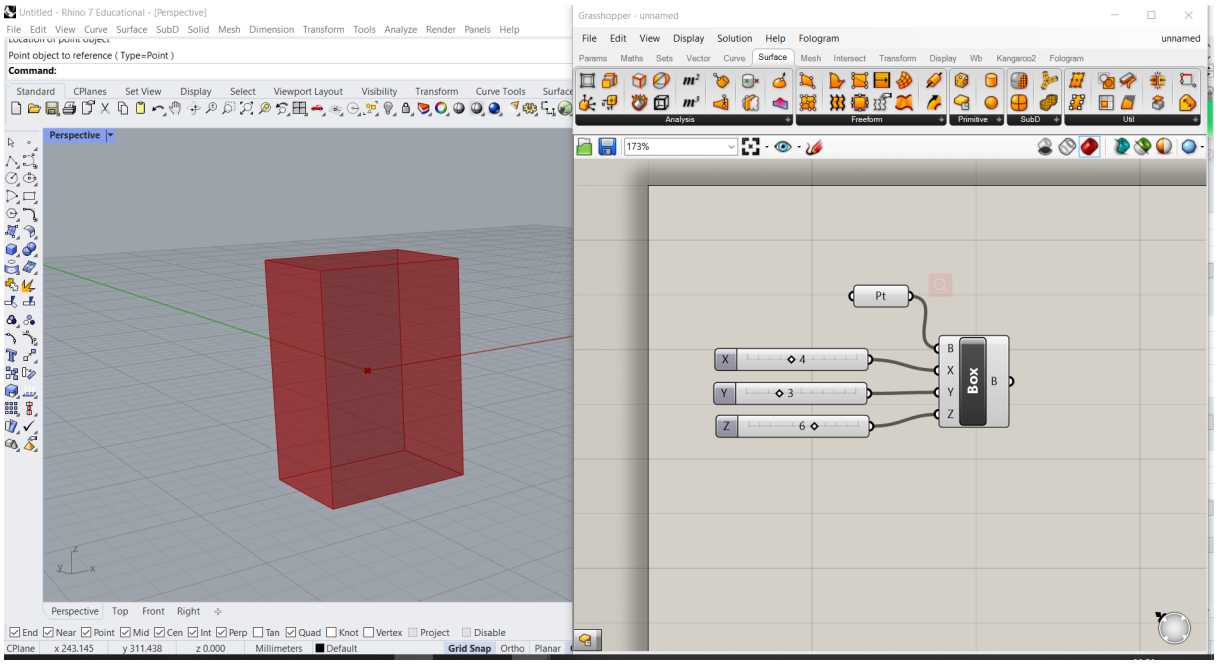
Creating line in Rhino through Grasshopper

But in order to establish a line through Grasshopper, we need to first define two points through the "Point" component, and then connect these two points by the ‘Line’ component to establish a line. Of course, we can also use the 'Point' component to define multiple points, and then use the 'Polyline' component to connect these points in order to create a polyline.



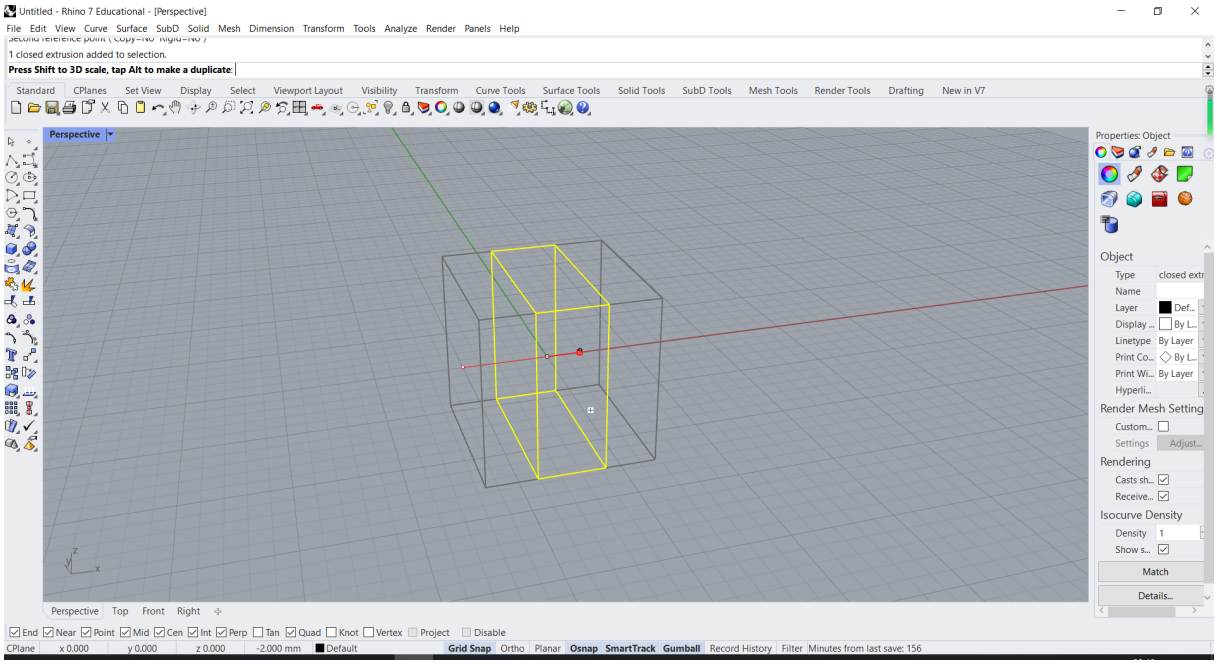
Creating a box in Rhino by established ‘Box’ tool

Next, let's take the example of building a solid shape, if we want to create a Box in Rhino, we need to select the 'Box' tool, click on the centre point (or corner point) on the canvas, and then drag the mouse directly to the length, width and height we want to create a Box.



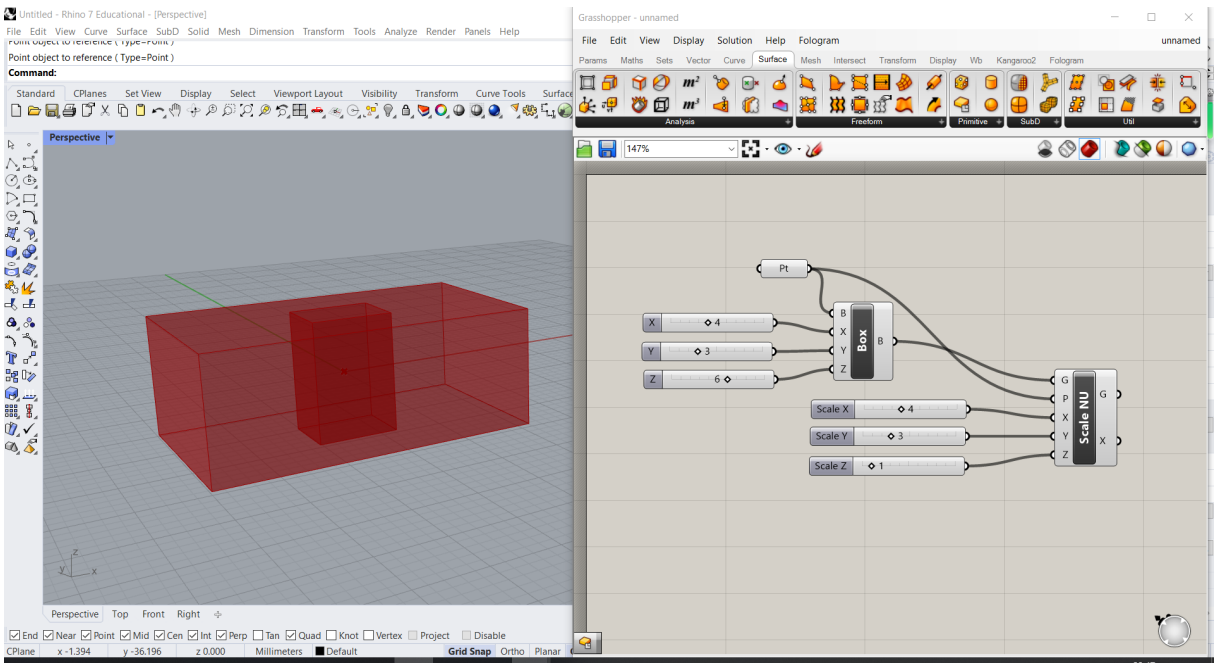
Creating a box in Rhino through Grasshopper

In Grasshopper, we first need to drag the 'Box' component onto the canvas, then connect the centre point defined by the 'Point' component to the ‘Base’ point on the 'Box' component. After that, we need to establish three number slider component and connect them to the X, Y, and Z Point on the 'Box' component, by setting the value of the slider component to define the length, width and height of the box to create a box.



Scale models in Rhino by dragging ‘Gumball’ (coordinate axis)

In addition to establish models, the transform of the model is also crucial functions in the modelling process, the use of the transform function through Rhino tool and Grasshopper is also different. Take the 'Scale' function as an example. In Rhino, we can scale the model in all directions directly by dragging the coordinate axis.



Scale models in Rhino through Grasshopper

In Grasshopper, we need to use the ‘Scale’ component. First of all, we need to drag the ‘Scale’ component onto the canvas, then we need to connect the model we want to scale (take the box we crate in the last example as example) to the ‘Geometry’ point on the ‘Scale’ component, after that we connect the axis for scale defined by the component such as ‘Point’ or ‘Line’, etc. to the ‘Plane’ point, finally we establish three number slider component and connect them to the X, Y, and Z Point on the ‘Scale’ component, by setting the value of the slider component to define the extent of morphological change along the xyz axis.

Through the examples above, it is not difficult to see that Rhino tools and Grasshopper are using different language to describe the same thing or function. Specifically speaking, Rhino establish the model through intuitive graphics and images but Grasshopper establish the model through the 'text' setting to tell the software models we need, and then manipulate the computer to generate the model automatically. In other words, for example, to create a line, Rhino uses ‘pen and paper’ to draw a line directly on the canvas, whereas Grasshopper tells ‘pen and paper’ that we need to create a line between point (x, y) and point (x1, y1). While Rhino tools are using established tools directly, Grasshopper is more like to building tools from scratch and then using them. Grasshopper is the 'foundation' of Rhino tools, and Rhino tools is more like the intuitive visual expression of the Grasshopper programming language.

Such a different way to use the same software and a different language for the same model or function seems very interesting to me. To some extent, this reflects the difference in the way that the same knowledge is presented in different fields. The same software, knowledge and skills have produced different expressions and applications in the field of jewellery design and the field of architectural design.

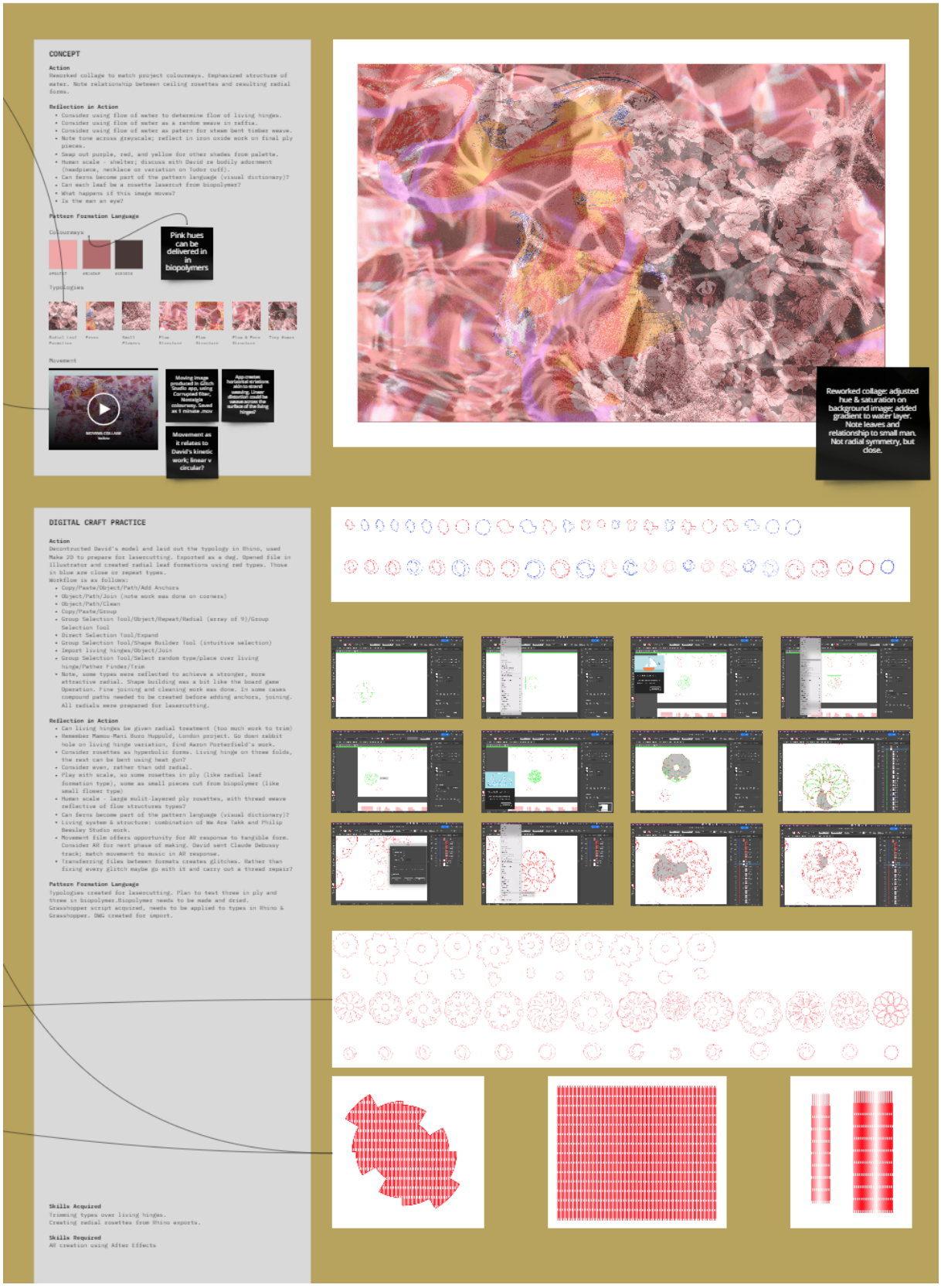
Jewellery designers are more likely to have direct contact with shapes and materials in their field, and they are better at intuitive shape shaping in their working way. Therefore, Rhino tools are more like digital versions of their hand tools, which can directly shape the shapes of the model. The use of Rhino tools is more closer to the work they are skilled in.

On the other hand, shapes and aesthetics are not the only aspects of an architect's skill set, the space and the structure of the architectures ask for not only aesthetics but parameters, mathematics, data, etc. is also as important to them. Therefore, Grasshopper provides them with the opportunity to access data and graphics at the same time, which is closer to the way they work in their field of expertise.

Due to the differences in the focus and working mode of the professional field, knowledge and skills are differentiated when entering the two fields, presented in a form that is closer to the professional field and easier to be used by the professionals.

In addition, the diverse expression of the same knowledge and skills in different fields not only provides convenience for professionals in different fields, but also provides a platform and basis for knowledge exchanges and collaboration between different professions. If the expression of knowledge and skills is unique, then it will only be used by a specific field of expertise to achieve a relatively single function. The diversified expression of knowledge and skills in different fields enables it to be applied in many different fields for realizing different functions, the utilization rate of knowledge and skills is greatly increased. At the same time, people working in different fields based on the same knowledge and skills can build connections on this basis. The diverse expression of knowledge and skills in different fields opens the way for them to have a better understanding of each other's work and expertise.

Appendix 7: Viral Making – Example of Row Data
(Model exchange 2 journals from Jo, Miro Board)



Because Jo chooses to use Miro board as the format to record her process and reflection, so I take screen shot of the Miro board page but it seems too small to see properly, so I will also provide pictures and texts of the screen shots as follow:

Action

Decontructed David's model and laid out the typology in Rhino, used Make 2D to prepare for lasercutting. Exported as a dwg. Opened file in Illustrator and created radial leaf formations using red types. Those in blue are close or repeat types.

Workflow is as follows:

- Copy/Paste/Object/Path/Add Anchors
- Object/Path/Join (note work was done on corners)
- Object/Path/Clean
- Copy/Paste/Group
- Group Selection Tool/Object/Repeat/Radial (array of 9)/Group Selection Tool
- Direct Selection Tool/Expand
- Group Selection Tool/Shape Builder Tool (intuitive selection)
- Import living hinges/Object/Join
- Group Selection Tool/Select random type/place over living hinge/Pather Finder/Trim
- Note, some types were reflected to achieve a stronger, more attractive radial. Shape building was a bit like the board game Operation. Fine joining and cleaning work was done. In some cases compound paths needed to be created before adding anchors, joining. All radials were prepared for lasercutting.

Reflection in Action

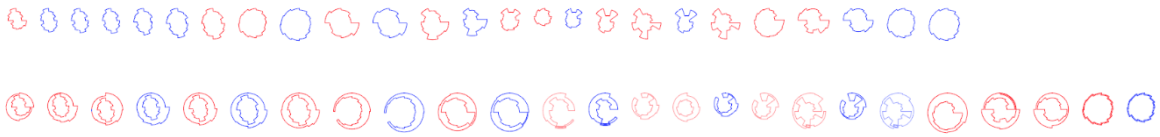
- Can living hinges be given radial treatment (too much work to trim)
- Remember Mamou-Mani Buro Huppold, London project. Go down rabbit hole on living hinge variation, find Aaron Porterfield's work.
- Consider rosettes as hyperbolic forms. Living hinge on three folds, the rest can be bent using heat gun?
- Consider even, rather than odd radial.

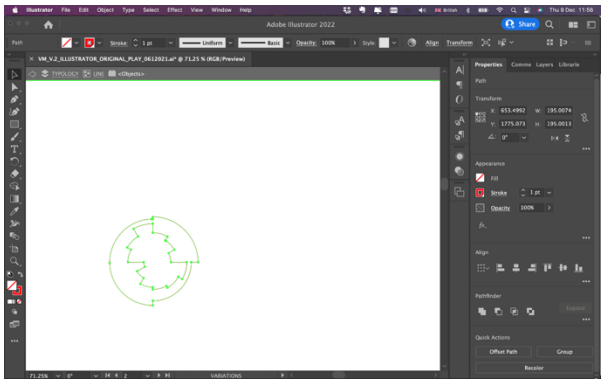
- Play with scale, so some rosettes in ply (like radial leaf formation type), some as small pieces cut from biopolymer (like small flower type)
- Human scale - large mulit-layered ply rosettes, with thread weave reflective of flow structures types?
- Can ferns become part of the pattern language (visual dictionary)?
- Living system & structure: combination of We Are Takk and Philip Beesley Studio work.
- Movement film offers opportunity for AR response to tangible form. Consider AR for next phase of making. David sent Claude Debussy track; match movement to music in AR response.
- Transferring files between formats creates glitches. Rather than fixing every glitch maybe go with it and carry out a thread repair?

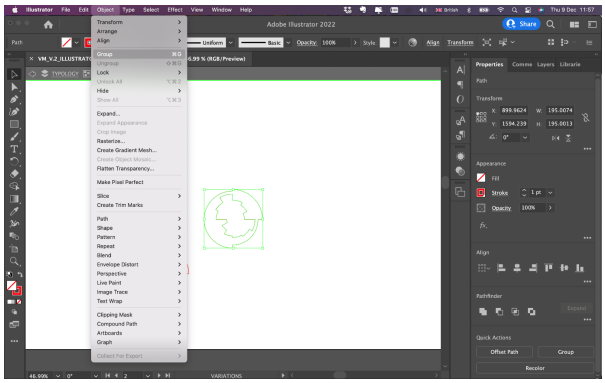
Pattern Formation Language

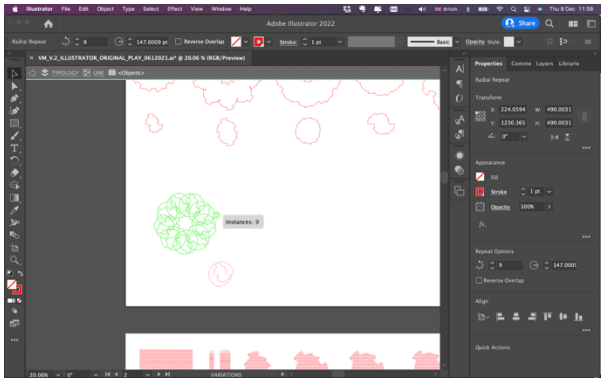
Typologies created for lasercutting. Plan to test three in ply and three in biopolymer.Biopolymer needs to be made and dried.

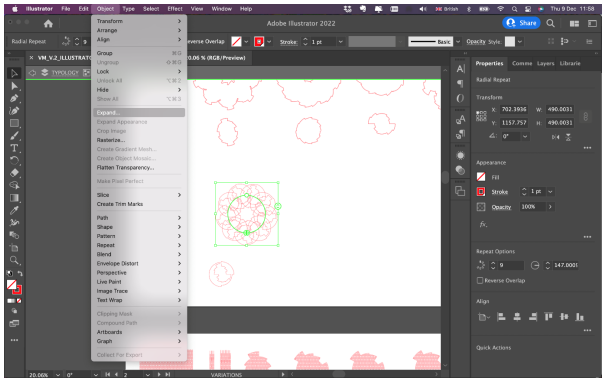
Grasshopper script acquired, needs to be applied to types in Rhino & Grasshopper. DWG created for import.

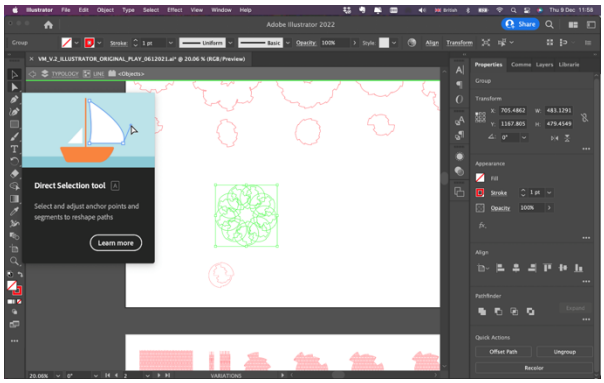


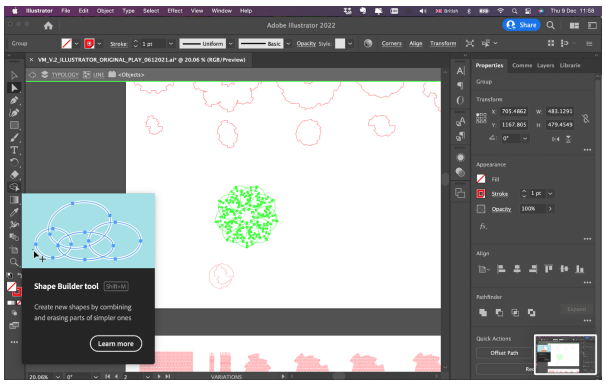


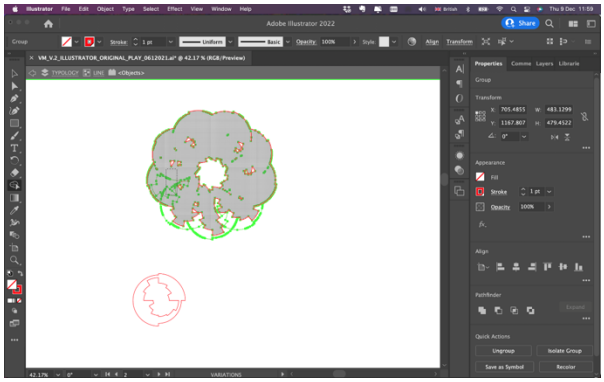


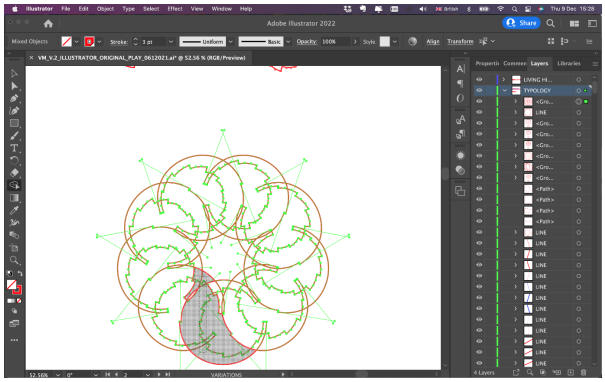


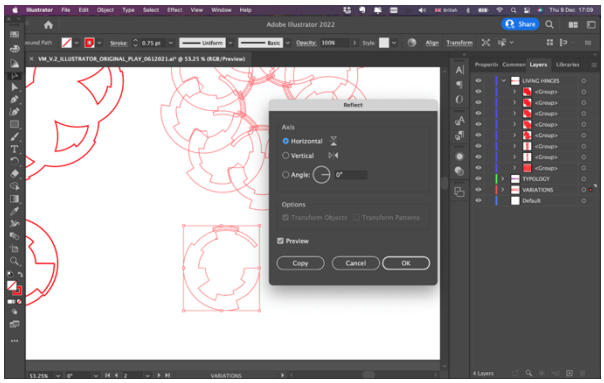


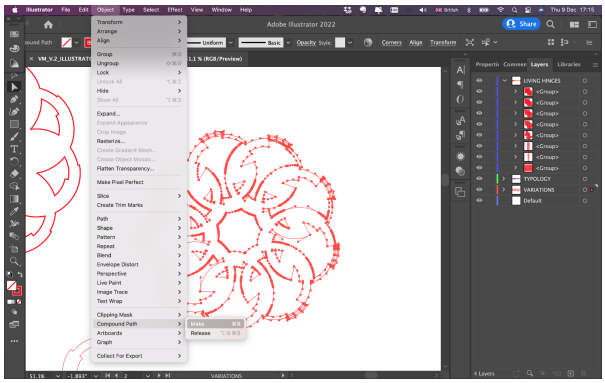

Direct Selection tool
Select and adjust anchor points and segments to reshape paths
Learn more

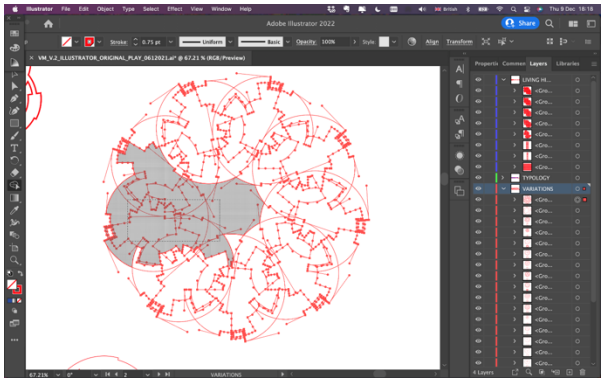

Shape Builder tool
Create new shapes by combining and erasing parts of simpler ones
Learn more

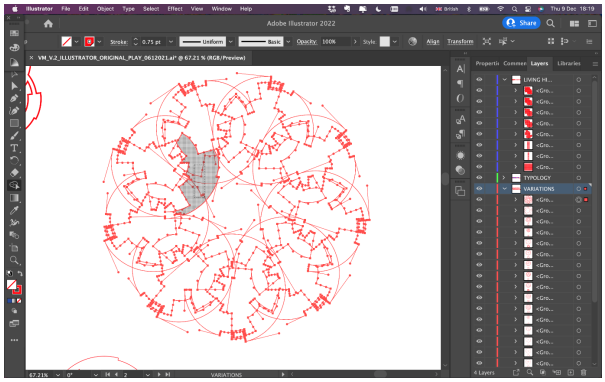


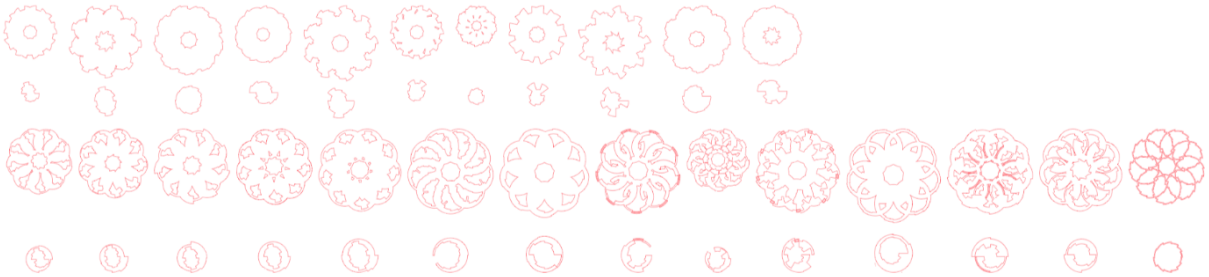


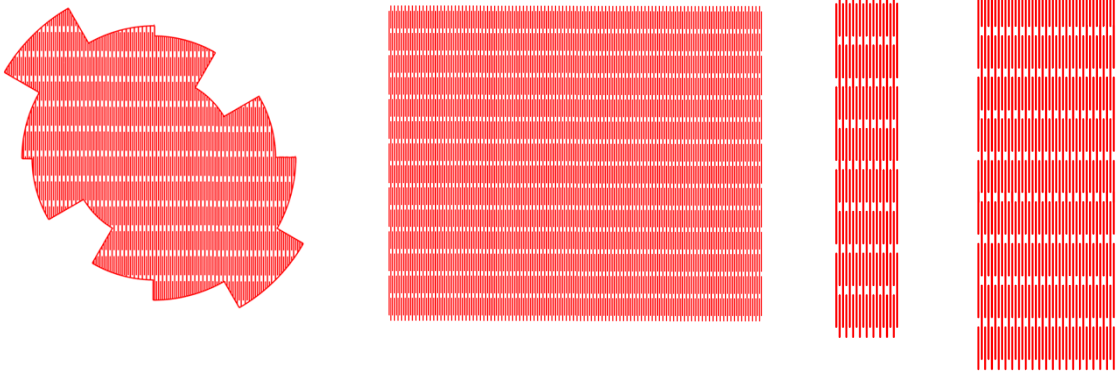

Reflect
Axis
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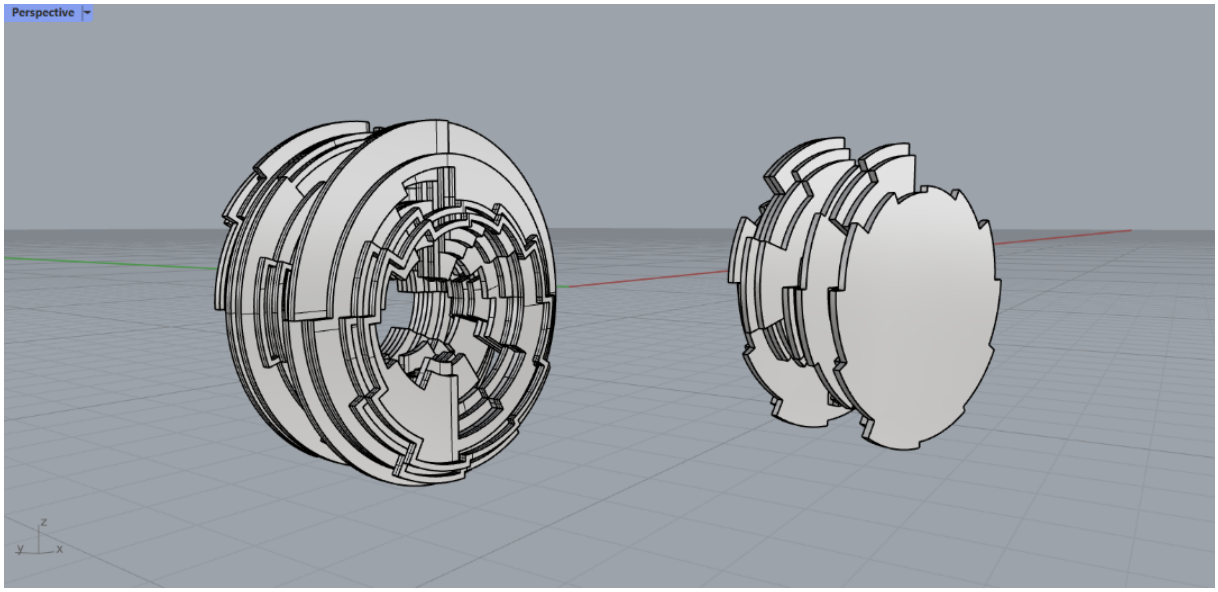


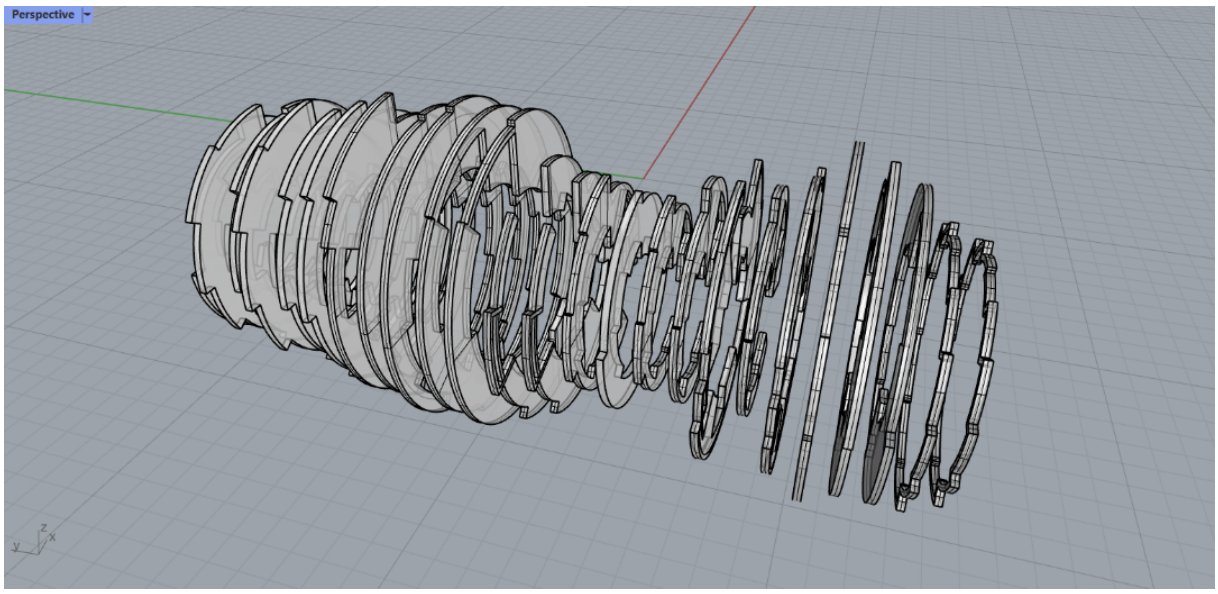




Appendix 8: Viral Making – Example of Row Data
(Model exchange 2 reflection journal from David)

As shown in Figure 1 is the original model I have been shared with Jo in this model exchanging circle. The Model is actually from my other musical collaboration project with Rebecca. Rebecca have been approved me to share models between projects. To using the model from the other projects can not only getting a anther perspective from another field to enrich the perspective for the specific project but can also creating connections between the two project by building contrast between the two projects.





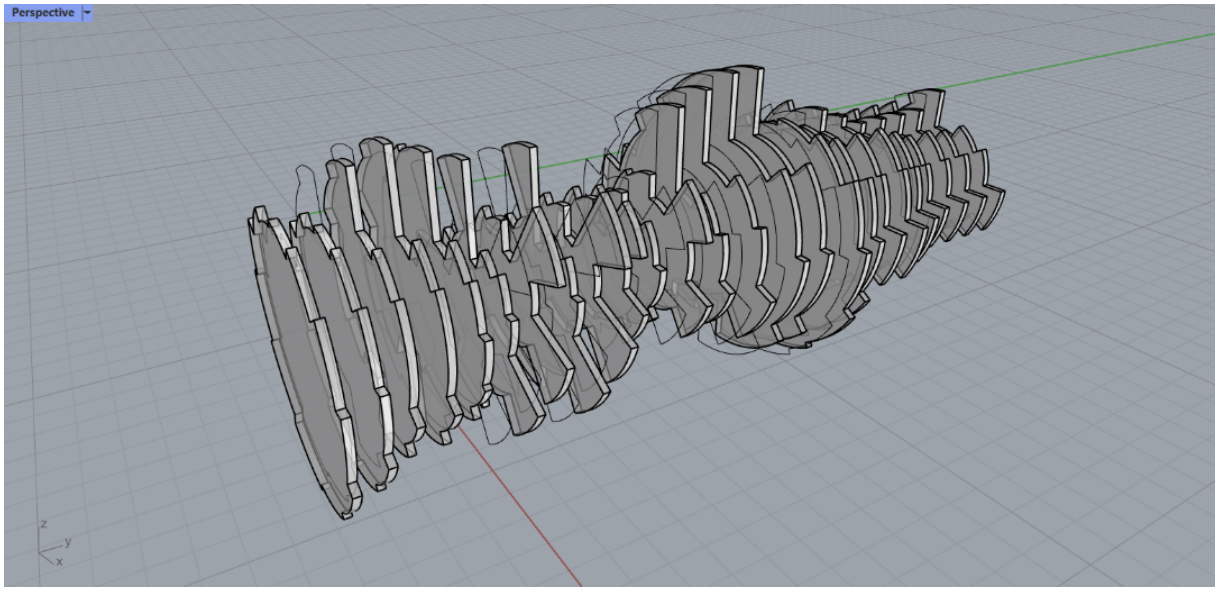


Figure 1 – Original Model shared form David
(Coming from the other collaboration project ‘Data - Music - Jewellery’)

As shown in Figure 2 is the first step of Jo’s process - to separate my model by layers in to pieces and pieces and I can see that she see all the layers of the model as flat patterns but not 3D-mdoels like my original models which is very interesting and creating another perspective for looking at the model.

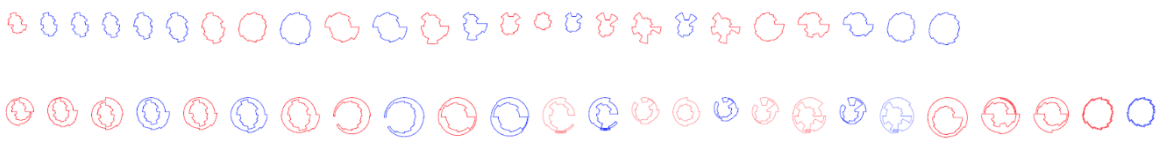


Figure 2 – First step of Jo’s Process

As shown in Figure 3 & 4, after deconstructing the model by layers into patterns, Jo start to creating new patterns from them by repeating the pattern, then to rotate or overlap them to form them into a more complicated pattern.

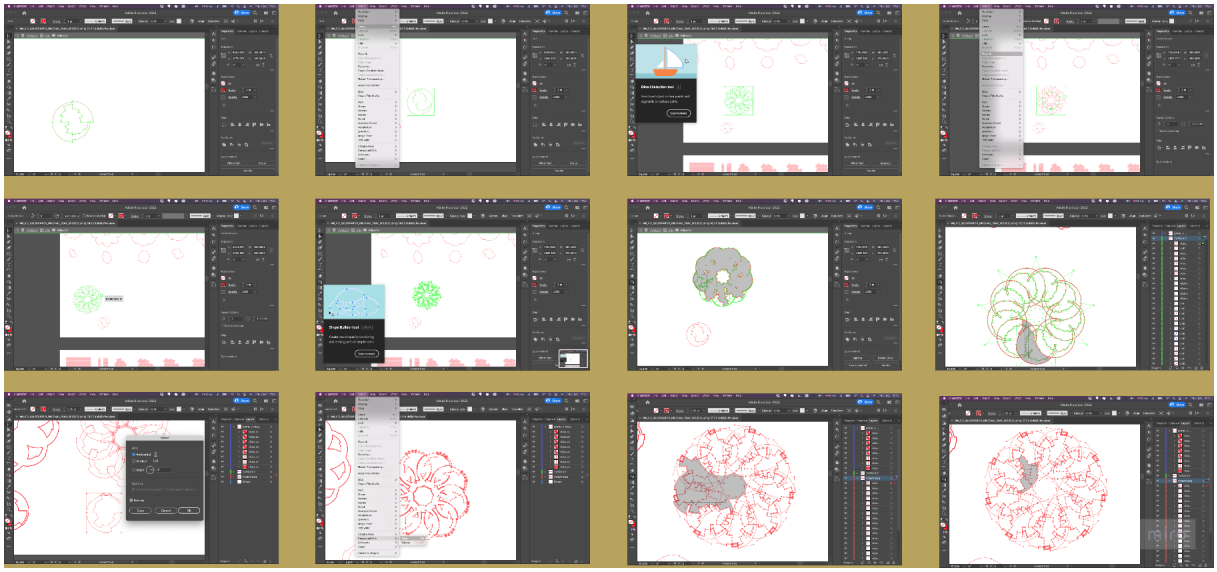


Figure 3 – Deconstruct and reconstruct to create new pattern

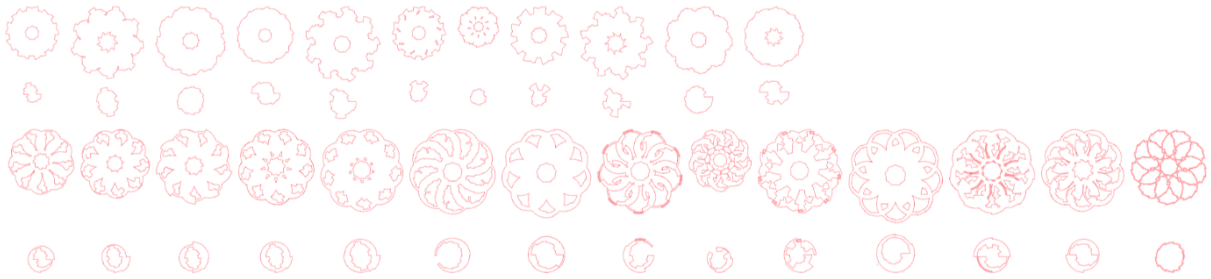


Figure 4 – New pattern that have been created by Jo

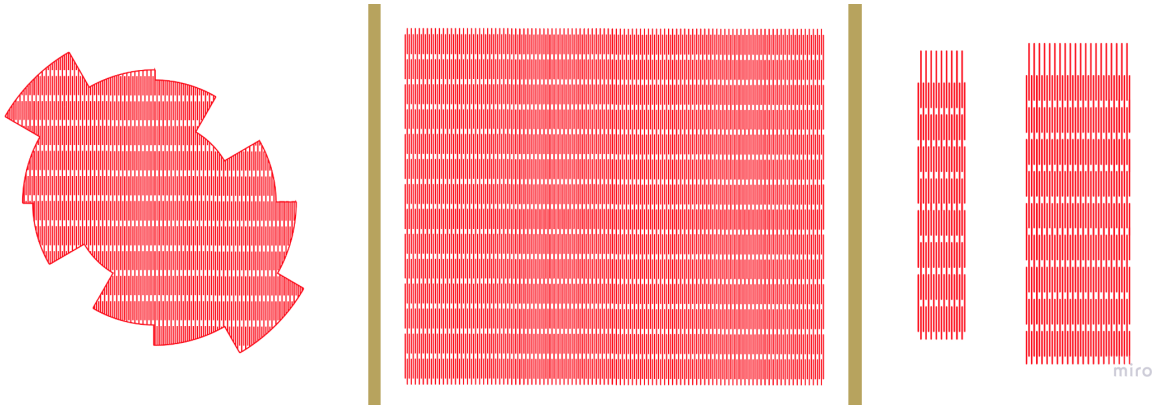


Figure 5 – Living hinges design applied on patterns

This is an interesting perspective of using the model for me, the model I create is transformed form a piece of music into single flat pattern and then transformed into 3D shapes and then layered them up. Jo just sees them back to flat patterns straight away and use them as single design unites then do designs based on that. This actually

gives me a new perspective to see my designs – I can try to see them back to patterns and making new designs on that or it can be a different way of layer them up.

Then from figure 5 we can see that Jo applied her architecture design of the living hinges on my model pattern. After seeing this pattern, I go do some research on the living hinge, which shows on Figure 6.



Figure 6.1 – Living Hinges from Jo's previous project



Figure 6.2 – Living Hinges (Available at: https://www.ponoko.com/blog/how-to-make/how-to-design-a-living-hinge)

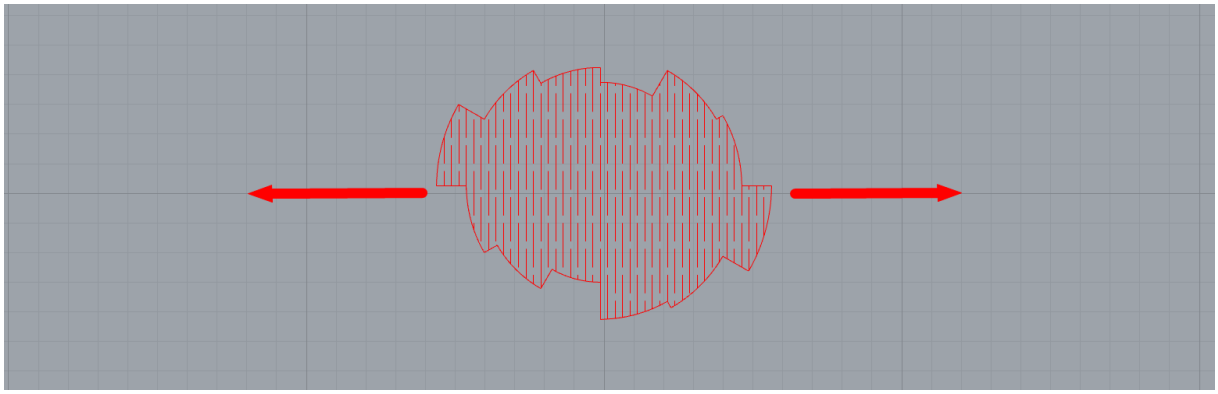


Figure 7 – Materials will be only extends horizontally as Jo's Design

The living hinges design will give the patten a flexibility when it applied to a real material. Hard materials like wood or acrylic can have a flexibility to move bend or stretch. But as the design Jo applied to my model, the design will only allowed the piece to stretch one direction – to extends horizontally as shows in Figure 7.

This makes me think about if it is possible to change the design of the living hinges and apply to my original design pattern which allows it to change shapes from different directions? I think this can be the design I will try for our next model exchanging circle.

Appendix 9: Viral Making – Example of Row Data (Model exchange 3 process journal from David)

As I have said in the reflection journal of our last model exchanging circle, I take the idea of the living hinges and I will try to do some design based on living hinges idea and my original model. As shows in Figure 1&2, I first import my original model pattern into Rhino, then to create the living hinges that Jo have been used the to apply it to my pattern.

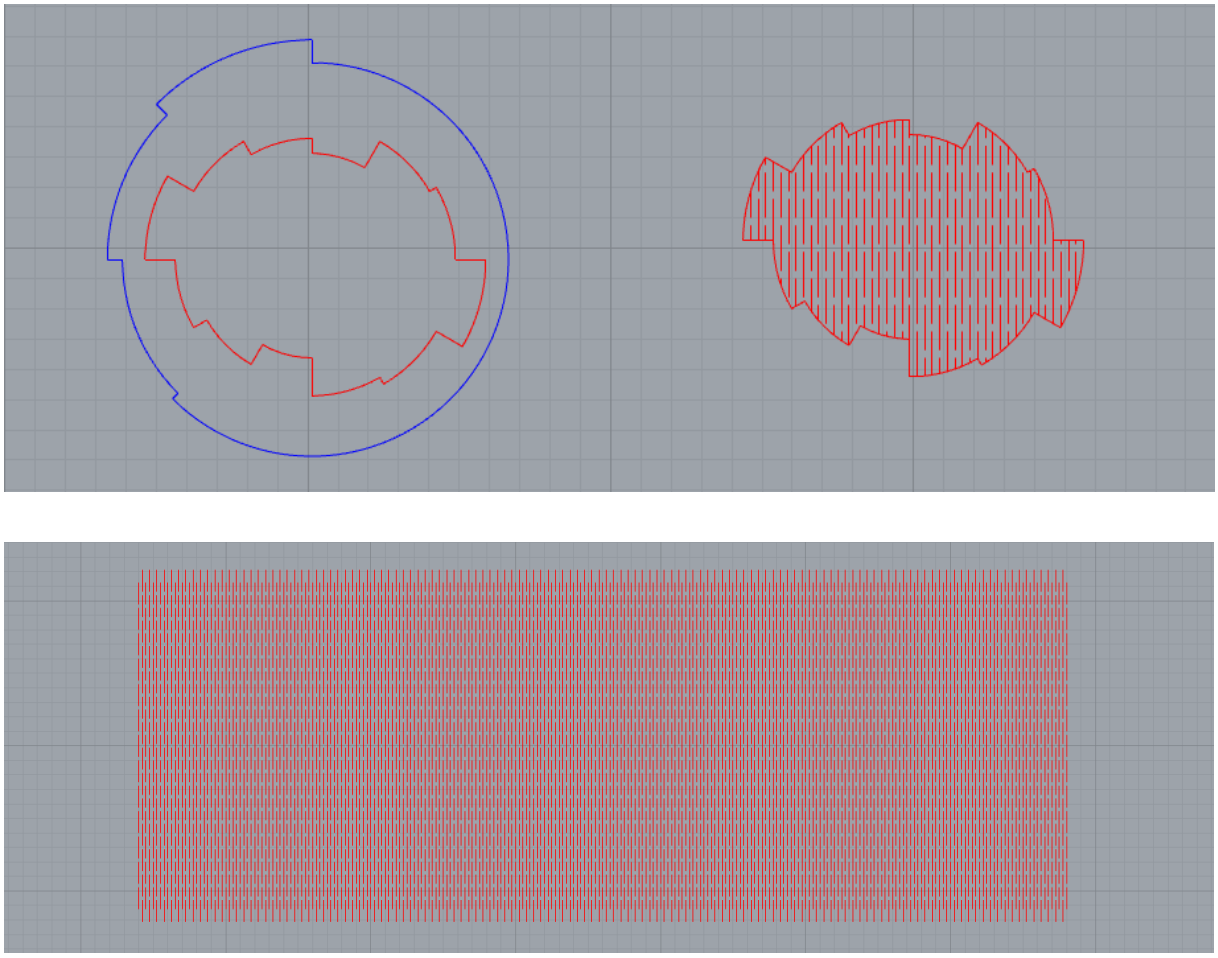


Figure 1&2 – Create living hinges pattern in Rhino and apply it to my original model

As shoes in Figure 3, we can see the pattern that Jo have been create can only allowed the material to stretch one direction, also it can only move horizontally. So I am trying to figure out a way of making it move in more direction and more 3-demational.

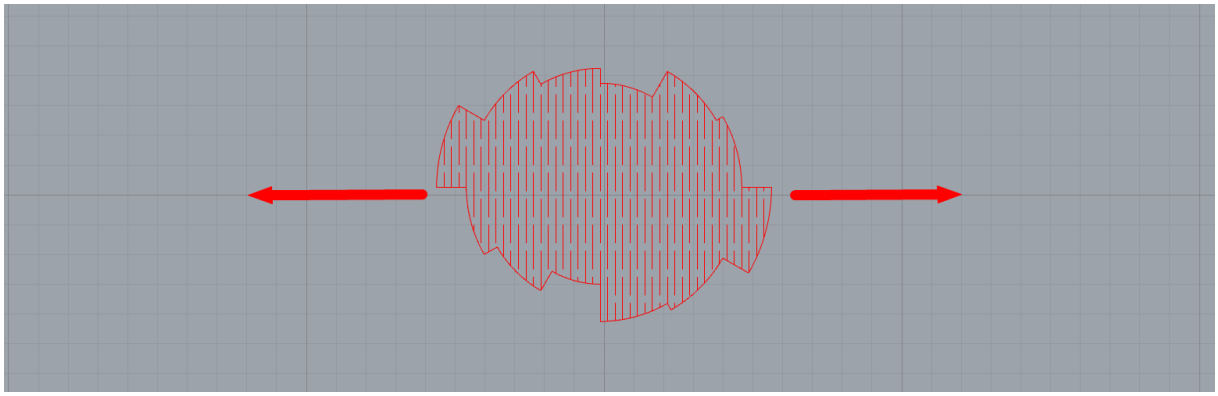


Figure 3 – Materials will be only extending horizontally as Jo's Design

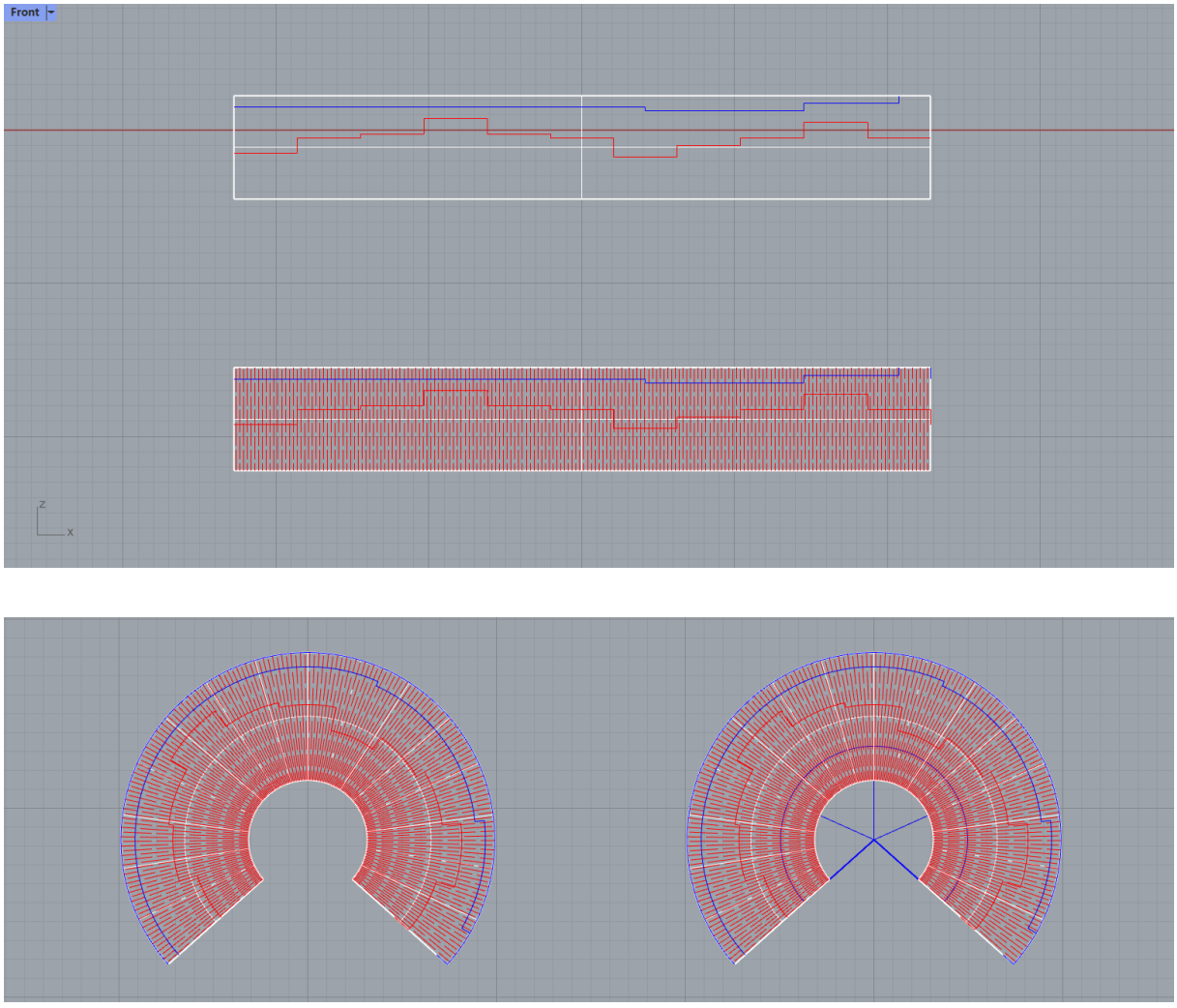


Figure 4 & 5 – Bending the whole pattern with living hinges

As shows in figures, I start to think by making some paper models, I try to use these paper models to understand how the living hinges works and how I can make the original pattern more 3D. Because paper is a more soft and easy bend material so I

can use it at the first point to getting understand on the shapes. Then try to combine the shape and the living hinges together to see how I can apply the pattern on harder materials to get some result by using living hinges.

As shows in figure 4&5, I start to try to apply the result I made by paper models into digital format so I can share it with Jo online. I am using the same logic and ways to redesign the original pattern to make it form round shape into straight shapes. Then to apply the living hinges patten on the straight pattern. Then to bend the whole thing to get the living hinges into different direction by flow the whole thing along a pre-created sector surface.

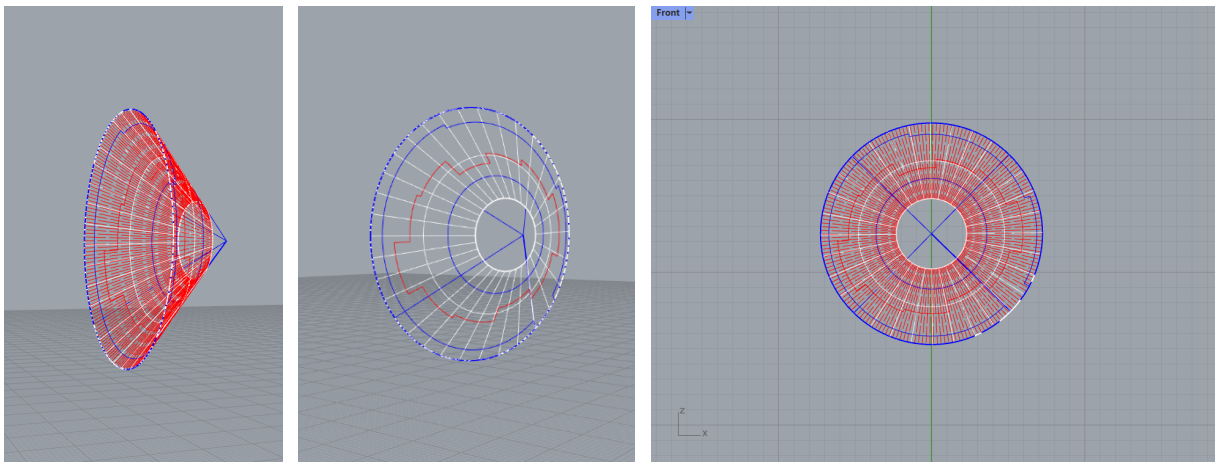


Figure 6,7,8 – The process of making the digital model

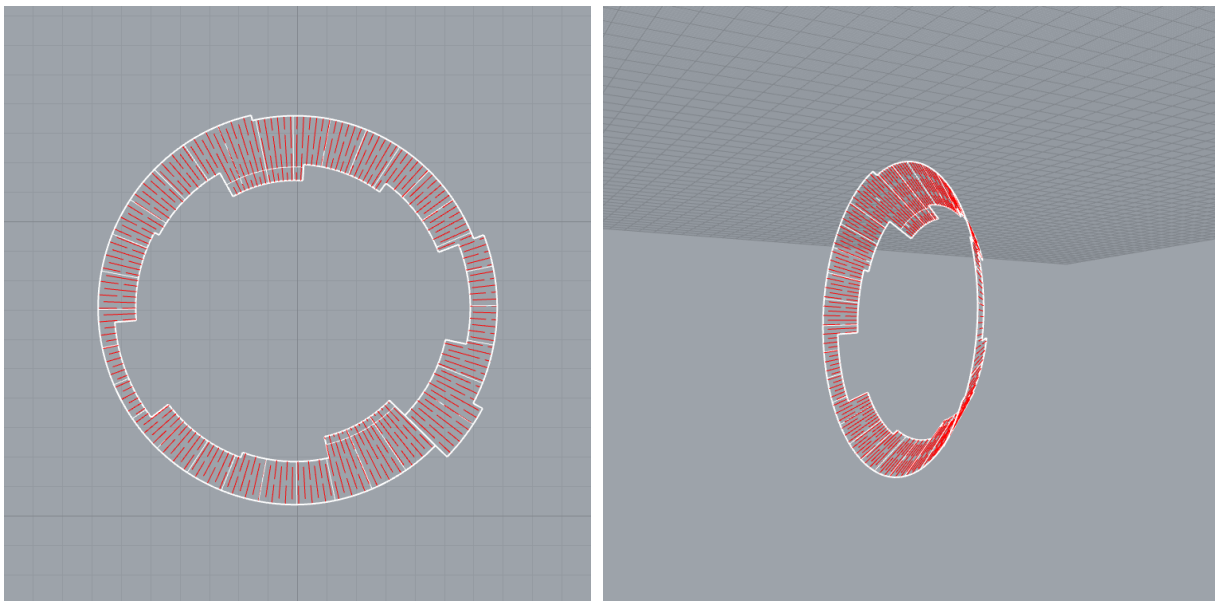


Figure 9 & 10 – The final model

As Figure 6,7 & 8 shows is the process of making the digital model after the paper model. The reason I make this specific sector surface is because I need this sector as a transfer media to flow the pattern on the circular cone shape. The circular cone shape will give the pattern a 3D shape like the paper model I made. Then to trim the cone shape by the pattern line it will become the final model which shows on in figure 9 & 10.

Appendix 10: *Data–Music-Jewellery* – Initial Project Brief

Participating Artists	
Dong Ding Contemporary Jewellery PhD in Design Edinburgh college of art The University of Edinburgh, UK	Rebecca Ruige Xu Computer Art and Animation Professor College of Visual & Performing Art Syracuse University, USA

Project Description

***Key Words**:*

Data, Data visualisation, Sonification, Music, Jewellery, 3D Form, Performance, Video, Cross-Disciplinary, Collaboration.

Introduction:

In today's art and design fields, cross-disciplinary collaboration is becoming more and more common, many artists begin to draw on or use knowledge and skills which are outside their field of study in their creative process.

Within this context, this project will invite artists from different art and design areas, to creating art pieces based on the same design element, in this project a specific piece of music by Claude Debussy: 'Arabesque No. 1', https://youtu.be/Yh36PaE-Pf0).

This project will produce different forms of art pieces and also try to explore the transformation and application of cross-disciplinary knowledge and skill sets within different fields; in tandem throughout various stages of the project such as independent creation, collaborative co- creation, reflection and feedback to each other and recreation and evaluation.

The research project aims:

- To invite artists from different design fields to create art pieces based on the same design element. A range of different creative possibilities and

applications of the same design elements by artists from different fields will be created.
- To explore the transformation and application of cross-disciplinary knowledge and skills across different fields.
- To record and analyse the communication and creation process of artists from different professional fields during the collaboration process and to discuss the process of cross-disciplinary presentation of knowledge and skills.

The research project objectives:

- Working within the framework of cross-disciplinary research, the research will explore the intersections between the field of jewellery and other disciplines.
- Collaborating with other professionals, to create different working models.
- Studying the ways of collaboration between jewellers and other professionals during the process.
- Bringing cross-disciplinary knowledge and skills through the process of creating jewellery, to explore the effects of cross-disciplinary knowledge and skills on the research process and results in jewellery production.

Project Description:

This project will be divided into three main stages:

In the first stage, based on the same piece of music (Debussy: Arabesque No. 1, https://youtu.be/Yh36PaE-Pf0), David and Rebecca will stand in their own professional perspectives respectively and independently transform this music into art pieces through data visualization technology and hand craft making skills. This stage will present two independent works.

Rebecca will start from the perspective of visual field, music will be analysed through programming and used as the base to create visual elements of a visual music project.

David will start from the perspective of field of craft, and will transform music into digital 3D physical forms (jewellery or sculptural pieces) through hand craft and digital making skills, and the output will not only limited to the final physical product, but also the video documentation of the making process as a performance, as well as the sound of the making will become parts of the final outcome, this will also provide material basis for feedback and collaboration in the next 2 stages.

In Stage 2, David and Rebecca will also choose a section of the music to create a collaborative piece(s) together.

In Stage 3, David and Rebecca will feedback on each other's works and make a second creation based on that. Or work with a composer to feed the artwork(s) into a new piece of music.

Project Outcome:

The three stages of the project will all have different outcomes:

Stage 1:

- A video of visual music - Rebecca
- A physical jewellery/ sculpture art piece - David
- A video art performance of jewellery/sculpture making - David

Stage 2:

- A collaborative art outcome (can be any format) – Rebecca & David

Stage 3:

- New creation of pieces after feedback - Rebecca & David
- A data sound project - David & Composer

Significance to the field:

The follow-up analysis and research process of the subject is expected to extend and fill a gap of knowledge within the cross-disciplinary field of craft. Also, the project will aim to understand the process and steps of the cross-disciplinary research approach, especially the research based on jewellery field, which will provide role models and guidance for other professionals in the field.

Appendix 11: *Data – Music - Jewellery* – Example of Row Data (Process Journal 1 form David)
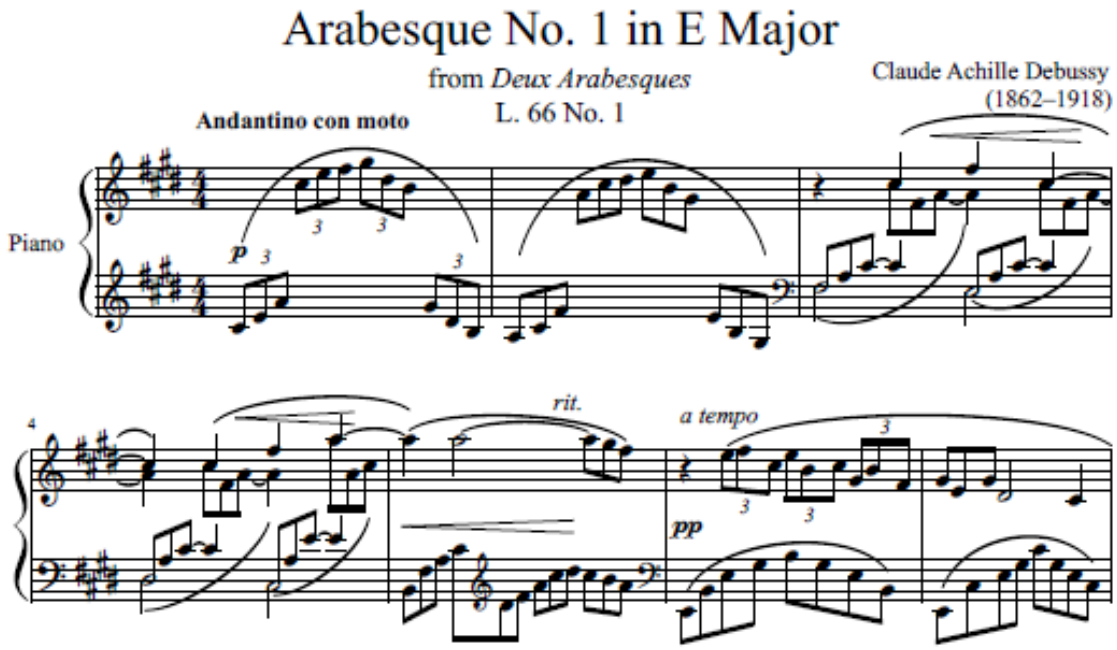


Figure 1: Music Score of Arabesque No.1

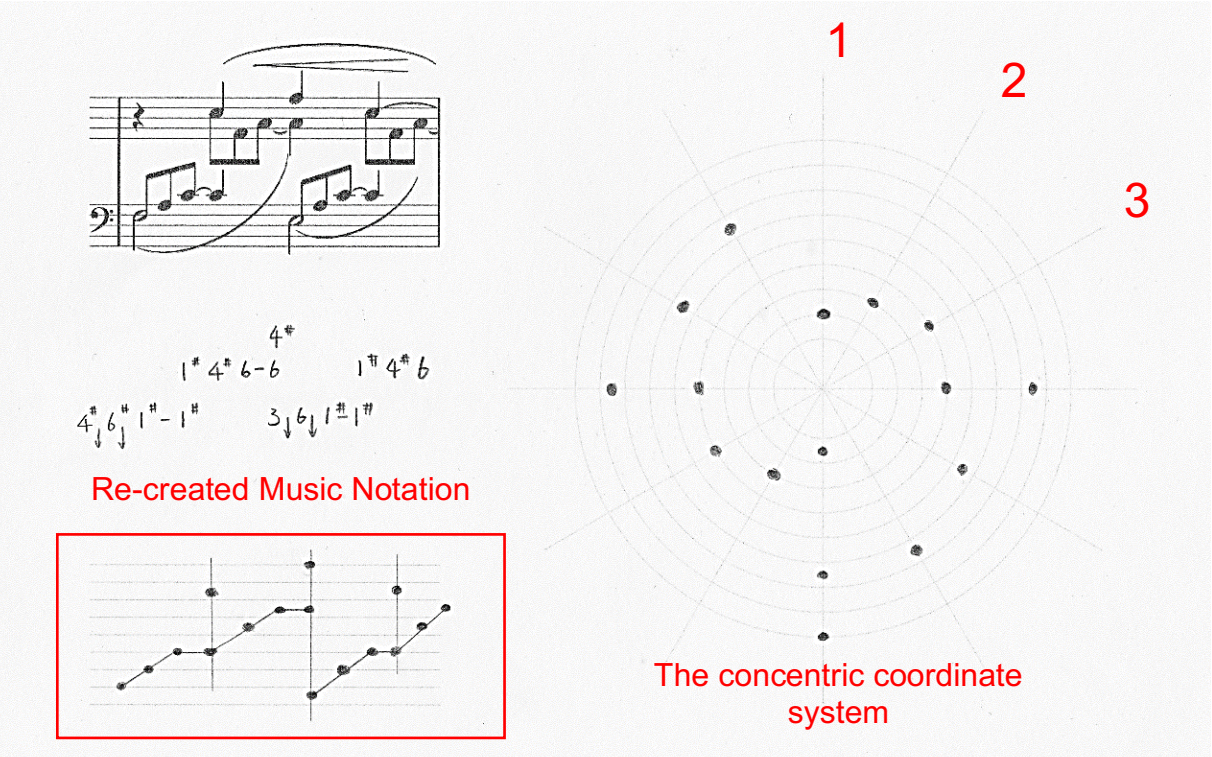


Figure 2: Design Sketch of Measure 3

At the first place, I start to do some 2D design by using the music score. I divided the score by single measures. From the first few measures, first and second measures looks similar and a bit simple, so I choose the third measure to do some test.

As we can see from the sketch, I first transfer the notes into numbers so I can read it more easily and put them in the same order even same layers. Then I try to get rid of non-used lines and keep the notes only. So, I re-draw the music notation, put left- and right-hand notes together. I put C4 note on line 4 so I can use that as coordinate to put other notes. Then I put all note into the re-created notation. After that I created a concentric coordinate system based on the re-created notation and put all noted into the concentric coordinate system on order to see what will happened. After marked the notes in the concentric coordinate system I get the result I shows on the left side of figure 2.

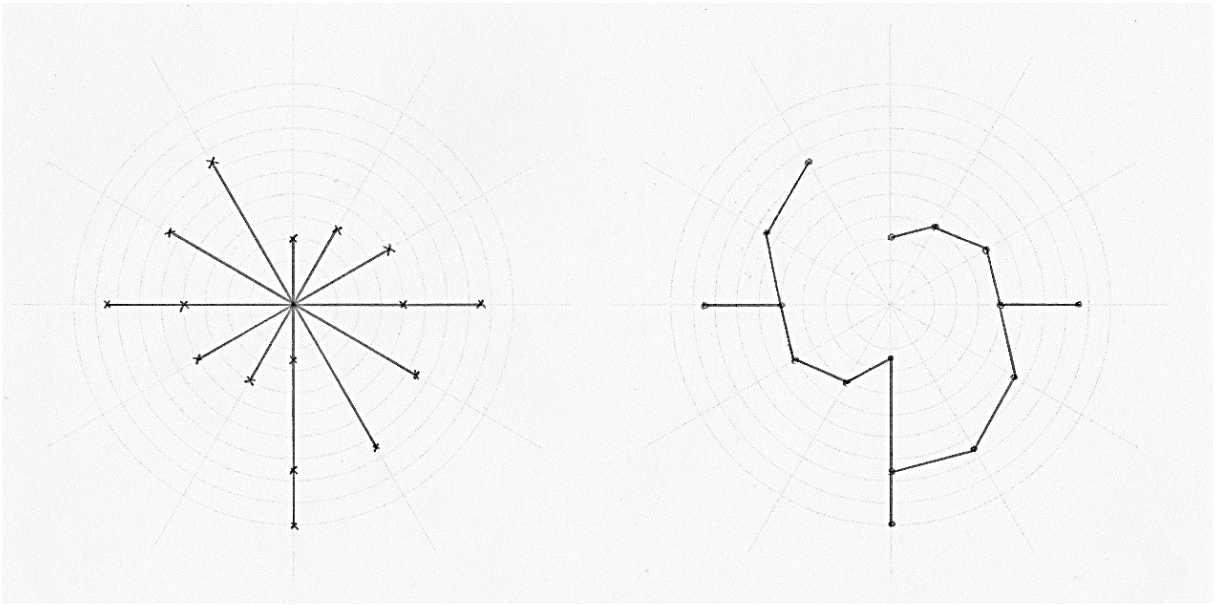
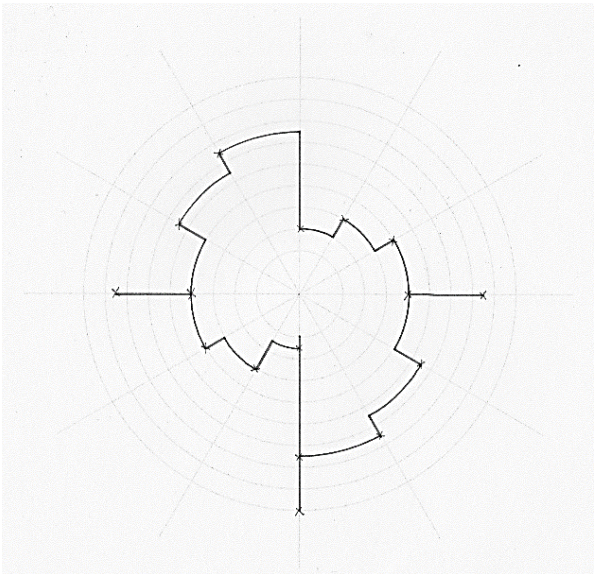


Figure 3: Notes connection in the concentric coordinate system

I try to connect all the notes together in different ways by lines and that's the result shows in figure 3. The result shows interesting radial and continuous line shapes.



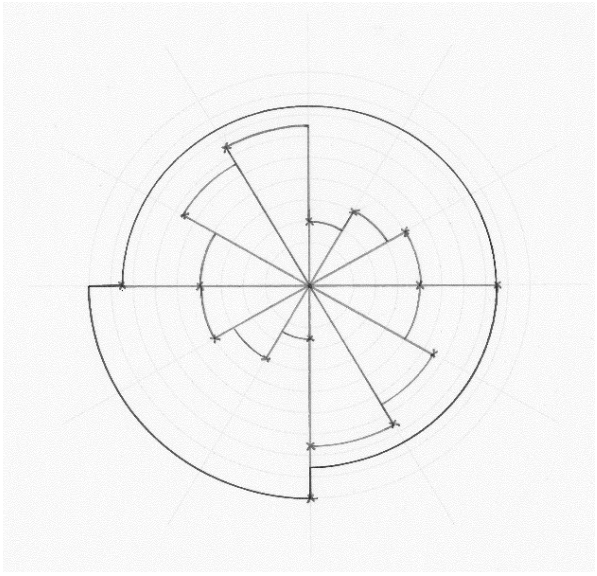


Figure 4 (Left) & Figure 5 (Right): Inside space and Outside Space

Then I try to connected the notes more geometrically and find out it start to crate interesting spaces which shows in figure 4. I also suddenly see the shape show an interesting symmetry that can not realize from the original music score.

There are also a few notes are outside the space it created. So I try to connected them together and find it crate a bigger space outside. The contrast between the inside space and outside space is very attractive to me so I decided to use this way to transfer more measures into 2D deign shapes.

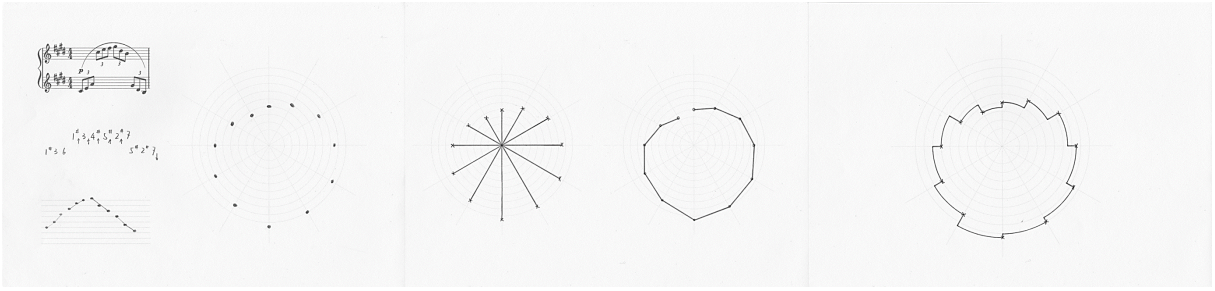


Figure 6: Sketches of Measure 1

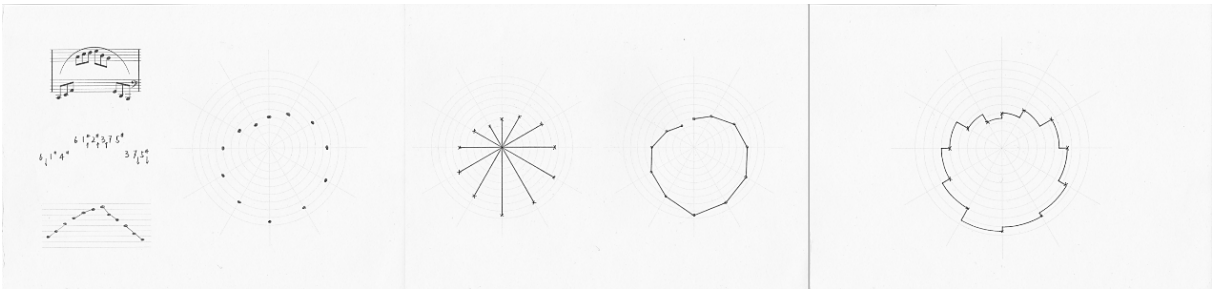


Figure 7: Sketches of Measure 2

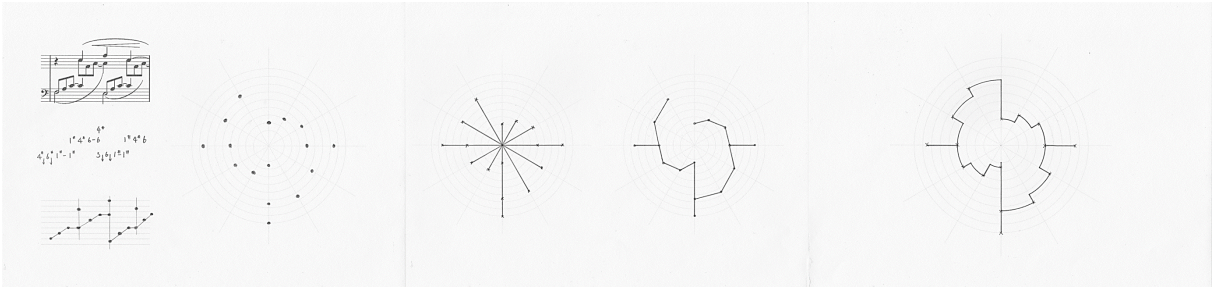


Figure 8: Sketches of Measure 3

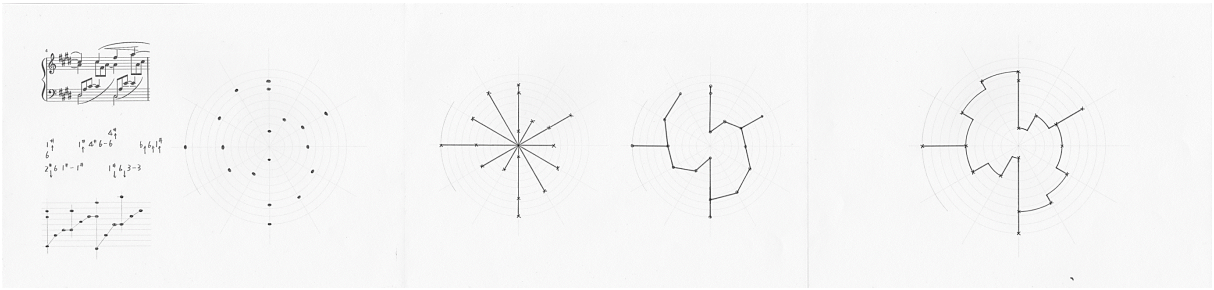


Figure 9: Sketches of Measure 4

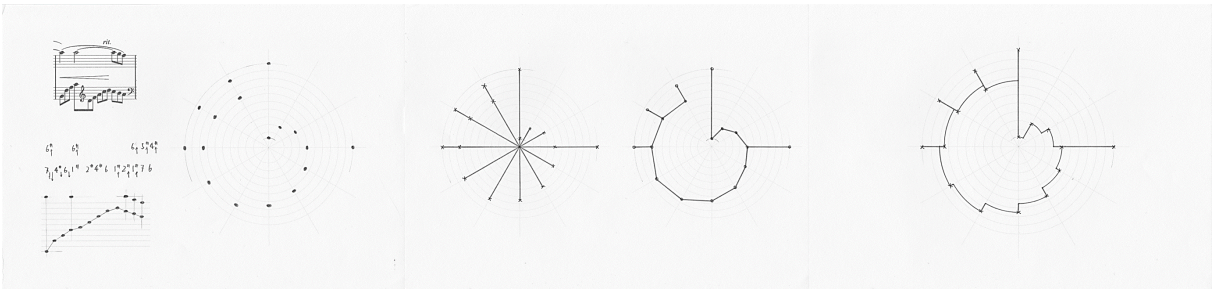


Figure 10: Sketches of Measure 5

Appendix 12: *Data – Music - Jewellery* – Example of Row Data (Meeting Transcription – 2021.06.09)

Rebecca 00:00:00

All right。go ahead。

David 00:00:01

然后学校的话大概是 4 月底左右的时候解封的，然后虽然说学校 campus 是开了，但是工作室我前两天去了，我们的 technician 没在，我们 technician 是去做陪审团了，所以我还是没干得了活。

Rebecca 00:00:25

对可以开始做了就还好，你的那个 deadline 是什么时候？就是说接下去的课题。

David 00:00:32

今年其实就是因为完全都打乱了计划了嘛，所以说也没有什么准确的 deadline 了，从现在开始做的话，我今年反正 annual review，我也不可能说提交完整的东西了，对吧？

如果今年是 7 月底提交，我反正就做到哪就给点啥，你有啥给点啥，然后我再 report 里面会说疫情影响了，我确实没办法对吧我觉得基本上大半年啥也没干。

Rebecca 00:00:59

是这个是这样子的，然后就慢慢来。 Ok 你 vaccine 都打了是吧？

David 00:01:13

还没呢

Rebecca 00:01:15

啊？你还没有打 vaccine。

David 00:01:17

对，因为我们 18 岁到 30 岁的这一批是我是 6 月头大概是上周才开放的预约。

然后我提我提交了就是说想要打，然后到可能要到 6 月底或者 7 月头才能打得上。

Rebecca 00:01:36

Ok，每个国家的它的政策它是不一样的。

David 00:01:41

对，他是从老年人开始打，他先打 80 岁，然后 70 岁，然后打这种老年人的护工，然后再是 60 岁、50 岁、40 岁、30 岁这样子打，然后也是先打了小孩，18 岁以下的小孩。

Rebecca 00:01:58

这样子啊，就是说中间这一段真的是各个国家不一样。

David 00:02:03

他是这样子想的，他首先先打小孩，然后打了小孩之后，小孩就可以回学校，他们的父母就可以解放出来去工作。

Rebecca 00:02:11

ok 也是有道理的。

David 00:02:15

一定是有道理的，反正你要是按照他们的思维想就也行。

Rebecca 00:02:20

对，我觉得也挺好。

David 00:02:24

他们最最后一批，因为他们觉得我们这批人防御能力最强，而且你只要不乱跑，这些问题都不怕。

Rebecca 00:02:31

应该这就真的是各个国家想法不一样的，你像中国是老年人最后打，他们当然跟美国也是不一样，因为中国的老年人的疫情，他做他疫苗然后做 test 做的比较少，然后老年人又特别容易出问题，所以说老年人是不可以打的，要到很晚，我父母也是刚刚才打了第一针。

David 00:03:00

国内的噢我好像是我外婆。

好像也是最近才说要去打，反正也没打，我爸我妈也前几周才打的，我爸我妈都 60 了。

Rebecca 00:03:04

是。

Rebecca 00:03:10

对，还蛮有意思的，你比如说加拿大那边的话，他们是什么政策

他们就是说所有的人我不保证你两帧，所有人我先把第一针打了，我昨天刚跟朋友聊，然后的话所以你比如说他在，应该是安大略省，他在安大略省这边，然后就已经打一针的已经是超过 70%了。

David 00:03:39

英国也是这么算的，英国好像我还没听说打第二针，它也是要保证所有国民先接种第一一针，然后再去考虑第二针。

Rebecca 00:03:47

Ok 美国这边就不一样，美国这边就说你只要打了第一针，他就肯定保证你的第二针他是那种策略。然后现在的话是打到 12 岁以上就都可以去打了。但他中间有一段的话，他刚开始是打老人，就也是就是说老人先打，然后就说是根据你的 job 的 priority 打。

David 00:04:09

对，然后其实这边也有考虑，比如说护工，然后学生是年轻的学生，然后就是学生的家长，对吧？他们其实是这样，他其实目的就可以很明显的看出来，他是想要赶紧复苏经济，让大家都回去上班。

Rebecca 00:04:24

对的，这边的话对学生对孩子是因为他是因为他测试的不够，所以他孩子是最近才放开，所以我们家两个孩子，我儿子 13 岁，所以他刚刚就刚刚一个小时前刚打了第二针，然后刚打。

David 00:04:44

都打上第二针了，我这第一针还不知道在哪。

Rebecca 00:04:47

我女儿现在就还不可以打，因为他 11 岁，所以他就没有他就卡到 12 岁的坎，anyway，所以你就看每个国家不停的应对还蛮有意思的。

David 00:05:00

你们那边是打什么疫苗？哪个。

Rebecca 00:05:03

应该是我看好像是三种还是两种，最最普遍的就是 Pfizer 和莫德纳，像我们一家现在打的都是 Pfizer。

David 00:05:15

就是辉瑞嘛

Rebecca 00:05:17

对，辉瑞对的。

David 00:05:19

英国这边也是，他说的是 18 岁到 30 岁应该会打到辉瑞或者是莫德纳。

Ok，然后你至于打到哪个看你运气，就反正当天有啥你就打啥。

Rebecca 00:05:33

你也没得选对吧？

David 00:05:35

然后还有阿斯利康，阿斯利康不是大家都不是很想打，因为说会有血栓的危险。所以说如果你当天打到是阿斯利康，你去跟他说我不想打这个，然后我愿意等，然后等下次有莫德纳或者辉瑞的时候再来，我们是可以这样。

Rebecca 00:05:55

还挺有意思的，看看各个国家是怎么应对这个事。

David 00:06:02

就是不太一样。

Rebecca 00:06:06

Ok，我再跟你说一下我现在的状态，我现在没有，我还属于一个怎么说，pre production versus the production，就是说因为我 production 的 phase 会比较短，我现在的因为我是 program generate 的东西，所以是一旦所有的东西就准备好了，我实际上做的期，有可能是两周或三周就会出来，但我在那之前有很多的准备工作要做，然后我的 idea 也是就说是 morph 了，从从我们最初的想法到我现在的话，就是说我是，怎么讲。

从大的 concept 上来讲，我是想把它 morph into 一个就是我在做一个 series，这个 series 都是 has a lot of thing to do with healing。

所以的话我就想更强调一下它的 meditation 的 side of music，所以在这种然后就是说它不仅是从乐感上，从视觉上，然后并且是从它的空间感上来，但是我又想这个是我这一个 healing series 里面应该算是从比较 musical…

（由于不是沉浸在一个固定的课题里，online 合作会受到很多其他因素的影响，比如手上的其他课题的 concept 有可能会影响到这个课题，但不能说是坏事，因为有可能会带来新的视角。对于 craft 来讲，一般来说都是沉浸在课题中，沉浸在与材料的 interaction 中来推进课题的进程，很少会受到其他课题的干扰。）

David 00:07:28

老师你卡住了，哈喽。你刚刚卡住了，所以说刚刚那一段我都没有听见。

Rebecca 00:07:52

Ok 好，我再说一下，就是说我是这样子的，因为现在我觉得是一个我原来是有一些零散的 idea，但是后来我又整个的把几个 project 我想了一下，所以我觉得就可以把它们整个的都归到一个 series 里面， series 的话 focus 就是 meditation 和 healing， which is what we need。

David 00:08:20

是不是有点像 musical therapy 这种感觉。

Rebecca 00:08:22

有一点点的意思，但是不全。对的，这个东西的话，虽然我现在恰好是赶上这个时候，然后并且我现在在想的一些东西跟，但我要是 back track 的话，这个东西就是说可以 track 到，你比如说我上一个 project 我可能我是给你看过的叫 fotasy 那个 project 我是给你看过的，应该是，你记不记得是一个 visual music talk about pregnancy lost?

我没有给你看过吗?

Ok，我可以发链接给你，你看一下那个是就说是一个比较 specific，我的最初的想法从那里它是一个很 specific 的 healing，就是说是 very specific 就是 talk about。

整个的 journey 就是 after 一个 woman lost her baby prematurely 就说流产或 for whatever reason。

之后 woman 的 go through physical 从 physical mental emotional 的整个的 journey。

所以它是有一个当然到最后他就有一点点 healing 的 part，那个是 project，我做是因为跟一个 female composer 做的，当时做的时候，他是恰好他前一年她就 lost 了一个 baby，然后的话然后她就去了，我碰到她的时候，她是正打算去西藏，她信佛的，她是信藏传佛教，然后的话她就去了，我这是 19 年还是 18 年的事情，19 年可能是 19 年的夏天，我在韩国碰到她的时候，她说她正要去西藏，然后后来她自己去西藏，这是他的一个 healing trip。

她在那录了很多东西，她是个 composer，她是 electronic composer，然后的话她把他录的那些东西加上她唱那些东西，她加了一些箜篌的成分放在一起，她弄了那么一个 piece，然后的话我根据她 piece 做了一个 visual，这个应该是。

19 年底 20 年初的时候做的那么一个做了那么一个东西，但那个东西就已经是 lead toward healing。

从那个地方的话在那之后我又做了一个 piece，也是跟 healing 然后又加了一个 Africa American 的一个 composer 在一起做的是，因为 pandemic 之后的那个就说是 anti-Asian crime，就在美国特别的多，然后在那之前还有 black live matters movement，所以美国去年是加的前沿就是非常的乱好多的这种事情，所以我们三个人就想在一起做一个 piece， focus 的话也是就是说其中一部分。

首先就说是大家都不好意思，都需要被 heard，不管是 Asian，不管是 Africa American，不管是 white，不管是什么样子的，所以他有做了那么一个 piece，那个意思就是我当时做完我很难过，因为是一个怎么讲，是一个很暴躁的 piece。

David 00:11:53

他本身整个的可能 piece 的情绪就会引导人觉得很难受，因为他本身是从一个很难受的事件里面来的。

Rebecca 00:12:04

对的，是这样子的。

然后并且是因为合作者也是第一次合作，尤其是 Africa America 的 composer 是完全不一样的 style，不一样的 sense，所以那个 piece 做完之后，我有很长时间我都不愿意回去看它，就有点，然后我前两天又把它拿出来看，感觉稍微好了一点，但它自己还是不是很能接受的一个东西。

对，但是另外一方面我也意识到就是说它是另外一方面的一个 healing，你知道吧？它是就说有时候你需要去面对一些你不愿意面对的东西，有时候你需要去就说是真的有可能会很难，但是这个也是 part of the healing process。

所以从另外那个角度当中，所以我觉得他也是 tied to 我现在想做的这个东西。然后说到我们就是说我们做的 Arabesque 的 music，刚开始的时候，我一直非常喜欢这个 music，然后这个 music 对于我来讲还有很多的 fundamental value，我可能原来也没有跟你讲过，就说原来有一个 computer graphics 的，不是 Edward z Jack 是 Edward z Jack 吗？看看谁做过

我就直接 search Arabesque 了。嗯我是一时想不起来它叫什么。

我来 search history of computer Art 到底是谁呢？也不是 Edward z Jack， 哦 John Whitney。Yes，John Whitney。他原来做过一个他做过一版 Arabesque，他的那个东西当然他做的是非常的，是一九六几年之类，他用的不是这个 music，但他用的是这个名字。

他的 Arabesque 就更接近他的本意，但是因为有 connection， 那个 piece 是当时对我影响非常大，对我自己的，所以的话 Arabesque 可能还有那么一个连接在里面，所以我现在想 approach 也是从说回我们的 healing，从这个角度来 approach，我原来只是想很单纯的做一个就说是 visual music 的一个 piece，但是我现在就想把 healing 的这个东西搁进去，所以我就想让他有一点 medication 的东西 feel 在里面。

所以这就是一个原因，我想把它转成 VR 你知道吗？所以我想把这个环境是做成一个 VR 的环境，所以是因为 VR 的话，它会有一个那种 immersive 和你在 real word 的这种就说你和你的空间的感觉它是不一样的，就是你在 virtual world 里面，虽然是现在大家都想模仿成 real word，但他没有到那个程度，所以它是一个 in between 的东西。

有一点像什么你做 yoga 吗？你有没有做过 yoga，ok 你不做，你可以去看一下好多的 yoga video，我最近没有做，但是我做过挺长一段时间的 yoga，yoga 的时候，你做的时候就说是他如果你跟着课，如果你有 instructor，他会有 instruction 你知道吗？

所以他给你 talk about 就是说因为就很多时候你是闭着眼睛，然后他就把你 put 到那个空间，你比如说他的好多的指令，就是说你躺在地上，他就会说，你觉得现在你的胳膊伸上去了，在空中，什么你左手上去了，你右手上去了，你的腿上去了，你的身体上去了，然后他就一步一步的你知道吧，就是说整个的就把你搁到那个空间去，你知道吗？

然后在他就在你的脑海里去创造一个那种 image，是一个很… 因为就是说你要达到 stage，你要 concentrate，你要 empty 你的 mind，所以它是一个很好的 meditation 的 practice。

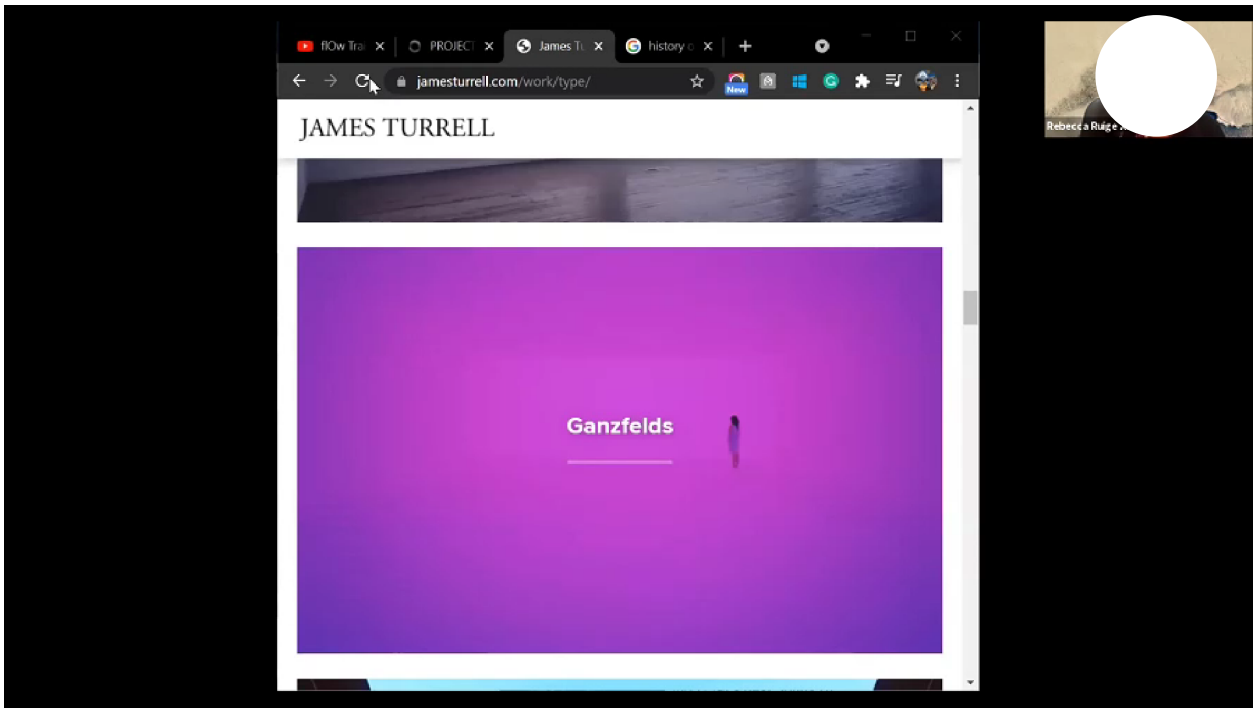
Anyway，所以我就结合到把那个东西想结合起来，然后我就想给你看一下。

所以我现在想这个是想做 VR，然后我技术上我上次大概跟你说过，我现在还是想用 Shadertoy 来做实时的根据音乐来做一些这个东西，这是第一步，然后以后的话我可能会加一些那种交互的东西在里面，anyway 我给你看一眼。你知道 James Terrell 的 work 熟吗？

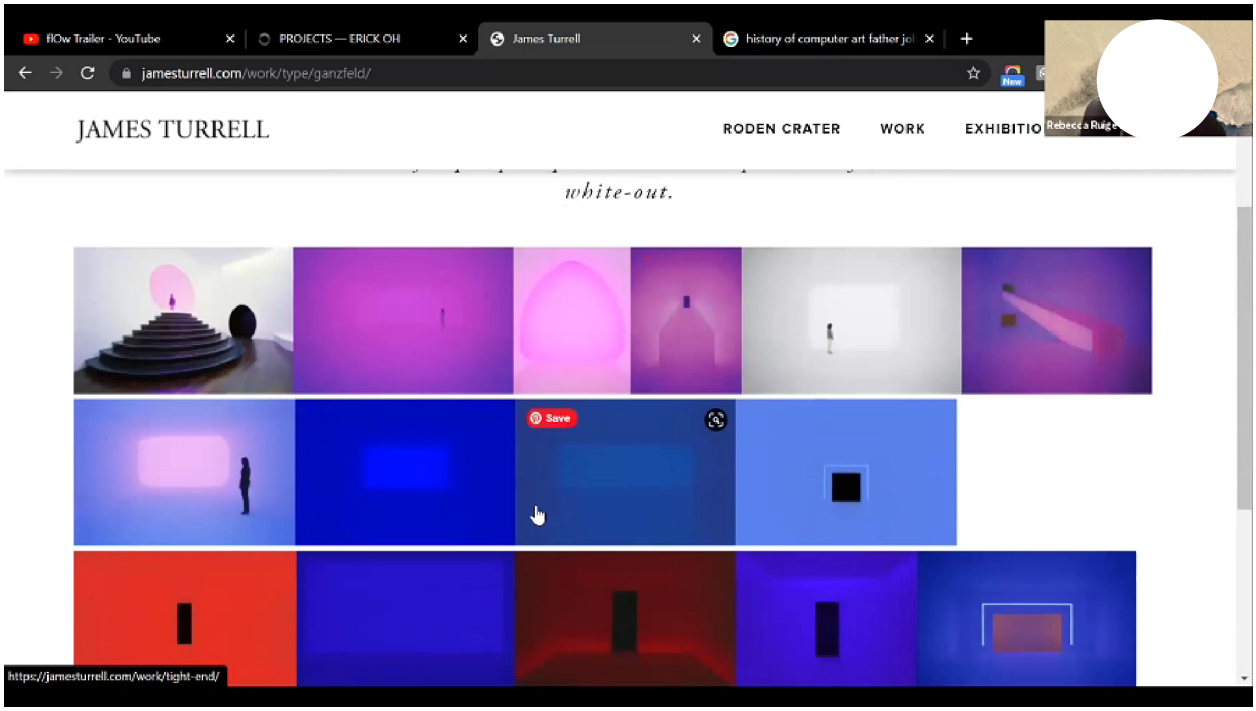
David 00:18:22

好像没听过。

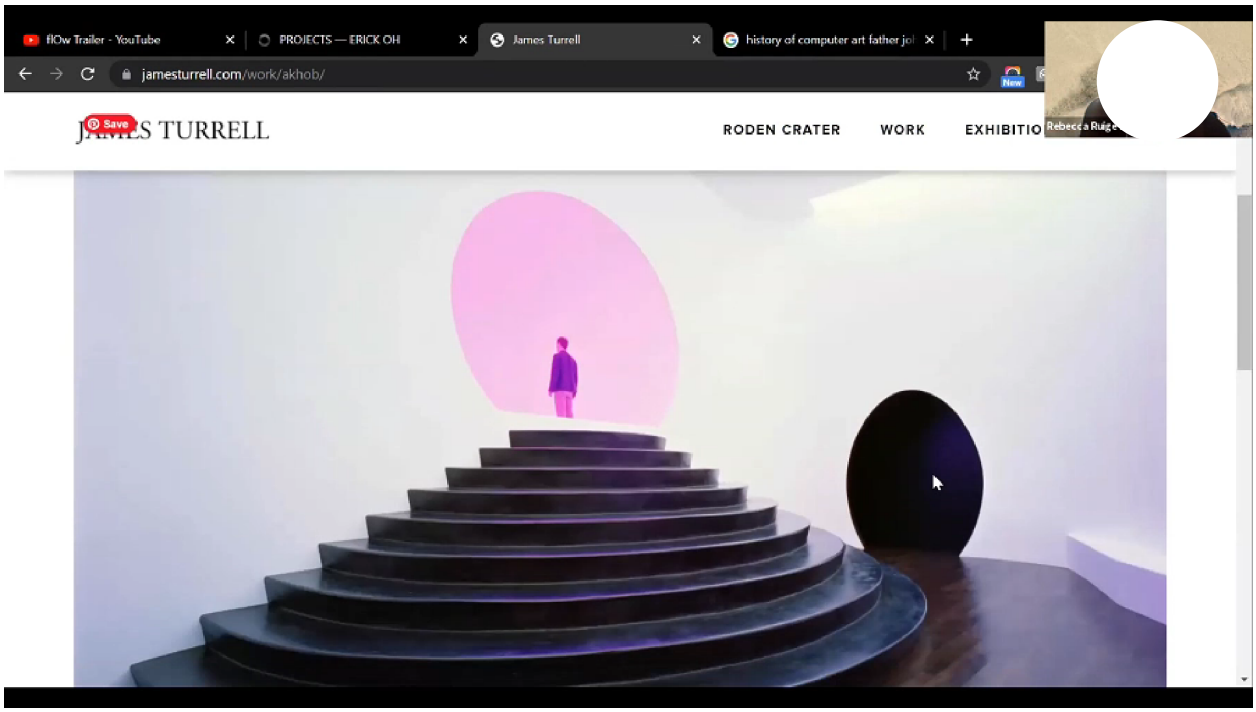
Rebecca 00:18:25



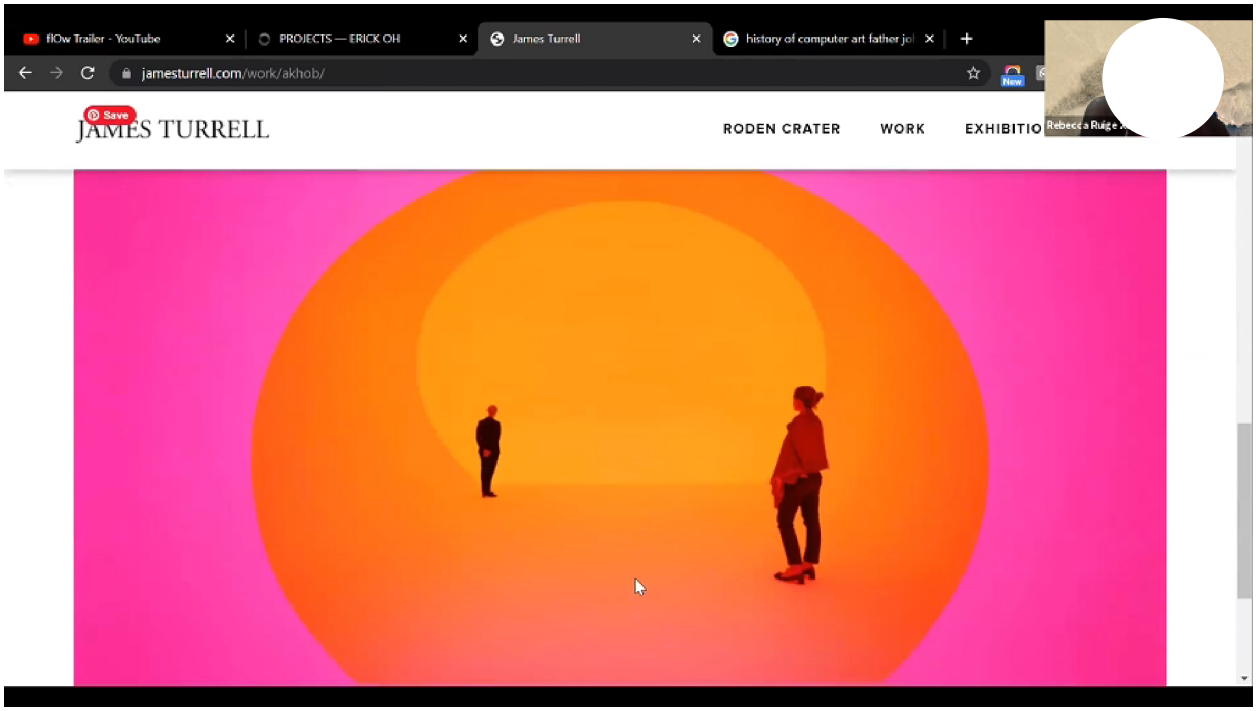
let me show you。我 share 我的 scram。好了，看看 James Terrell，他是用他最出名的是什么，他用光你知道吗？他用光来 structure space。



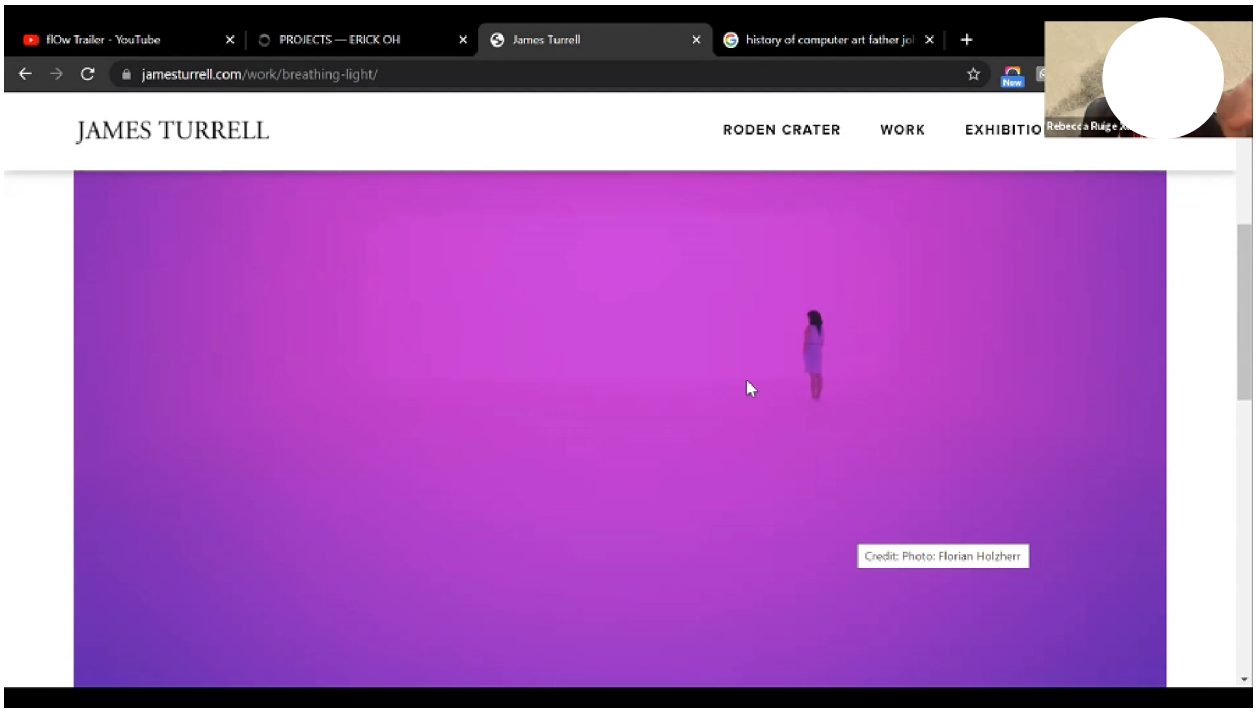
看看有哪个是比较合适的，比较像我想做的一个 feel，I see this one 对这个作品的话是在麦斯莫卡 Massachusetts modern museum and modern art 在展示就是常年坐在那里展，所以我是去看过的。



他这个作品的话就是说你从这里面你就上去，你从这个门进来，ok 然后他一组一组人放，你就进去上到台阶里，然后你进到这个空间，看看我怎么能走到下面，ok。



这个就说是差不多，你就从外面看里面，还是从里面看外面，anyway 你就可以看到这个空间，但是的话看看你在这个空间它应该有更多的图片。



我刚才看到很多图片，差不多是这么一种 feel，就是说你进到那个空间的话，你在这个时候我们看那个图片，因为它是图片，你还可以看到边界，但是你实际上人在中间的时候你是看不到边界的，整个的你就是被一种 colour 给 surround 这种稍微有一点 light 的这种 colour，它这 colour 是会变，它会很缓慢的变，但是你自己是就是说你就真的就是被包在里面，有的人会有不适感，因为它是整个的是 360 这种，所以的话你除了你脚下

David 00:20:46

会有一种孤独感。

Rebecca 00:20:48

会的。

如果是人很少的话，但是一般情况下的话，它会放好几个人在一起。

在这种情况下你这个感觉就很微妙，我觉得他放你要一个人去的话，对我没有机会，因为他一般都是很多人去你知道吧？我想如果是一个人感觉会特别的强烈。

David 00:21:08

因为你被身边的一个空间所环绕，其实这空间在挤压你，就是这种感觉。

Rebecca 00:21:17

对的，你就是那种感觉。

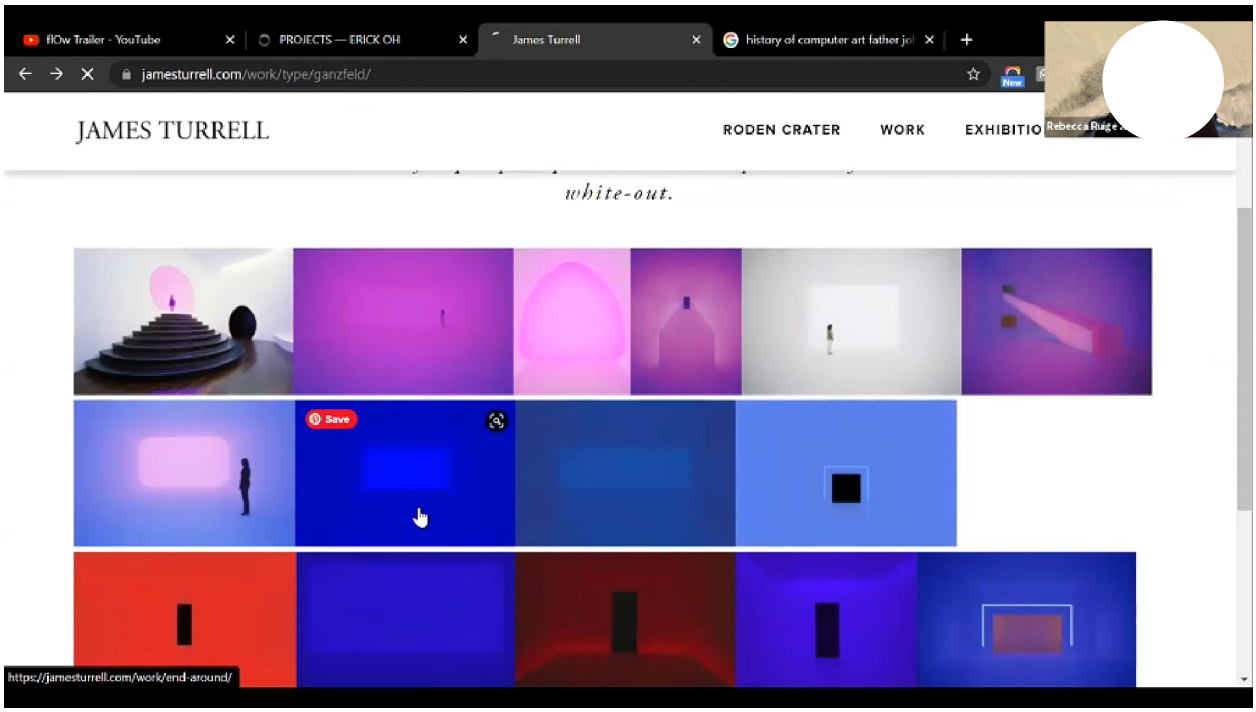
然后你还会有一种悬空感，你知道吗？你在这个 space，但是唯一 help 的是什么？就是说你的你的脚是有触感的在地上，那是唯一的一点，真的是唯一的一点，否则的话就是说是它跟 VR 的环境是非常的相似的。对。

David 00:21:44

因为这是你的脚有触感，你感觉好像站在地上，但是实际上你的眼睛看见的是一个无限的，光的空间。

Rebecca 00:21:53

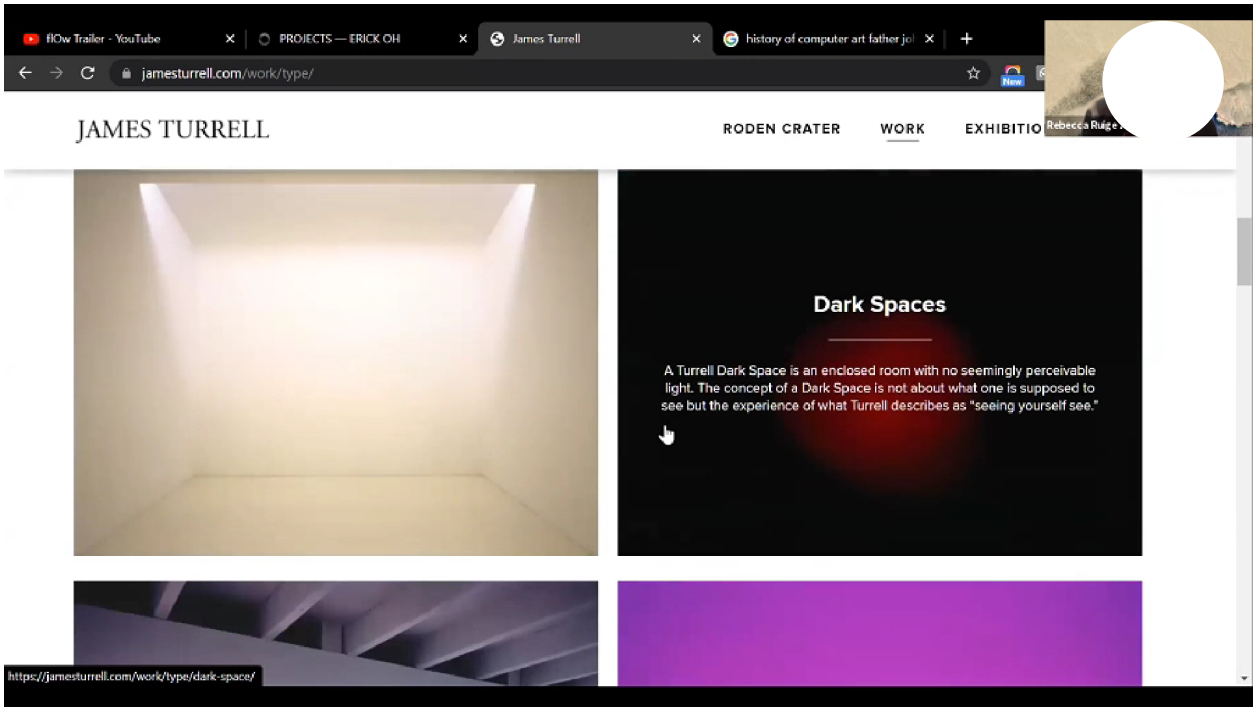
对的，所以的话对所以我想把这两种感觉就给它连起来，就是要要这种感觉的空间的东西，所以是这么一个想法。



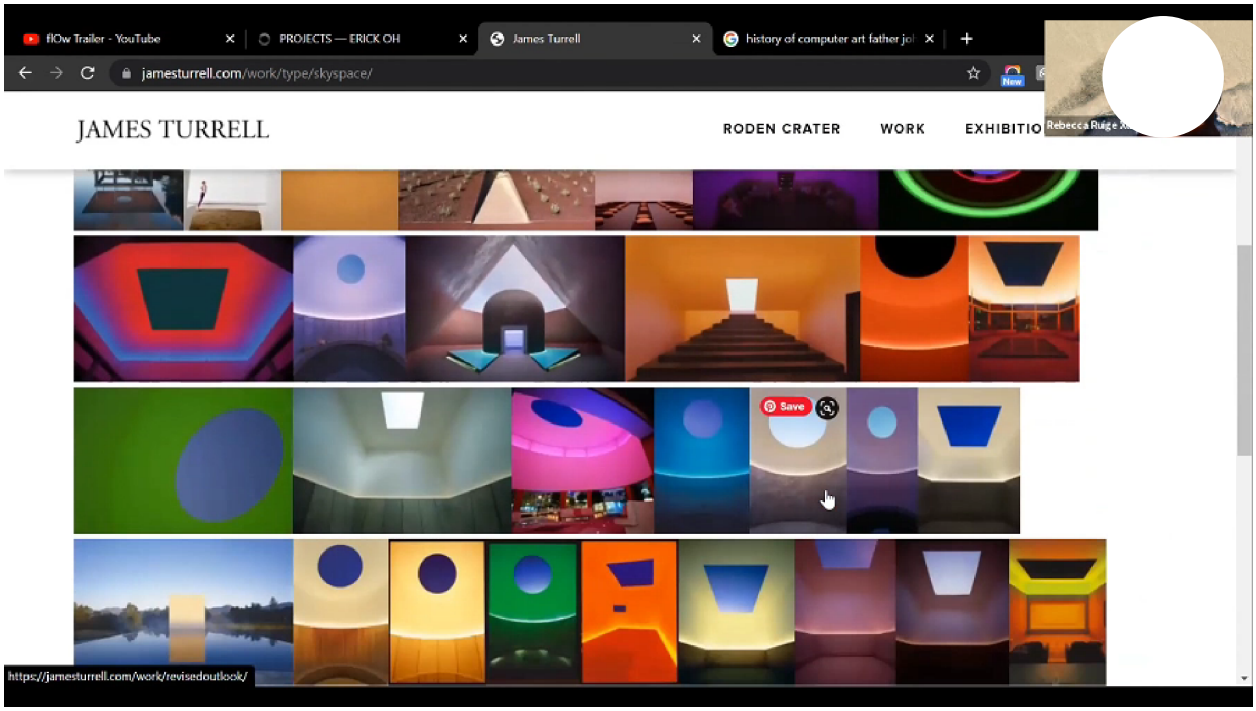
看看，还有它应该是由就有很多这种，你看它的图，他做了就很多这种颜色系列的，但是他就是很有名做这个，你可以去看一下，你要是感兴趣的话可以了解一下他的作品。

它在世界各地它都有大大小小的，它用光来用颜色来创造这个空间非常有名的一个 Artist。

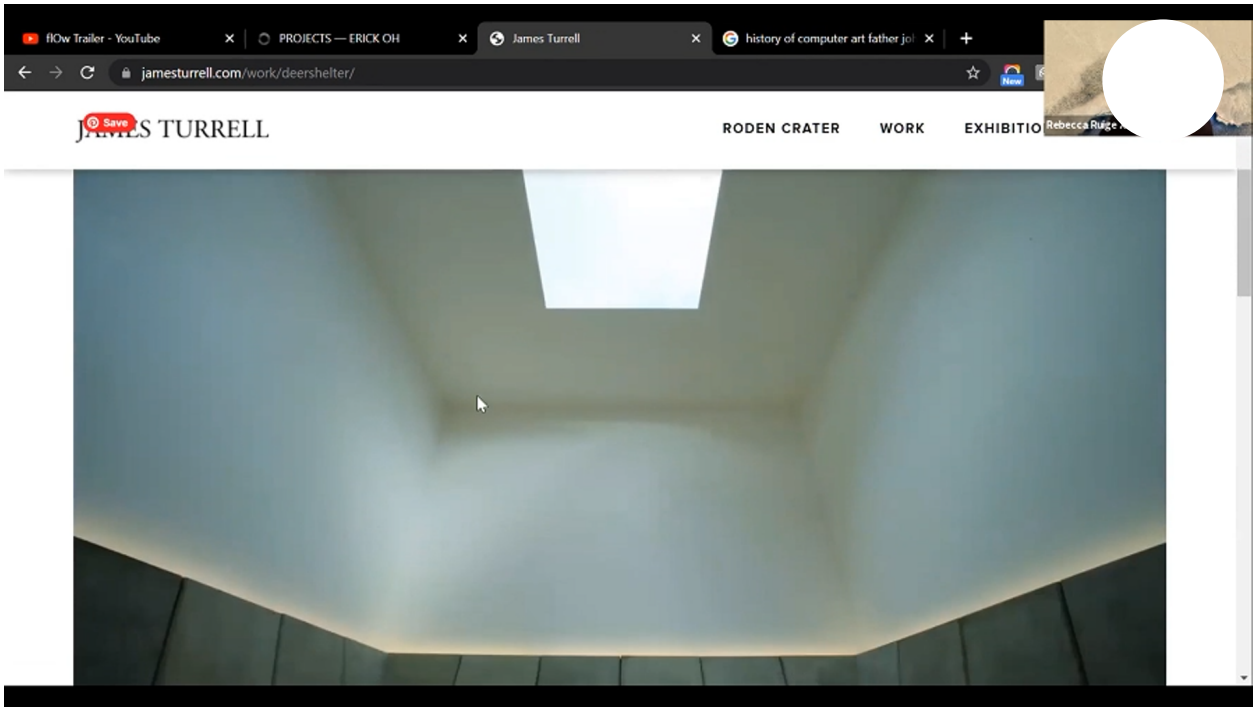
Anyway 就说尤其是这个作品，我觉得就跟我想想达到的就是 sense 比较接近，所以我就跟你给你看一下，你知道吧是这样子。

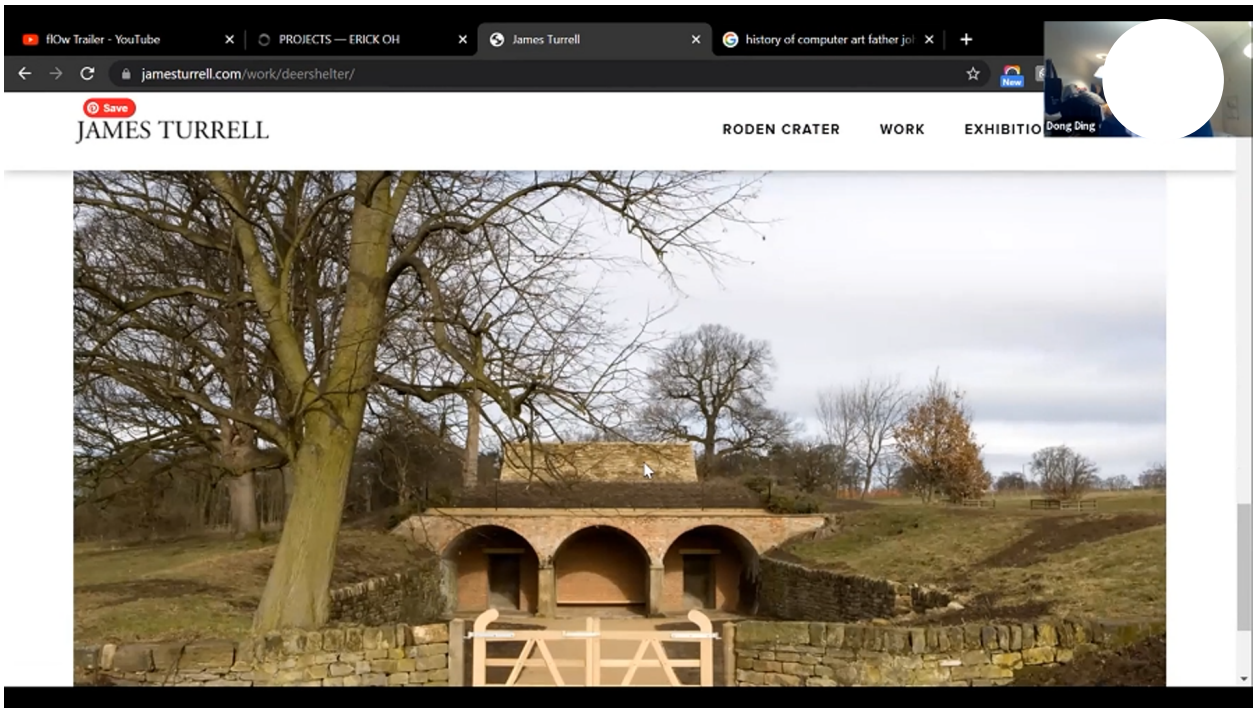


如果是你去看他的作品的话，他还有很多，有一些他这种简单的，就是这种全是跟 light 有关的，看看你可以去看一下它的 website 可以去他的 skylight series 也是非常有名，给你看一下，他的很有名的，讲他最有名的是哪些，忘记是哪个了，反正是一堆…

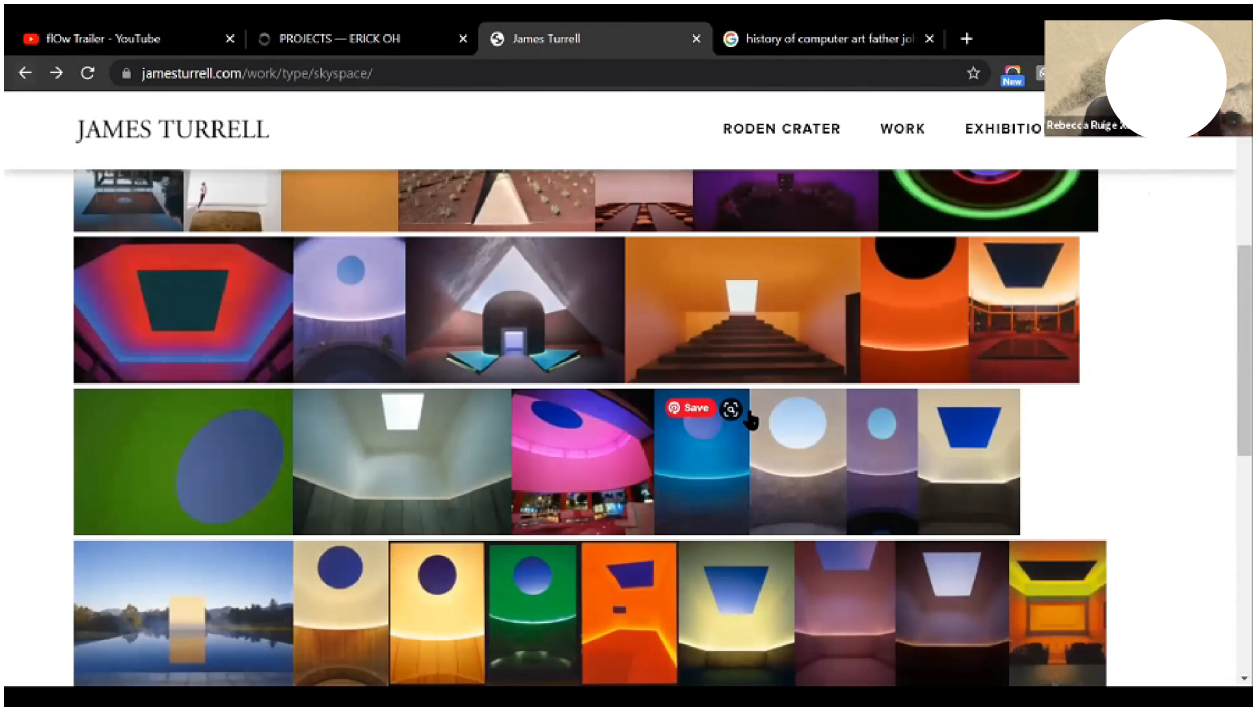


sky space 它这个是在世界各地都有这个你有可能都看到过，它这个东西就是整个它是用 space create，是这种 physical 你可以走进去的，它建了很多个世界各地，就是说你不同的颜色，它有时候会利用环境，有时候全部的就是纯粹的内部的 lighting，你知道吗？





你像这个就是用了天光，他用了天光来做的，这个东西是建在这里的，对，他就是这个东西，你进去看。



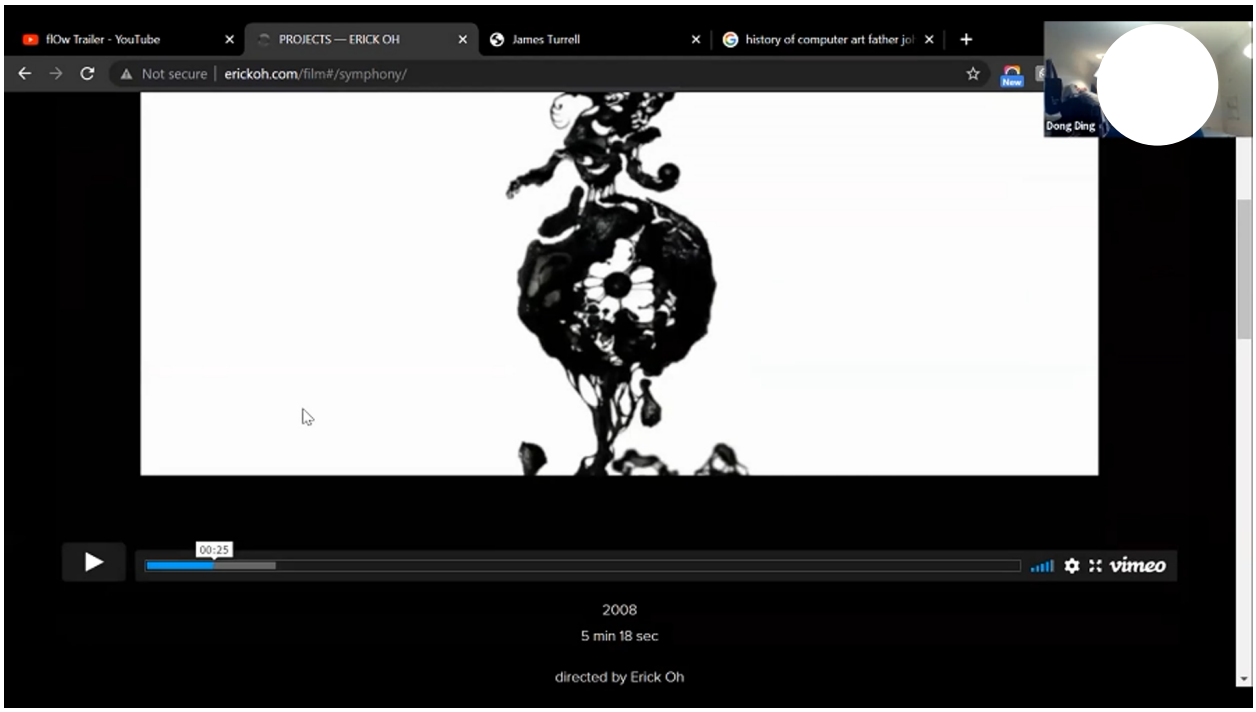
我看看这是哪里，他反正世界各地都建，自己去看，对他世界各地，他可能是最著名的就是这一个 series 了，因为是这种 physical 的东西，大家可以进去看的，反正一堆，对，你自己可以去看这个东西，它有一堆 ok 但我要做的就是更的那个东西。

David 00:25:00

那你的想法是会说在 VR 的空间里面会有一些图案或者是光，然后根据音乐的律动来产生一个变化，然后它可能是挤压你，或者说是把你放松这样子撑开，然后就这种感觉。

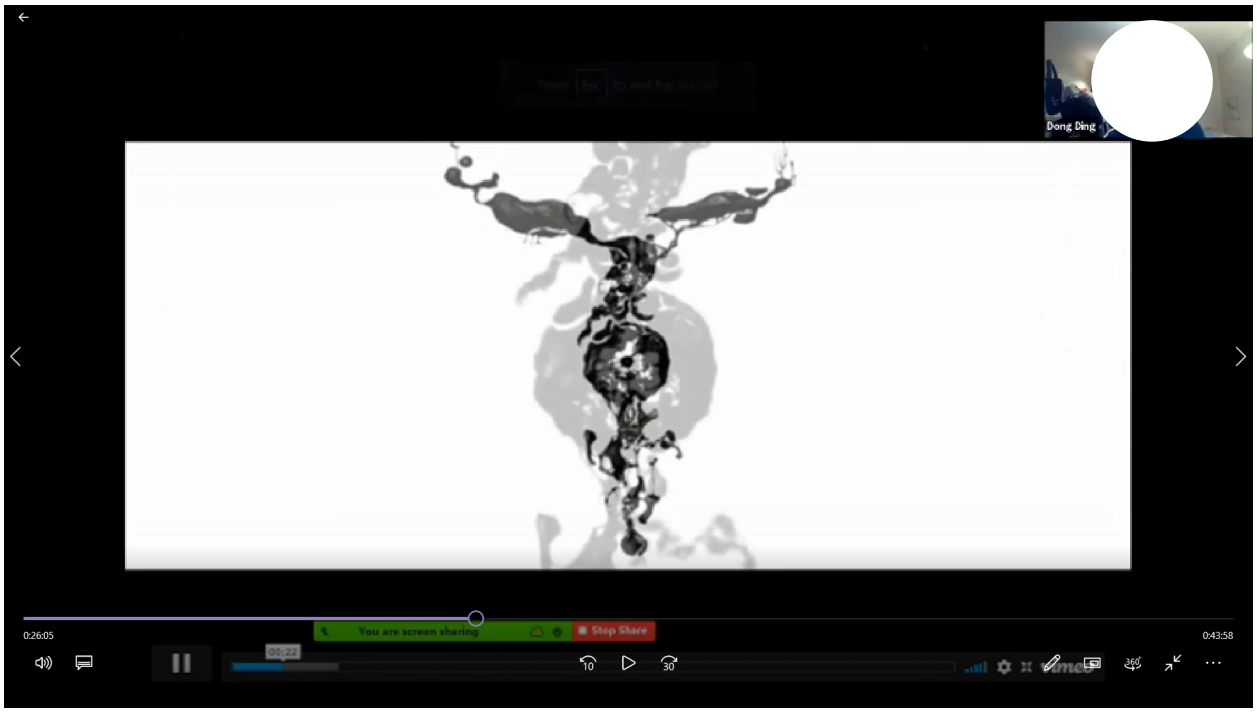
Rebecca 00:25:16

对的。



音乐上的感觉我想是一个什么样子的感觉，是给你看一下，你能看到这个吗？黑白的那个 ok。这个是一个 piece，是 Erick Oh 做的比较老的一个 piece，这个 piece 叫 Symphony。

Ok 他是用的自然是用的 Symphony，但是我想给你稍微看一点他的整个的感觉，我再重新试一下，因为我要 check 一下 audio，ok 我们来看一下这个能听到吗，这个我往后一点。





这个地方 okay。

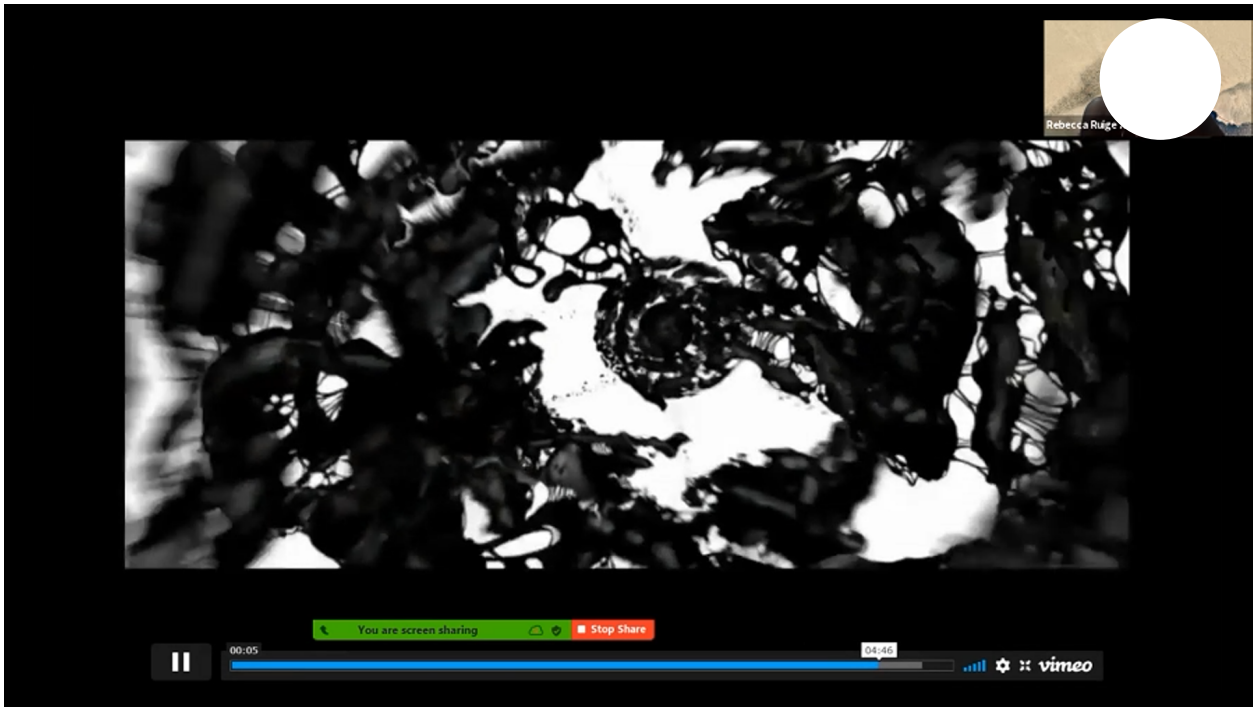
David 00:26:48

对，这好有意思。

Rebecca 00:27:51

它这个的话说是有很多的 character 在里面，我不会有那么多的 character，你知道吗？但是它的 Movement 跟音乐的对应，我希望会有一些，我不会说是那么 specific，但是我会有一些因素对应，然后那个形态也会是比较 abstract。那个环境，然后并且这个环境也跟他就说是跟我想的有一点类似之处。

我看看到最后的结尾是什么样子的？



他没有太多的变化，对。

David 00:29:29

很有意思。

就这个意思给我的感觉他像是如果我们 focus 在这个会跳动的这个东西上面，它给我的感觉是在一个未知的空间里面在做一个探索，然后在像一个 adventure 的这种感觉，然后在这个过程中，他有时候会触发到某些机关，会触发到某些东西，就会有人有东西追着他，然后他其实是在是在探索，同时是有一个他感觉他是一个在找寻的这样的感觉，然后到最后他又把这个世界进行了一个缩小，就好像比如说我在探寻地球，但是我把视角拉大了以后会发现是一个太阳系，再拉大以后发现是一个宇宙，是一个银河系，然后再拉大一个宇宙这个状态。

Rebecca 00:30:14

是的，你可以就是说有些地方是可以这么理解的就是说对就像我说的，当然他那个的话就说是因为就是说怎么说 character 的痕迹非常的重，你知道吧？所以的这个东西我是想

David 00:30:34

它的故事性和叙事感很强。

Rebecca 00:30:36

对的，再给你看一个东西，这个的话是你玩过叫 flow，玩过没有游戏，没有 ok 我给你看一下。

就他做过的一系列，他做 flow， journey，flow 是他的第一个。





但我很喜欢这个的感觉，你知道吗？当然是他这个东西他因为是游戏，所以他也有这种。你要不停的要 catch 什么，然后要变成什么样子你知道吗？

David 00:31:33

他像吃很久以前玩的有些类似像大鱼吃小鱼或者是有那种就是一个虫子，我玩过那个游戏是一个原生生物，然后他在吃到各种不同的东西之后，他就会产生一步一步的进化这个感觉。

Rebecca 00:31:50

对的，它也是有一个这个东西也是一样的，它也就是说是有比较多的 Character 的，但是我是不看他 character 的那部分，我看的说是他的他的 flow 你知道吗,他的 motion。

然后那个东西是我想 create 的，就说是因为那个点是我对于我来讲是一个就说是连接音乐和我的 visual 的一个比较相似的一个点，是这样，所以我现在脑子里基本上就是这几种东西，大概的感觉我不知道是不是能 help 你 understand 现在我的想法。

Ok 所以我基本上是就是说首先它要有一个它是一个很 immersive 的 environment 这个东西，所以我们做的话肯定是 360 把你包容在里面的这么一个环境。然后的话在这里面它的音乐的流动性一定要给体现出来，对于我来讲它那个 piece，Arabesque 真的是一个非常好的 flow。

所以这个 flow 是用一个什么样的角度，是像我刚才 show 的那两个 piece 它的不一样是什么，你看怎么说最后叫 flow 的 piece，它是一个更 free 的 360 就说，你往前推往左推往上推，就说你在任何一个角落的动都可以 vs 在前面的那个 piece,就是 Erick OH 的那个 piece 叫 Symphony

Symphony 的话，它在很多的时候它是一个两维的 movement，它是一个很多两维 movement，它有个别的往往近身推的，但是它绝大部分的地方都是一个两维的，就是上下左右就是那种这种 movement，所以就说是 movement 的角度，对于我来讲的话，我现在没有想特别好，因为是怎么回事，就是说如果是你给太多的 movement，你 control 它的 movement 的方向的话，就容易 become random，random 这个东西是 go against 的 flow of the music。

所以我的想法是想还有一定的 control，这个 control 的话，有可能我刚开始做一个比较简单的，你比如说我就往一个方向推，然后中间会换方向。

David 00:34:15

那如果说，我有一个想法，就是我听到这里我给我的感觉说我的想法就是，如果说我处在这样的一个空间里，然后我需要 focus 在一个点上面，对不对？

有点类似于刚刚的那个 character，如果它是随着音乐去律动的，我的眼睛会跟着他跑，比如说他往左边跑了，我人就这样转过去了，然后再这样我的眼睛会跟着他去在这个空间里面去行走。

Rebecca 00:34:42

我觉得在有些 moment 可以这样子，但是我不愿意把整个的 overall 做成一个这种.我不愿意就是说是，我觉得有点太…

太 simplify 的话，就是说你在这个环境里，我就要我的眼睛，我的感觉就要 follow 这一个东西，我觉得稍微有一点太 simple 了。

David 00:35:02

可能给我就是一个单一的感觉，我只 follow 了这个东西，你更多的是想要整个空间对人产生一个影响。

Rebecca 00:35:11

对的，感觉是对的。

所以我这个的话我还没有想特别的明白，我肯定会有很多的因素在动。他的这个东西在我周围的这些因素你不定在什么时候，就跟音乐的哪个点合上，我有可能想做一个这种东西。

David 00:35:34

或者我会想到比如说空间会，空间的光效和大小 size 的变化会给人一个挤压或者一个释放感嘛，比如说我在挤压到一个极点的时候，突然冒出来一个东西打破了这个空间，然后我眼睛就跟着他走了，然后就一个释放的这样的感觉，然后再释放到最大化的时候，又有一个慢慢往回这样子推进的这样的感觉，我觉得整个跟着音乐的 flow 去做样子的，不停给你身体的这种样子往外或者往内这样推进的冲击会感觉会很有意思。

然后在这些东西中穿插那种可以让眼睛 focus 的那个点，它可能是一个突破点，把它作为一个突破点去打开这个空间我觉得会很有意思。

Rebecca 00:36:20

说得很对，如何找到这些东西中间的平衡是一个要试验的一个地方，尤其是我想这个环境的话，我不想让它有太多的 dramatic 的东西，但是你要要有一定的东西去 keep people 的 attention，对吧。

所以在这种情况下，就是说是你在哪里就说 maintain 那个 meditated feel，然后同时的话又能让大家不 loose 兴趣，这个东西实际上也是 meditated 选经常要 deal with 的一个问题。

Meditation 的话就说是你很难 keep 你的 mind empty 就是，你人就整天有，起码我是这样子有无数的想法就 pop up。

David 00:37:13

对的，这种东西对的，是，其实 designer 都一样。

Rebecca 00:37:16

对，你很难 quiet 你的这个 mind

所以我们现在想做的这个东西说是你想 quite 它的 mind 到 certain degree，因为所以的话你就需要有一个或者很多东西 attract 你的 attention，这样的话你的 mind 就不想其他的东西你知道，但是你又不想有太多的 too much going on，然后就说你的 mind

David 00::41

会显得 busy，然后你的 mind 就 explode，就是真的东西太多，我导致 explode 这种感觉。

Rebecca 00:37:46

是，所以我要找平衡，对就是这样子，所以基本上我现在的这个状态就是 conceptual thinking 就到这一步。

Technical 的话在，已经开始做一些视觉的东西了， technical 的话我现在这里没有，因为是在刚开始，因为我说做视觉的说是我要用 Shadertoy 要改一些现成的 shader 然后出。

如果说我有一等我有了第一批，就是说我觉得有可能的东西的话，我到时候我再 share 给你看看，对，因为现在我这个东西就是有一点 sense，但是还就没有什么特别确定的东西，就现在在这么一个阶段。

David 00:38:37

然后我的话我目前，我更多的可能就是我的脑子里面会有一些很简单的想法，比如说我说之前说过通过敲击或者通过其他的 technique 来符合音符或者 beat 这样子的东西，然后或者说我可能就是简单的把乐谱打下来，然后我看乐谱的线条的 flow 什么之类的这种，然后去做一些这种小的 test，我要准备要开始，从下周开始。

Rebecca 00:39:06

我很 looking forward to it，你知道吗？

David 00:39:10

我现在有一个没有想好的事情，就是我们假设说我可以通过这种 technique 去做出一种 pattern，但是我如何塑造物体整体的 shape 我还没有想好。

比如说我们说假设说在一根棒子上面，我通过敲击我可以通过敲击的力度，那么我在敲击的时候，它会产生一个自然的这样的弯曲，那种弯折可以形成一个空间对吧？这是一种。

另外的话如果是用一些比较平面的像这种工艺的话，我就不知道它会产生一个什么样的，这个东西就得试，首先这肯定得试。

Rebecca 00:39:53

但是我觉得这种未知性，我觉得才就是 make it very interesting。

David 00:39:59

然后我刚刚有一个想法，就是在看您刚说的这个东西的时候，我在想的是在后续我们进行一个交流的时候，进行一个 reflection 的时候，我可以通过你的空间给我的感觉来固化一个空间感，比如同样是一个小节，这个小节，你的这个东西给我的一个固化的空间感，它比如说是一个往内挤压的，比如说我们假设是一个球体，这里有一个坑，然后这个地方有一个往上的东西，或者这里有一个往下下沉的这样的空间感给我，我就可以把这一个小节通过敲击的方式塑造成一个这样子的空间。

我觉得这个是一个，很好的 collaboration 的突破点。

Rebecca 00:40:45

Ok 很好，你第一步的时候，我觉得你也不用特别的局限自己，我觉得你可以有一些 pre defined shape 你可以有一些 basic 的 shape to start with，你比如说你有一个球，你有一个方块。

David 00:41:01

我可能最一开始会采用，比如我可能做实验会用一个小节去做实验，或者说可能最终我的成品也是会挑出某几个小节来做这个东西，因为如果是一整篇谱子它太长了。

对于我来说很难去展现。

Rebecca 00:41:18

对，然后你刚开始敲的话，你在什么上面敲你那个形状？

David 00:41:25

我可以去采取，比如说在我现在想的是片状的结构就是一个铜片，然后或者是一个铜条这种，然后我之前用的您看看我用 车床用的比较多，然后我可以通过我听到的感觉或者说音符的感觉，比如说往前推进，它就会有一个很深的槽，然后可以把它拉长，然后去做一个样子的纹理，然后可能就是在一根棒子上面，反正就是看感觉去做一些小的 test piece，我要我准备做先干这个事情。

Rebecca 00:41:57

Ok 好的，我是很期待，我觉得这个东西就是转 jewellery 的话还蛮有意思的，好像还没有看到有人在做这方面的探索，就说是雕塑的这个就说是声音，等会我在现在给你说的，我想想我来 search 一下。

David 00:42:19

然后我觉得这个东西会很有意思，还有另一个想法可能是跟我自己的 research 相关的，我比较希望我们交流之后，或者说在做的过程中，可以写一些类似于像 reflection 这样子的东西来记录自己的想法，然后这种文字性的资料对我后面的 research 会很有用，就是我要做 analyse 的时候，这个东西可能会很有用，所以说我可能会写一些，如果有时间的话你也可以写一点，然后这样子你的这个部分和我的部分同时期的 blog 可以放在一起去做一个比较，然后我就可以更好的去分析，就是来自于不同领域的人在讨论同一个 element 的时候，他有什么思维上的变化。

Rebecca 00:43:04

明白，我尽量，但是我我这个人就说是，这个是我比较缺乏的一个部分，就是说我 document process 会比较弱。

David 00:43:19

我也是，因为我平时是从来不干这事，我这是被逼无奈属于是。

Rebecca 00:43:22

Artist 嘛，artist 就是我要 focus，我要 push forward 这种。

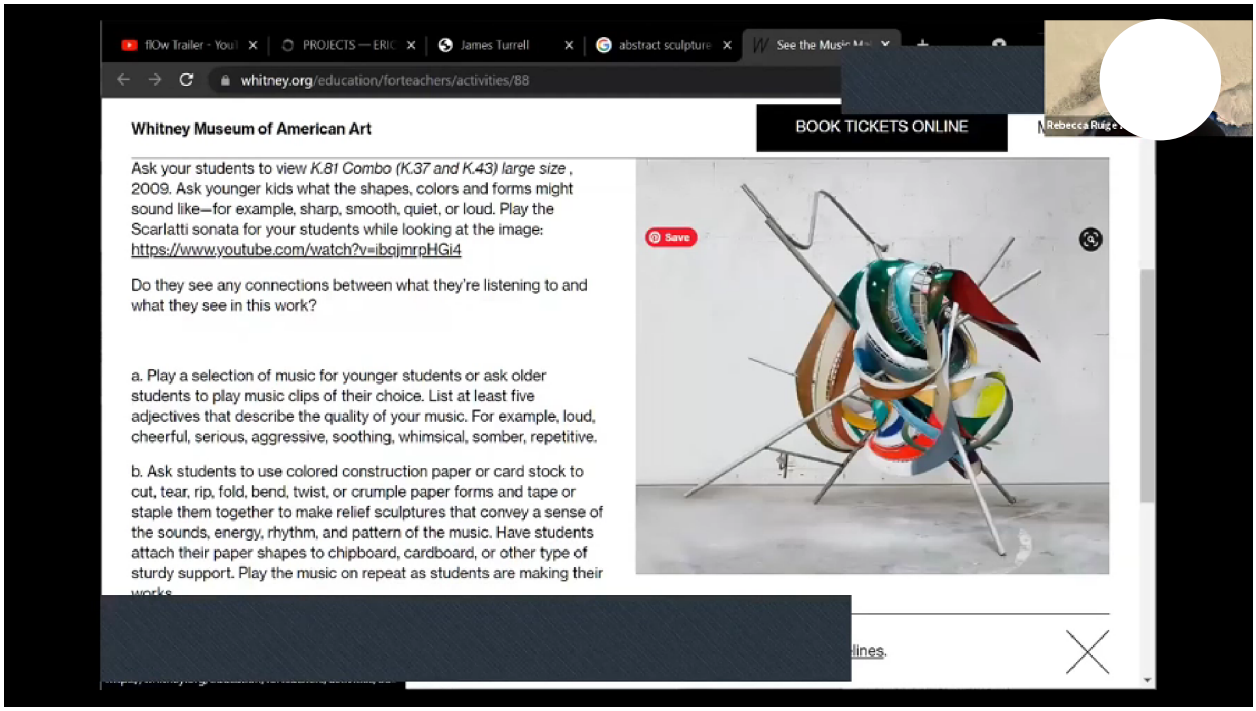
(对于 process record 的 thinking)

David 00:43:27

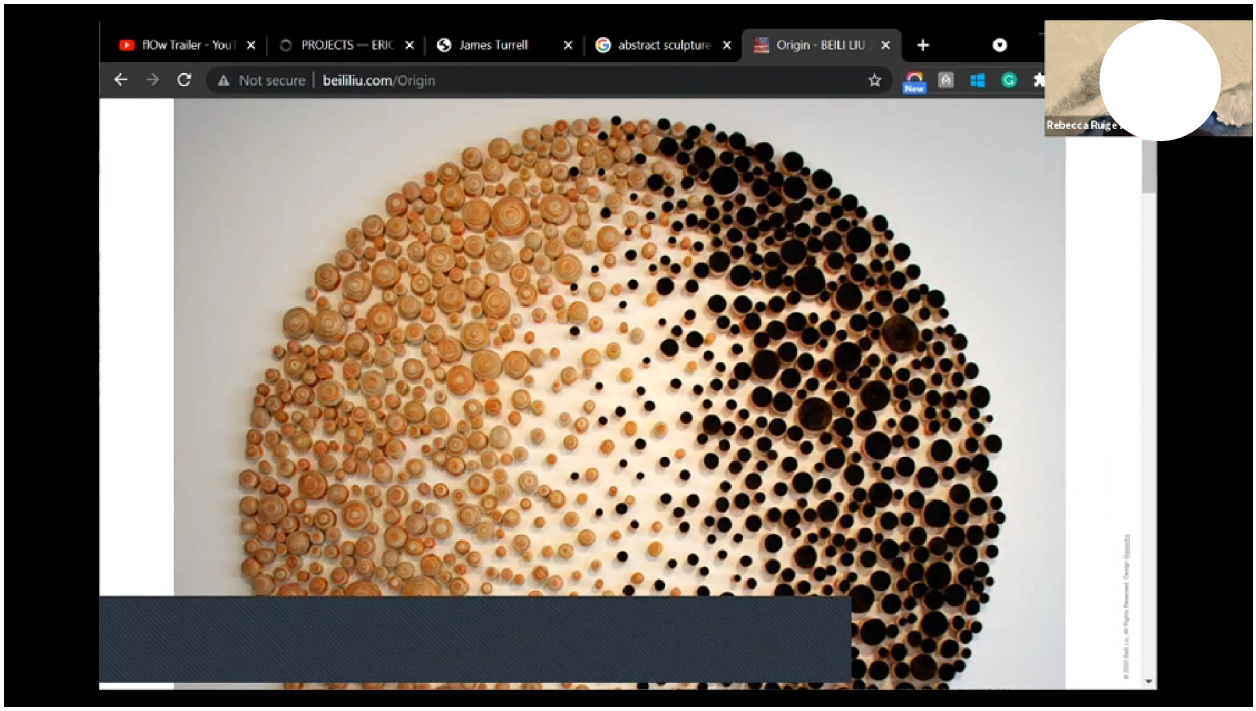
但是它不一定非要是文字性，它也可以是草图，甚至于是 process，你比如说在你的 program 里面的时候的一些截图，我觉得这些都会对于我来说非常有用，如果可以了尽可能保留多的这种 sketch 和 process 的过程，这样的话我后续做分析的时候就会非常好。

Rebecca 00:44:21

Abstract structure 好像找到跟 music 相关的说话，也就是 Kandinsky 的一些这种 painting，也就是这些什么最多也就是这样子。好像是 sculpture， ceramics 还没有。



我给你 share 一下这张图好像有一点意思，我觉得这还蛮有意思的，这是一个 Music piece 应该是。当然它是一个比较固化的东西了，对吧。它并且跟 Kandinsky 的好多的 painting 有一些这种相似的东西，而其他的我也没有看到什么了。我看看谁的 work 里面会不会有一些那种 texture pattern 的东西，Beili Liu。我有给你看过他的东西吗？我想给你看的是他做很多的 installation，但是他早期做过一些蛮有意思的东西，



这个看他那个这个东西，当然它是一圈一圈绕的，我觉得说是他的 pattern 会比较有意思，然后它这个形式也比较有意思。

所以我就在想，但我不知道你这个工作，但是就是说我就比如说你敲击，你敲击的走向是不是也可以就说是控制一下，你刚才说如果他音乐有什么变化，然后你的 motion 是有变化的，对吧？你敲击的时候你也可以控制敲击的方向，你可以就是说比如说你就敲击这个走螺旋线，你怎么一点一点走，一点一点

走，会走成什么样的 vs 你的线的方向是左边右边上下边，或者就是你有一个什么样的 pattern，是不是也可以设计一下，我就在想这个东西。

David 00:48:20

我也在想这个，但是我得试试。

Rebecca 00:48:23

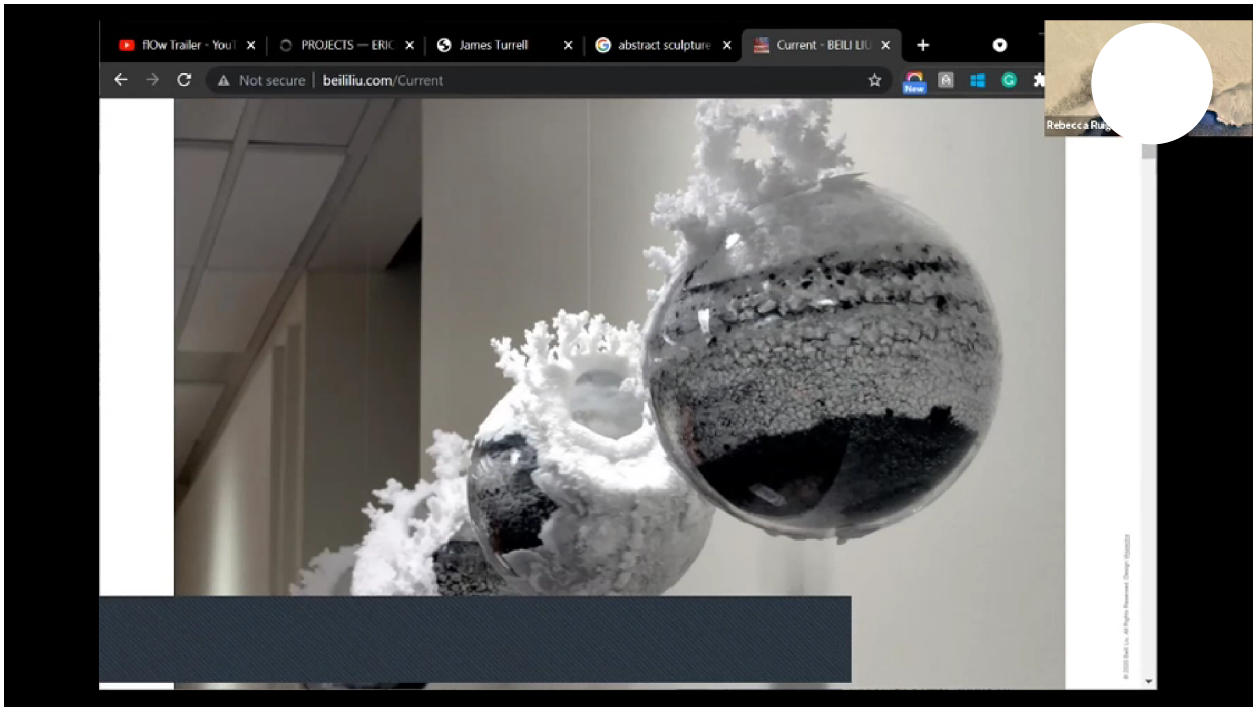
就是我想的我觉得你可能会试很多。

David 00:48:29

所以我会出茫茫多的 test piece。

Rebecca 00:48:32

然后我记得他作为一些很 texture 的，他当年是他做了一些 bio art 的一些东西。



看一下这个。这个东西的话，它是用一个什么材料长出来的，

David 00:48:55

就是晶体在水里面长出来，无论是盐也好糖也好，反正就类似的东西长出来。

Rebecca 00:49:00

对的，所以我觉得它的 texture 就还蛮有意思的，你知道吧 texture 的东西。

所以我就在想，然后一个是 texture 有意思，然后另外一个的话，当然我就不知道对于你的 concept 来讲，比如说你本来是有一个个体，这个也是因为 possible to create something like this，就说是有一个主体的东西，然后再敲出来一些东西，甚至我就想你有没有可能你就是 mix things together。

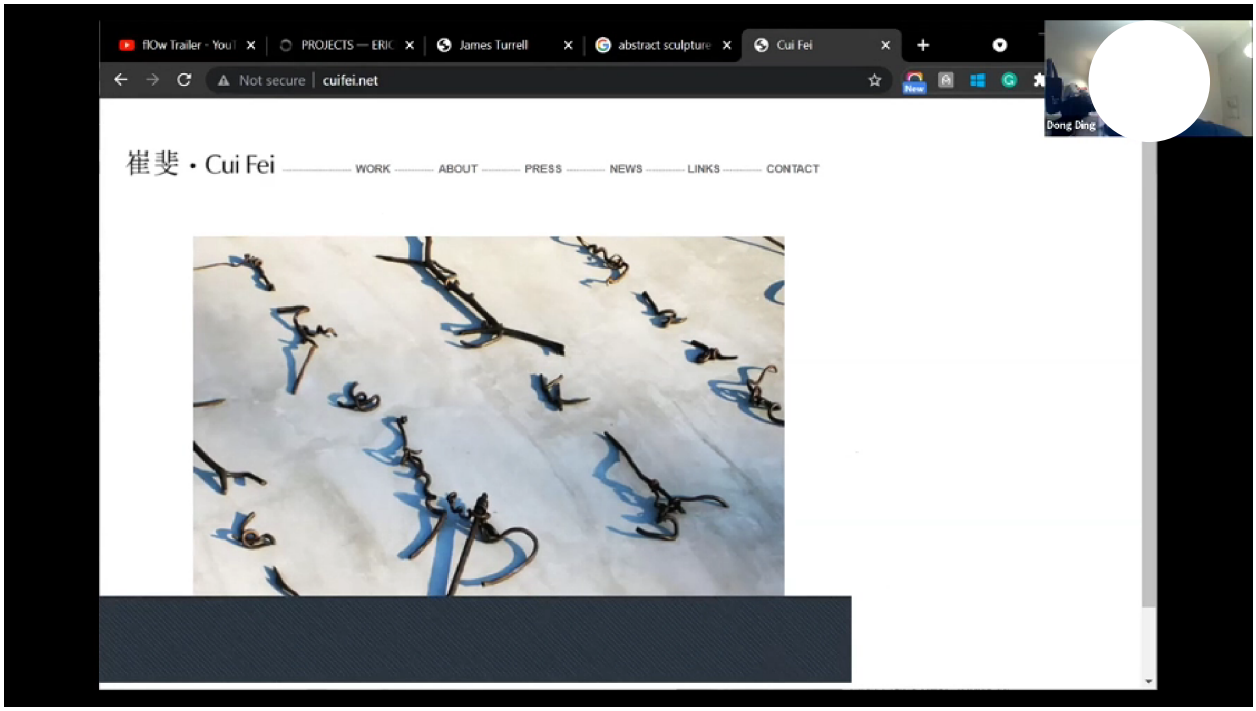
你知道就是说是我不知道这个音乐的话，Arabesque 的 piece 可能比较 simple，你可能很难有 multi-layer，我就在想我如果是如果一些其他的，Arabesque 是比较难，Arabesque 因为就是个 piano，如果是一个 Symphony，我觉得你就可以有不同的 layer，你知道吧

David 00:49:51

来对应不同的乐器。

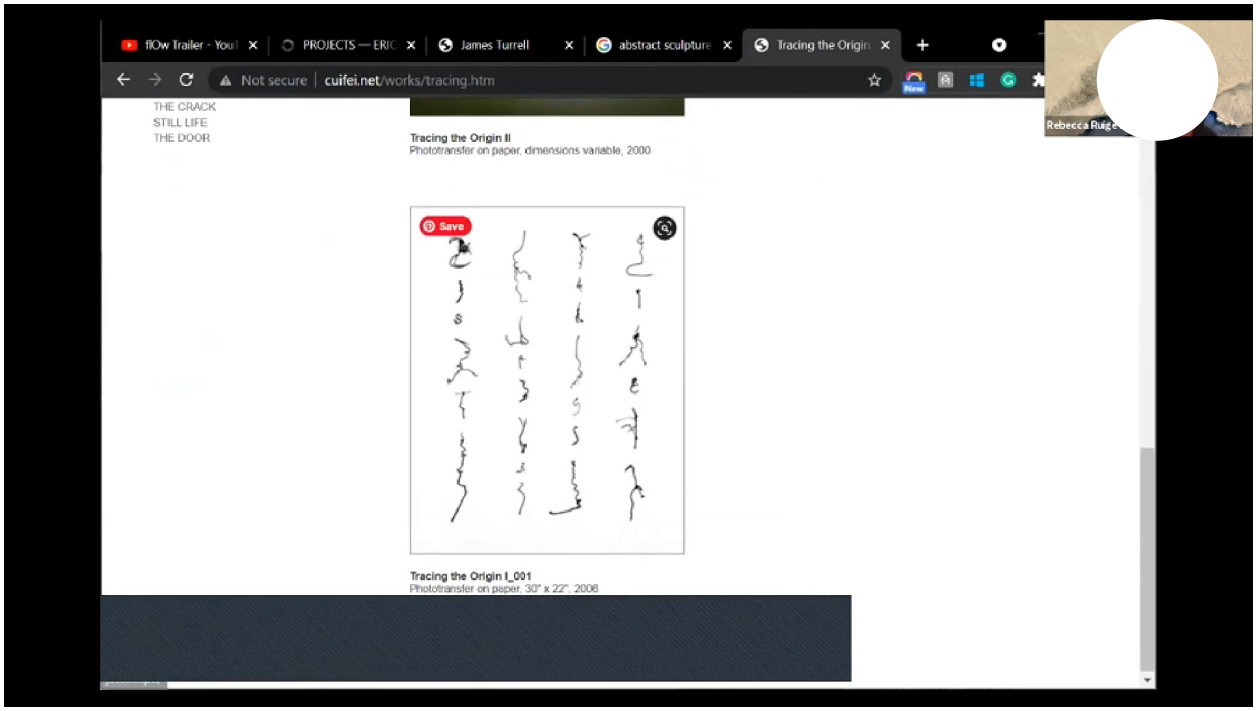
Rebecca 00:49:54

对，不同的乐器你可以做成不同的 layer，看看还有什么，为什么刚才会想起他的作品，我不记得。忘记为什么想他了。既然想起了他那就紧接着再看一下崔飞最近在做什么。



David 00:50:41
我这好有意思。

Rebecca 00:50:44
他的 series 他实际上做过很多的 series，他的这个东西它有好多是他自己弄的，有好多他全是捡的，你看一下他的。



他 series 的话基本上都是。他这些东西它是在自然里它捡的一些那种树枝什么的东西，有点像。

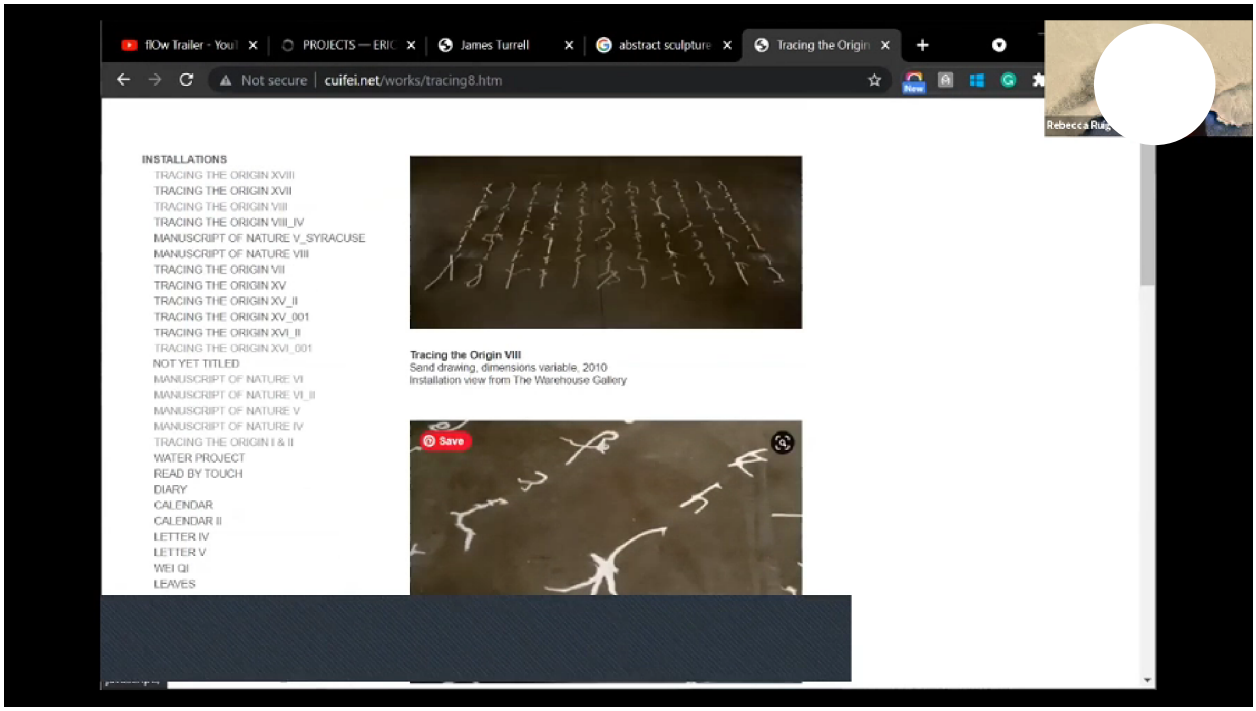
David 00:51:39

这个有点像书法的那种。

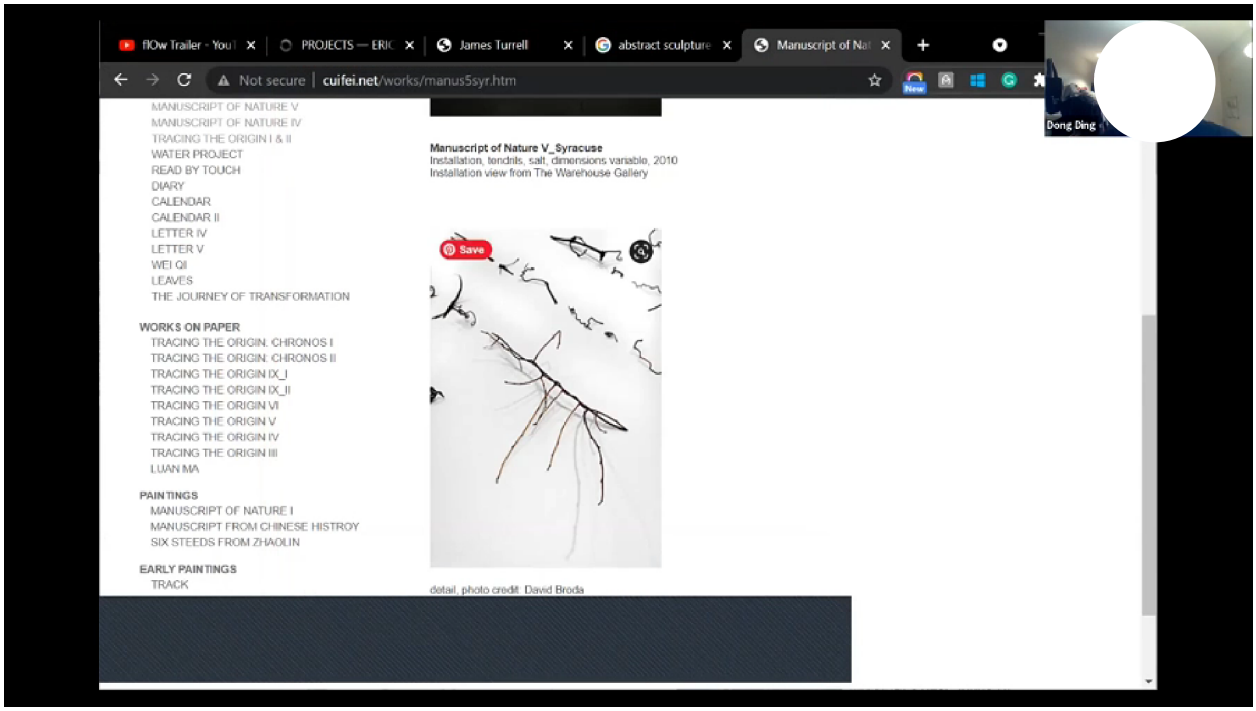
Rebecca 00:51:41

对的，这些东西实际上有可能说是跟 jewellery 它有的 sense 会比较接近。就是说是所以我就在想你除了敲打是不是还可以，你比如说你 bend 我不，我当然不知道你的材料了，这个东西就是你自己来定了。看看还有什么应该是。

看看他在做些什么。



我当然这个东西就要去读了，我就不知道现在他做我刚才给你看的比较早期。



他现在看着 project 的样子还是 similar，但是我相信他的 concept 已经 develop 了很远了，你能看到吗？这个很明显的，这就是树枝字。

最近也不知道在做什么，我好久也没有跟他联系。我原来去过他在纽约的 studio， ok 那位反正就忽然也想起了这两个 artist，所以想跟你就分享一下，也不知道会不会对你有启发。那个嗯，所以看一看，我觉得说是不仅想你的制作的方式，然后也想一下就说是我觉得你可能就是说你的操作什么的，你还记得我们在中间讨论过，就是说是把你这个东西更作为一个 performance piece，对吧？

就是说实际上你在整个的过程，它是 part of the piece。当然我们讨论了很多不同的方式，用 recording，对吧？或者是用 sound。就是说是用你的那些行动产生的材料，然后我们来做好多东西，但实际上另外一方面的话就是你整个的过程，它就是一个 performance，所以我就在想你要考虑 performance 的话，当然你一方面也要记录了，你看你怎么记录，但是另外一方面有一些这种 performance 的 element，你比如说你敲击的动作，还有我就想就说是你的敲击的这种这个方向，你的环境这些东西都可以考虑进去，我觉得搞的就更丰富一点，反正我就是想我觉得是所有的东西都可以考虑进来，你不要只是想自己，我就在工作台前我就开始敲了，所以我一直想有没有可能把一些其他的东西得加进去。

David 00:55:20

我还想到是，我刚刚讲到，我突然想到比如说我们说一个空间，然后在后续的合作里面可以考虑到，比如说你的空间的变化可以根据我敲击来产生一个变化。

比如说我们假设说这是一个有球形的空间，我在这个地方有个凹陷，在这里有一个突出，在这里有一个凹陷，它可以跟着音乐的律动，就突然这边啪有的东西降下来，然后这里突然突出去了，就仿佛是你在这个空间里面。

Rebecca 00:55:52

对的很有也很有意思，那种也很好玩，我觉得那种那种反而会我对可以做一个就这个就可以做一个小的 p 出来，我觉得就很有意思。

David 00:56:04

这几个包括这个是一个，还有刚刚我说固化空间的，就可以放在我们 step two 的时候去做 corporation 的时候来考虑这个东西。

Rebecca 00:56:13

对我觉得现在好像就有很多好的 idea，可以 collaborate 我觉得 piece 可以做一个很小的，但是这个东西就属于什么你知道你知道，电影节，我不知道你电影节你去的多不多，电影节就都是很大的片子，它中间会有那些小的片子，你知道那些的话都很短几分钟，但是他就会特别有效果那种，要么就是特别的 funny，要么就是说特别的 shocking 或者是特别什么的，他都有他的那种特别的高光点，你知道吗？

那种这种东西，所以我想我们刚刚说的这一个小点，你比如说我就产生这个空间，你就可以那边敲就声音，我想在 virtual 里面就是说你从左边敲的话，你声音从左边来。

David 00:57:06

然后左边的空间突然推进了塌陷了一样这种感觉。

Rebecca 00:57:07

对，然后慢慢的挤，慢慢的就是这种 sense。也蛮有意思，就这个东西 itself 我觉得就挺好玩。

David 00:57:17

对这个就可以放在我们合作的第二步里面去做，我已经可以我目前就想到第二步，我们可以做一个通过你的空间变化产生的一个固化空间的一个 sculpture，和通过 sculpture 产生的一个空间变化的这样一个 VR，我觉得这两个加在一起再形成一个对比，它就是一个很好的一组作品。

Rebecca 00:57:38

挺好。

David 00:57:40

对这个挺有意思，我的唯一想法我们最好能够稍微有一些文字上面的记录，这样在我后续做分析的时候都会很有。

Rebecca 00:57:52

Ok。我就在想，因为我们也在 record 的这个东西对不对？

David 00:58:02

我们也可以从这 record 里面其实就是摘录一些 bullet points 什么之类的，其实也可以。

Rebecca 00:58:07

对，是可以从这个来整理一下的。

然后另外一方面的话，当然说是我们自己 work on 我们自己的 project 的时候，那个东西是需要 document 一下的。

David 00:58:22

我不是说我另外有一个 project 是跟澳大利亚的一个博士合作的，它是一个建筑设计师，然后我们目前 Project 也是就突然停止了，因为他家里也出了一些事情，她的父亲去世了，然后她然后他就暂停了，他说要过个一两个月才能再继续。

我们那个课题也是他我们采取了一个什么方式，我们都是运用 rhino 来做一些模型建立的建模的这样的一个东西，然后我们就互相交换我们的模型，互相交换在产生一个交换了之后，我可以在它的模型上面去做一些改动，然后我在改动的时候，我就会写一个叫做 process blog，就会我可以写下来，我为什么要做这个改动，我怎么改，我改的时候的想法是什么？

然后她也写一个这个东西就产生了一个这样的，然后我们把改过的模型再进行一次交换。

然后我会写一个 reflection blog， reflection blog 就是我看见他改我的模型之后，我有什么想法，我觉得这个地方很有意思。

Rebecca 00:59:27

这很好玩。

David 00:59:29

对，每一次模型交换会产生 4 个 block，分属两边，然后这个材料就可以成为一个很好的定性分析的这样一个材料，对于我来说，然后会进行多次的这样的模型交换，这是第一步。

第二步也是其实跟我们一样，就会在同一个 VR 的空间里面共同去操纵一个模型，那么有一个软件叫做 fologram，我们原本是这个想法，我们两个人都可以戴着像手套一样东西就可以，比如说有点类似于像立体雕塑一样，我就可以这样去挪动这个东西，在一个 VR 的空间里。

然后在这个过程中，我们俩之间的交流也是一个知识转换的这样的过程，然后也可以去产生一个分析的材料，然后目前是那个课题是这样，我就觉得这个模式也可以差不多的应用在我们这个里面。

Rebecca 01:00:19

你们那边的话 blog 有没有开始写。

David 01:00:24

我写了，但是她还没写，因为她暂停了，我们目前只进行了第一次的交换。

Rebecca 01:00:31

Ok 我比较好奇，我比较好奇。

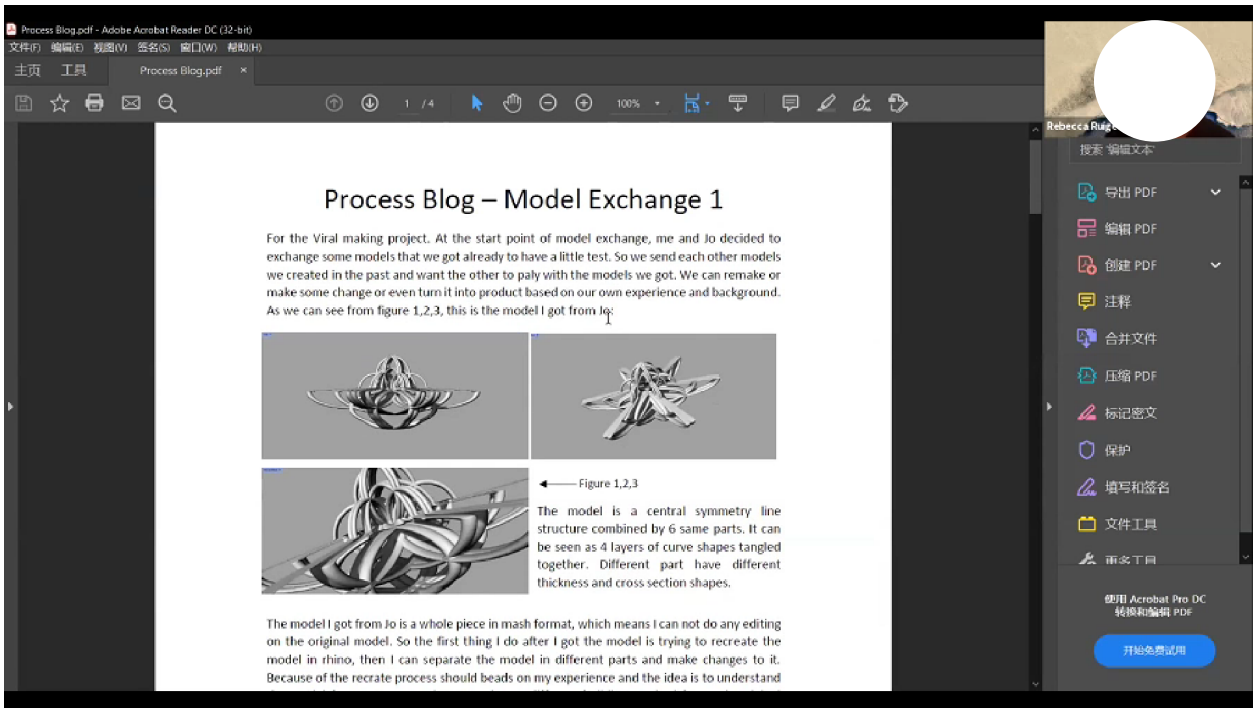
David 01:00:35

我这个东西我可以给您看一下，我先找一下，然后 share 给您看一下，您看。

Rebecca 01:00:40

对于我来讲，我觉得实际上你们两个怎么讲，对从我的理解来讲，我觉得 architect 和 any kind of 3D artist，我觉得有很多的共通之处，对吧？我觉得所以就是说尤其是你们对空间的处理，只不过是这个角度不一样罢了，但我的感觉是有很多的共通之处的，

David 01:01:28



你看我会说这个是我拿到的它的模型，然后我会说我对这个模型有什么感觉，然后我感觉它是一个什么样的扭曲的形状，然后我重新构建了这个模型是一个很相像的东西，然后我对它做了一定量的这种稍微的调整，然后一个扭曲，然后产生了一个什么样的变化，然后同时我以 jewellery 的角度来说，我把它 Scale 进行一个改变，然后多加了一些 layer，然后产生了一些比如说跟身体的连接，比如说这个就可以是耳钉，或者说我把切掉一层做一个 hollow，它可以作为 head piece 或者 shoulder piece 就这样子的感觉。

Rebecca 01:02:18

Ok 挺好玩，我我觉得蛮有意思。

David 01:02:22

对，这个就是我写的第一个 blog，然后我现在就要等到她写 blog，并且把她的模型反馈回来，我写一个 reflection，这样子的话就会产生这样子的文字的材料。Ok。

这个是第一次，因为我们第一回，像一个 pilot 一样，是她用了一个她给了我一个，她已经老早就建好的模型，我也给了她一个我老早就建好的模型，我们只是好了解一下，看在模型改变上面，然后写点东西去感受一下这个过程。

Rebecca 01:03:00

所以 ok 我觉得可能还要加一点点，就是说起码虽然是你们用以前的模型，但是我觉得就说是你要是从 process 的角度来讲，你刚开始你 create 这个模型，你为什么把形状设计成这样？要有一个最初的 thinking。

David 01:03:18

是的。

Rebecca 01:03:19

你们看可能要补充一下。不过我觉得挺有意思的，。

然后我就在想说我们做 project 的话，我觉得是这样子的，我肯定是起码第一步我们是做不到程度的这种往返，因为我没有这种 exchange 对吧？

David 01:03:41

就我们也是三个 step，第一个 step 是各自的创作的过程，我会觉得第一个 step 下面我们会更多的是记录自己创作的过程。

在第二个 step，包括我们刚刚说的，您用我的空间来做模型，然后我用你的空间来做模型，这个就已经产生一个交流了，这个过程我们就可以有一个有来有往的 reflection。

Rebecca 01:04:07

对的是这样子的。

好，好我赞成，我尽量。我这是 visual artist 一般情况下这个东西，就是说尤其是你在在创作的过程中是很难。

(对于 process record 的 thinking)

David 01:04:23
我也很难，我们一般没有文字记录，我会就随时随手拍照片，但是我可能后面我会把这照片排在一起，在旁边写一点点 note，我当时是咋想的，或者是能不能做一个小的 note 的记录，其实也够。

Rebecca 01:04:40

我就尽量在我产生 image 的时候，多记录。

好，我们接着再各自往前推进。

David 01:05:05

然后在做模，我是做模型，您是做一些图像上面的这样的一些 edit，推进也没有什么特别的时间限制，就走到哪一步是哪步，反正慢慢往前推。

Rebecca 01:05:12

然后对我希望我们下一次 meeting，你可能看到我 Schedule 的 set up 模式就是说 every two weeks 我不知道你可以吗

我觉得就说是 every 2 weeks 我们就碰一下头了，这个也未见得每次都要一个小时或者是一个半小时，这个时间我们不限制的，有的说就多说一点，有的有就是说没有太多的话那就会少一点。

这个就比较 flexible，但我希望我自己的话到下次起码会有一些那种 test 的 image，就是说我 visual 会更 from 一点。

David 01:05:59

我至少得出一些 test piece 出来，有一些型小的形态，或者是一两个的这种 test 模型出来，如果再不出来我也来不及了。

Rebecca 01:06:20

好的，我行可以我觉得慢慢的我们都又开始启动生活，慢慢回归正轨，希望如此。

所以就挺好，我们来接着做，对这个 project 的兴趣还是蛮大的。

然后因为也是我 healing series 中间的一个，所以我觉得它还是一个在我心里是一个 VR 的探索，是一个比较唯美的东西，所以我还是蛮感兴趣的，然后我先生因为他做 programs，然后他也是就说是一个，他很喜欢 classic music，所以他对这个东西也很感兴趣。

David 01:07:08

我还有一个事情也想问，您在做音乐分析的时候，因为我本身我是弹钢琴来着了，但是我没有做过这种东西，如果您产出了一些比如说对原始音乐的分析，比如说它的 beat 或者什么，你可以分享给我，因为我找不出来，我可能只能用耳朵去听但肯定是有差别，如果你出了出现了一个 beat 比如说你把 beat 分离出来，你就发给我，这样我就可以根据 beat 来做一些下一步的事。

Rebecca 01:07:40

Ok，我问一下我先生。what's the best way of doing this? 因为是这样子的，他原来是用一个音乐的分析的软件，你像我做的话，我在软件里面就可以看到 waveform。你可以看到 waveform，你可以对时间。

David 01:08:02

就截图给我也可以，因为我没有。

Rebecca 01:08:06

你就只是需要一些时间点。

David 01:08:09

我没有音乐分析软件，所以说我也不知道什么，是因为它里面就一段音乐里面有很多的 element 对吧?

它有节奏，它有强弱，它有波形，然后这个东西我没有办法得到信息，就是如果我们波形强弱这些东西就分享给我。

Rebecca 01:08:29

行，我跟我先生上商量一下，就说 what's the best way to share that Information with you?

David 01:08:36

好的，没有问题

Rebecca 01:08:38

然后在这种情况下，就是说你不是只是凭感觉，而是就说是有更直接的这种 data 的 connection。

David 01:08:48

可以无论是音乐的形式，或者说是图像的形式，或者说类似于像鼓点一样，就是一个叉一个叉一个叉，我就会知道在这一个小节里面，它的节奏是这个样子的。

Rebecca 01:09:00

行。好的，这件事情我问他一下，然后给你。

David 01:09:07

对能 as soon as possible 这样我就可以做更多的尝试。

Rebecca 01:09:14

行，看看今天礼拜二，好，就这几天看看能给一点。

David 01:09:20

因为我正好下周才能开始干活，我的 technician 医生去当陪审团了，我也没有办法，我从下周可以才能开始进工作室干活，其实时间真挺紧的，我就尽量会多做一点东西。

Rebecca 01:09:42

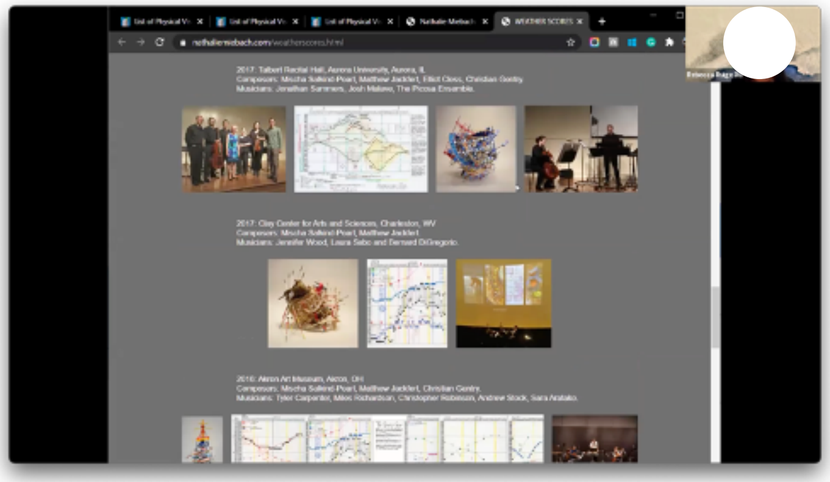
好的，我们先这个样子。Ok，好的，拜拜。

David 01:09:59

谢谢老师，拜拜。

Appendix 13: Examples of Data Review round 1.1

The raw data review round 1.1 occurred concurrently with the transcription process, during which I made simple annotations and comments to capture my immediate reactions to the data. The red sections in the figure 4.5-3 show an example of how the immediate comments are made alongside the data during transcription. This first round of review, serving as foundational material for subsequent analysis. Here is just an example of how the comments are been made during the transcript process.



看他的 project，首先是他把 weather 的数据它转成这种 sculpture 对吧？然后它转成 sculpture，你看从这是他的 sculpture，然后他从 sculpture 的话它又转成乐谱，这个 pop up 的乐谱你能不能看得到？

David 00:22:09

我能看到，但是我不知道这是怎么转过去的。

Rebecca 00:22:13

Ok 这个你就要做 research 了，但是它基本上就是说这个东西信息的转化，就是说你要有一个 system，你就要建立一个自己的 system，然后的话你一旦 system 建立的话。

David 00:22:27

你就什么东西丢进去，自然就会有产出。

（现在回过来看发现（从新回顾 或者说以第三视角审视才发现）我的 design 采取的也是这种方式，是 create 了一个 system 来将乐谱转化为图形和空间，所以在某种程度上来说，我采取了类似 data visualization 的方式在做 design，那么是否意味着我创作的 jewellery sculpture 就已经成为了 cross disciplinary jewellery 了呢？是否是由于 collaboration 过程中受到对方 field 的影响从而产生了领域的融合，进而影响到我的 design thinking 于是产生了 cross disciplinary 呢？这种过程在目前来看似乎是无意识的，自然发生的，是由于合作者之间的交流所产生的自然影响和自发的领域交叉。所以 cross disciplinary jewellery 是否不仅仅可以在以跨领域首饰创作为目的的合作课题中产生，是否有可能是（无意识的）合作课题中的自然产物呢？）

因此我们得到了另一个值得讨论的点：cross disciplinary jewellery 产生的条件是什么？或者说什么情况下会产生，是自发的，还是必须有意识的去创造？目前来看有自发产生的可能性，是由于合作课题中不同领域的交流会对双方的设计思路产生影响从而导致领域界限的模糊，双方领域所拥有的独特的思维方式，知识和技能会自然的在交流中产生流动从而影响到最终设计成果的呈现。

并且我们做的这个东西还是很想跟那个，你年轻人你随时去跳舞对不对？你去看那个 vg，vg 他们做的那些东西，它是一个它就更是那种一对一的反应，就是说音乐和图像是一个一对一的反应，那个东西刚开始看的比较酷炫，但是你三五分钟之后它就是永远是那样，它就一模一样的。

所以因为你的 expectation 你就已经 rich 了，你就知道这个东西怎么样样，所以就没有意思了。

正经的 vivo music 的 piece 它就说是永远有变化，他强调的是音乐和图形两个一起，它是两个一起，所以有音乐未见得有图形，有图形未见得有音乐，它有时候会在一起，它有时候不在一起，更是一种这个东西。

（回过来看可以发现，这是时候设计和合作的过程中 Rebecca 对于 flow，time 等属性和元素特别的强调的原因。）

所以的话如果是我们也是想做一个视频的，想做这样的东西，然后我还要给他确认一下，因为他现在比较想做一个这种 interactive 的就说是实时的东西，所以我也在考虑一下，不过我觉得这个很好，我很想。

David 00:42:39

我觉得有很多可以发展的方向，甚至于比如说就从我平时做就是 development 的方方向来说，我甚至于可以想到比如说您做的东西出来之后，给我，我对您的东西再去做一个反馈，比如说根据您的这个东西再去做一个反馈，可以把它越来越往前推，是不是？

就有点给我们 2D 转 3D，然后 3D 再转成 2D，再转成 3D 这样一种发展的过程。

Rebecca 00:43:06

好 ok，我们先再想一想 ok，但是我觉得基本上大致定的话，就是说我这边是做做一个视频版，然后你那边是做一个，选取一段，就多大一段随便你，然后来做一个这种 physical 的对吧？然后的话然后我们再想一想，我们怎么能把我们两个东西合在一起？合在一起，我已经有一个 idea，我觉得合在一起你可以就是说像我们刚才说的 performance piece，对不对？Performance 的 piece 和加上你录的声音，ok 然后再加上我这边的 visual，这个东西就是我这边的 visual 可以用我第一段的，然后也可以重新做一些其他的 visual，我觉得这个东西是可以怎么弄在一起的，你比如说把我的，ok 我可以这样，我可以就说是针对比如说你录下来你做的过程对吧？

你录下来的声音，我真正针对你那个声音，我去 visualize 那个声音。

David 00:44:15

对，这就有点像我刚刚最后说的，你给我的东西做一个反馈，对，然后我也可以给你那东西做一个反馈，对。

Rebecca 00:44:22

然后把那个东西然后我们搁到最后的 piece 里面。

David 00:44:26

是的。

Rebecca 00:44:27

Ok 那个时间上你是有一个什么样子的限制？因为 phd 会有，至少有一个大概的 timeline

Appendix 14: Examples of Data Review round 1.2

The round 1.2 took place after all meeting recordings were transcribed. This round provided a more detailed breakdown and commentary of the data, partly influenced by the comments and questions raised during the round 1.1 data review. The comments from round 1.1 inspired more detailed questions and comments in this round, which leading to the identified of additional relevant data during this round 1.2 and led to further reflection and discussion. The method used in this round of data review was carried out by using the review function of the Microsoft Word software to add comments to the specific selected data, as shown in figure 4.5-4 is an example of where comments were added to documents. Here is just an example of how the comments are been made by using the review function of the software.

David 00:08:36

因为比如说我敲出来的时候，它的形变是不一样的，或者说是我用不同的纹理去敲敲出来的纹理是不一样的，然后它会形成一个非常有趣的form，这也是可以的这样的东西就是从design角度来说，然后另外我觉得这个也是一个很好的课题，甚至于是我可以比如说加入您的某一个课题，就不一定限定是一个，甚至于可以是几个，然后或者说你已经在做的课题里面，我们可以去做完了以后整个课题产生一个对比，比如说作为一个craft的人，我进入了这个课题之后的产出和您作为一个比如偏2D的这样的人的产出和不同的专业人的产出，他们这群产出的区别。

Rebecca 00:09:18

欸我觉得这个很好，我觉得这蛮好玩的，我觉得这个东西蛮好玩的，如果是这样的话，我觉得用Arabesque就最合适。

你知道为什么Arabesque，因为就是说大家都是特别的熟的一首曲子，就全世界人民都知道，你在这种情况下的话就说是呃呃，然后又没有版权问题，然后我们做两种不同的呈现方式，我觉得做出来就会比较的就会有很有意思，你知道吗?

我觉得而且是就比较有意思。

IDavid 00:09:49

如果说本身从我自己的课题上面来讲，我也可以把它作为一个它也是一个很好的理论分析的例子，因为它涉及到不同专业的人和不同专业的人对应的不同产出，你就可以看看到这个knowledge或者说是各种不同的数据在这里面产生什么样的变化，然后出去以后通过不同...

Rebecca 00:10:11

好好好，我们来做这个.,我要一下,我去跟那个pianist要一下permission，要一下permission，我觉得这个东西是可以做的。这个对我反正是要做一版visual的，如果是你能再做一个就说是这种实体的whatever这个形式，我们这个东西当然可以。我们可以在仔细的想一下这件事情就是说这件事情我们俩 completely separate，你做你的我做我的，还是说就是说我们中间有一些什么样子的connection，你比如说我们就define一些parameter，就说有一些东西我们都走，比如说我们都走 pitch，ok或者是我们都走他的就说是他的，我想因为我的音乐我是过 program来分析的。

David 00:11:11

所以它好多都是波形。

Rebecca 00:11:14

对它的波形是分析出来，然后我把波形再转到我的 program里面来生成图形，它是这么一个过程。

Yes, the wave forms are analysed by the program, and then I transfer the wave form into my program to generate graphics. That's the process.

所以我就想就说是可以有一些东西的话跟你跟你商讨一下，这样的话我觉得我们两个东西如果说完全不一样，还不是很有意思，我觉得最好是有一些相关的地方。有几个点。

So I just want to say that we can discuss something. I think it's not very interesting if we create pieces completely different. I think it's better to have something related, like some points.



然后另外一种像我这种人我可以做到的，我听到音乐的时候，如果我想我脑子里面是是有颜色的，有图形的。

The other one, it's like, people like me can do, When I hear music, if I want, there are colours and graphics in my mind.

David 00:13:44

这种通感就好厉害，太羡慕了，真的我太羡慕了。

Rebecca 00:13:50

对他是这样样子，但是我还跟他们的不一样，我不知道他有那种condition的人，他是怎么回事，他是就说，每次听这个音乐它是一样的图形一样的颜色吗？还是？你像我的话就比较的虚无，你知道吗？

David :14:04

都是不一样的，是偏 Free style的那种。

Rebecca 00:14:09

对于像我来讲的话，并且我很受我的就说我的surrounding的影响，我的情绪的影响，这些东西它会影响就是说我听到音乐的感受，然后在我脑海里也是不一样的。

David 00:14:21

这个也很有意思。我觉得我好像之前听过有专门那种疾病的人，或者说有这种问题的这种人。中文应该就是叫通感还是叫什么？

Rebecca 00:15:52

Anyway所以我觉得，所以的话可以就是说这个表现的方式，我们想一下就说是怎么弄，所以我现在就比较直观，我刚开始讲我对jewellery design的理解和对sculpture的理解，就是说这个东西是一个静的对吧？你就有这个东西他就在那里。

但是你刚刚跟我描述了一下，就是说你比如说像你在打击什么的。对我觉得过程中也是可以掌控的。

Rebecca 00:16:22

对,你这个东西的话就成了一个在我们这个领域里就成了一个 performance art.

你整个的过程是是part of的piece，你不是说只是final outcome，你是整个过程成了一个performance的piece，就是整个的过程你在跟他的是连起来，并且另外一点的话，你整个的过程你知道你对john cage的work熟不熟?

The whole process of your making is part of piece. It's not just the final outcome. Your whole process has become a performance piece. The whole process is connected. And on the other hand, do you familiar with John Cage's work?

David 00:16:51

栋 丁栋
2022年11月14日

How Rebecca feel music

栋 丁栋
2022年11月14日

这奠定了她的design decision的基础，比如她选择的color range就是基于此决定的

栋 丁栋
2022年11月14日

Design decision Making

栋 丁栋
2022年11月14日

Design Decision Making

栋 丁栋
2022年11月14日

同一种表现方式或者说设计的手法在不同领域里的呈现完全不同，首饰设计和制作的过程，在visual领域里成为了performance art。在首饰领域中敲击，声音等这些只是技巧或者通向成品的过程，但在visual领域却可以输出成为作品的一部分，是很有意思的。

Appendix 15: Analytical tables from Data Review round 2.1

In round 2.1, data was thematically classified based on the comments from the first two rounds. Data was processed in a tabular format, as shown in figure 4.5-5, by thematically tagging each single data file (divided by the date of meeting) . Each table contains the location of the original data (i.e., time code), keywords, themes, and comments on the original data. Here I will provide all tables of been created during round 2.1.

Analysis - Meeting Records - 2020.10.09

Time	Key Words	Comments
00:00:46 - 00:01:20	Collaboration Process Documentation	对于在 practice project 中 research purpose 相关的 method - 即 documentation process 的初步讨论
00:03:08 - 00:08:17	Collaboration Process Design decision making	对于 visual music 的 beginning interest
00:09:18 - 00:09:49		Rebecca 认为 arabesque 合适的原因
00:24:56 - 00:26:41		Why Rebecca pick this music
00:13:22 - 00:14:21	Design Decision Making	How Rebecca feel the music - 这奠定了她的 design decision 的基础，比如她选择的 color range 就是基于此决定的
00:15:52 - 00:20:42	Design Decision Making Design Process	同一种表现方式或者说设计的手法在不同领域里的呈现完全不同，首饰设计和制作的过程，在 visual 领域里成为了 performance art。在首饰领域中敲击，声音等这些只是技巧或者通向成品的过程，但在 visual 领域却可以输出成为作品的一部分，是很有意思的。
00:21:18 - 00:22:29	跨领域首饰的产生 Design Process Design Decision Making	现在回过来看发现（从新回顾 或者说以第三视角审视才发现）我的 design 采取的也是这种方式，是 create 了一个 system 来将乐谱转化为图形和空间，所以在某种程度上来说，我采取了类似 data visualization 的方式在做 design，那么是否意味着我创作的 jewellery sculpture 就已经成为了 cross disciplinary jewellery 了呢？是否是由于 collaboration 过程中受到对方 field 的影响从而产生了领域的融合，进而影响到我的 design thinking 于是产生了 cross disciplinary 呢？这种过程在目前来看似乎是无意识的，自然发生的，是由于合作者之间的交流所产生的自然影响和自发的领域交叉。所以 cross disciplinary jewellery 是否不仅仅可以在以跨领域首饰创作为目的的合作课题中产生，是否有可能是（无意识的）合作课题中的自然产物呢？
		因此我们得到了另一个值得讨论的点：cross disciplinary jewellery 产生的条件是什么？或者说什么情况下会产生，是自发的，还是必须有意识的去创造？目前来看有自发产生的可能性，是由于合作课题中不同领域的交流会对双方的设计思路产生影响从而导致领域界限的模糊，双方领域所拥有的独特的思维方式，知识和技能会自然的在交流中产生流动从而影响到最终设计成果的呈现。
		因此是否应该从另一个视角来分析跨领域首饰的定义及产生？是非目的性的，是思想，知识和技能在领域之间流动的自然产物？
00:40:17 - 00:42:39	Design Decision Making	回过来看可以发现，这可能是设计和合作的过程中 Rebecca 对于 flow，time 等属性和元素特别的强调的原因。

Analysis - Meeting Records - 2020.11.13

Time	Key Words	Comments
00:00:56 - 00:05:20	Design decision making Project management	一开始我是试图按照 filed 来界定课题中我和 Rebecca 的部分，但实际上在各个阶段中我们的领域都产生了一定程度上的 overlap，并且我们的设计创作并非只被限定在自己的领域中（这和之后提出的跨领域首饰是否是合作的自然产物的讨论有一定的关联性），所以我们讨论之后决定以课题的阶段来分类（阶段时通过 time line 以及合作的方式 - individual? with feedback? or co-design? 来区分的）
		回过头来看，跨领域首饰的属性在建立课题的初期其实就已经对课题的建立产生了某些方面的影响，但由于我 allow 课题完全的自由度去自然发展，所以在课题建立的过程中没有意识到这一点。
00:08:38 - 00:09:39	Multi-role	Rebecca 建议分离 practice 和 research 的 aims，这里可以和之后提出的 craft and design 背景的 researcher 在一个带有 research 目的的 practice project 里如何去平衡，界定和 manage 两个不同的 role 的讨论联系起来。
		同样的，在合作课题中同时扮演多重角色的（设计师和研究者）的问题在一开始建立课题的时候就有一定的显现，并在之后课题发展的过程中对课题的展开产生了极大的影响

Analysis - Meeting Records - 2021.06.09

Time	Key Words	Comments
00:06:06 - 00:08:20	Design Decision Making Collaboration process Project management Design Development Process	由于不是沉浸在一个固定的课题里，online 合作会受到很多其他因素的影响，比如手上的其他课题的 concept 有可能会影响到这个课题，但不能说是坏事，因为有可能会带来新的视角。对于 craft 来讲，一般来说都是沉浸在课题中，沉浸在与材料的 interaction 中来推进课题的进程，很少会受到其他课题的干扰。
00:08:22	Design decision making Design Development Process	
00:12:14 - 00:18:22	Design Development Process Design Decision Making	Rebecca speaks about 为什么会想要 link 到 healing
00:18:25 - 00:20:46	Design Decision Making Design Development Process	
00:20:48 - 00:21:17		
00:21:17 - 00:21:44		rebecca 通过找寻和 vr 相似的感觉去理解 physic piece 的方式让我想到之后我们的讨论，我通过 physic 的思维去看待 digital model，这是我们被自己专业背景和专业惯性思维所影响的结果。
00:21:53		
00:25:16 - 00:34:15		
00:34:15 - 00:37:13		effect between collaborators in step 1
00:38:37 - 00:39:59		
00:36:20 - 00:37:13	Design Thinking Documentation Multi-roles	
00:37:16 - 00:38:37		所以会不停的有想法的 shift, design decision 的 shift，回沉浸在 design thinking 里而忽略 research
00:39:59 - 00:41:57	Collaborative Decision Making	
00:42:19 - 00:44:21	Collaboration process Documentation Multi-roles	
01:03:41 - 01:05:05		对于 process record 的 thinking
00:55:20 - 00:57:40	Collaborative Decision Making Design Development Process	
00:57:40 - 01:00:19	Collaboration Process Documentation	

Analysis - Meeting Records - 2021.07.06

Time	Key Words	Common
00:03:18 - 00:05:04	Design Decision Making Design Development Process	
00:05:04	Design Decision Making - Concept shift	
00:08:32 - 00:10:20	Design Decision Making Effect between collaborators in step 1	回过头看，这里的交流可能影响了我的整体造型的塑造，我也选择采用层叠的通道空间
00:10:20 - 00:11:35		我的设计的整体形态在讨论的过程中受对方思维的影响产生了变化
00:07:05 - 00:08:32	Collaboration Process Documentation Multi-Role	
00:15:09 - 00:16:19	Collaboration Process	Ida 的态度变化说明 Base 在一定的 benefit 上的合作可以提升合作的兴趣
		合作建立在双方的合作意愿和 benefit 之上

Analysis - Meeting Records - 2021.08.03

Time	Key Words	Comments
00:09:39 - 00:12:42	Collaboration Process Collaborator role	合作成功与否在某种程度上也要看合作者对于自己的定位和对于合作的 motivation，如果只认定自己是技工技术的工具，那参与感的缺失必然会导致合作进程的缓慢甚至失败。
00:19:26 - 00:22:57	Collaboration Process Documentation Multi-Roles	
00:26:05 - 00:26:51		
00:22:57 - 00:26:05	Design Decision Making Design Development Process	

Analysis - Meeting Records - 2021.09.09

Time	Key Words	Comments
00:06:01 - 00:09:03	Design Decision Making	
00:10:53 - 00:14:16	Design Decision Making Design Development Process	
00:14:38 - 00:16:33	Collaborative Decision Making	
00:17:26 - 00:19:48	Collaboration Process Documentation Multi-roles	Artist 往往更沉浸在设计与材料的感知中，会快速的在不同的工具，材料之间产生 shift，而沉浸所带来的的往往是只针对于 project outcome 和 process 的关注。这是 craft practice 的一大特点，也是区别于 research 的地方。也可能是为什么 craft research 难以使用普通 research 方法来推进的地方。Artist 的工作方式决定了他们在沉浸在课题的过程中很难转换 researcher 的思维，两者不同的 focused 的点决定了他们工作方式和关注点的不同，很难兼顾。会对 process 产生影响。也是为什么我选择采取沉浸式的 practice process 并通过不影响沉浸体验的 recording 方式来获取数据，在 practice 结束之后再重新 review 数据的原因。这种方法论的使用的在这里得到了验证。
00:29:32 - 00:30:12		Practice collaboration project 建立与我的 research 的联系？

Analysis - Meeting Records - 2021.09.23

Time	Key Words	Comments
00:00:08 - 00:08:22	Design decision making	
00:08:22 - 00:08:54	Design develop discussion between collaborator	
00:11:16 - 00:12:22		这个关于 display 的讨论在我第一部分的最终设计中也有所体现，最终的呈现是受到讨论影响的
00:13:01 - 00:16:19		对于 display 的讨论
00:16:19 - 00:18:10		对于内外空间区分的讨论
00:19:02 - 00:21:02		对于成品形态/展示的讨论

Analysis - Meeting Records - 2021.10.07

Time	Key Words	Comments
00:07:36 - 00:11:44	Design Decision Making	
00:15:32		
00:11:44 - 00:13:16	Collaborative decision making	

Analysis - Meeting Records - 2021.11.04

Time	Key Words	Comments
00:01:50 - 00:04:06	Design decision making	
00:04:16 - 00:10:45	Design develop discussion between collaborator	
00:15:53 - 00:17:46		
00:13:19 - 00:14:46	Collaborative design discussion	
00:30:21 - 00:30:39	Collaboration Process Documentation Multi-roles	如何去定义值不值得？是从什么角度来判定是否值得？从 craft role 还是 research role？是否是 craft 的思维导致的这样的判断？应该用哪种思维判断？如何选择？
00:31:03 - 00:31:33		是否应该在一开始就提出问题？我采用的 free 的方式和这种有目的性的存在的区别？可以 discuss。

Analysis - Meeting Records - 2021.11.17

Time	Key Words	Comments
00:10:37 - 00:10:51	Collaboration Process Multi-roles	Craft researcher 如何平衡 research 和 project，以及这两部分是如何相互影响是值得探讨的，比如 craft base 的人由于以往的沉浸式 project 习惯，会很难介入 research 的元素，比如 Rebecca 不习惯 record，比如我对于沉浸式的 project method 的选择就是尝试在解决这个问题，尝试减少 research 对于 project 发展的影响
00:22:39 - 00:25:47	Design decision making	Rebecca 在整个设计中最在乎的属性是 time，她认为音乐是 time base 的所以一定要想办法去体现音乐的时间属性，这也是她不停的做测试的点。我的 design，每一片是一个小结的总和/积累/留存，整个通道就是整个音乐的积累，我是通过这种方式来体现音乐的时间属性的，可以思考是不是因为 background 的原因，这是通过 physical 来固化时间属性的方式？是否是因为 physical piece 是无法变化的所以才采取固化的方式来体现时间属性？Rebecca 由于不同的 background 采取了不同的方式来体现音乐的时间属性。由于 digital video 或者 vr 是可以变化的，所以采取了不同的方式体现时间属性？）
00:26:27 - 00:27:12	Collaborative decision making	或许这是合作的其中一个方向？我表现乐谱，Rebecca 表现细节？
00:27:12 - 00:28:43		
00:31:02	Collaboration Process Multi-roles Project management	很多 craft 的人，包括设计师，由于我们习惯工作方式的原因，之前文献有提到，design 是一个在过程中发现问题再解决问题的模式，所以很难有'大局观'会等待问题自然产生在针对解决，这也许是产生这个 gap 的原因，是没有相关理论指导的原因，因此很难有一个理论去总结这种类型多样且繁复独特的过程。也许并不需要产生 common 理论而是告诉大家存在这个问题？告诉大家通过我的观察发现由于 craft 的属性这个理论是很难产生的，应该具体问题具体解决的，并解释原因？
00:33:32 - 00:34:13		也是同样的原因，导致我的 manage 会与别人不一样，所以我觉得 craft 是否应该遵循一般的 research 步骤来做 research 是很值得讨论的，拥有 craft 背景的人在同时身兼 researcher 的时候是否应该采取独特的研究方法来 approach craft 研究呢？当一个 craft research 身兼数职的时候，是应该以 craft 的视角还是 research 的视角来做呢，我认为以纯 research 的视角会丢失 craft 的独特性，但以纯 craft 的视角是不适合做研究的，那既然这样又是否存在一个中间值呢？是否有一种方法可以以 craft 的思维来做 research 呢？
		包括是不是 stay with plan，plan 的 flexibility 都有 craft base decision 的影子
00:36:32 - 00:36:57	Research interest/gap Project management	有很多研究 collaboration 的书，也有很多讲 collaboration process 的书，既然有很多相关研究，我是否应该把研究重点放在 jeweller 如何通过 collaboration 来做 research？或者说在尝试定义和检验定义以及为 create cross- disciplinary jewellery through collaboration 提供案例研究的过程中，由于我的多重身份，从而可以讨论这类研究中的身份定义，身份转换等？

Analysis - Meeting Records - 2022.02.17

Time	Key Words	Comments
00:00:00 - 00:13:03	Design decision making Design develop discussion between collaborator	
00:13:03 - 00:15:33		
00:17:18 - 00:37:21		关于我的 design 的颜色的讨论，这部分虽然 Rebecca 提出了自己的建议，但由于我们 design 方式的不同产生了分歧，但在这次的讨论中我们并没有影响到对方的 design thinking，而是双方都坚持了自己原本的看法
00:37:21 - 00:38:06		我和 Rebecca 在颜色的选取方面产生了分歧，我觉得是由于我们的设计方式以及设计思维不同造成的，Rebecca 通过 emotional 的方式来感知音乐所以会对乐曲的 color range 有一个界定，但我并非通过感知的方式来获取对于音乐 piece 的 design idea，所以乐曲的颜色属性对我来说并不重要。
00:38:06 - 00:42:29	Collaborative design decision	
00:46:27 - 00:53:32	Collaboration process Project management	两个课题在这里产生了 connection，music project 产生的模型被使用在 viral making 的课题中并产生了新的 development，产生的新的 develop 被拿回 music project 讨论，这符合之前讨论的，远程合作的特点，即由于远程课题的时间线很长，并且不是沉浸式的课题发展，会很容易受到其他课题的影响，甚至使不同的课题产生链接，比如之前 Rebecca 把课题 concept 转向 healing，把课题转向共生等，在这里是我的两个课题产生了联系。这样的发展是有好有坏的，在这里是好的，因为提供了课题的新视角，产生了联系和新的发展。
00:55:03 - 00:58:15	Documentation	

Analysis - Meeting Records - 2022.03.21

Time	Key Words	Common
00:00:29 - 00:00:44	Collaboration Process Documentation	
00:02:14 - 00:02:38		
00:27:54 - 00:29:16		
00:30:20 - 00:33:04		
00:00:00 - 00:17:11	Design decision making	Rebecca 对于色彩，空间，元素等的选取和理由
00:20:21 - 00:27:54		
00:33:04 - 00:36:53		David's design process
00:37:18 - 00:38:22		
00:43:15 - 00:48:51		
00:50:22 - 00:57:38		
00:17:11 - 00:20:18		
	Collaborative design discussion	
00:29:16 - 00:30:15		
00:36:53 - 00:37:14	Design decision making Design discussion between collaborator	
00:48:51 - 00:50:13		不同的 media 导致作品有不同的呈现方式，这是和专业背景相关的讨论

Analysis - Meeting Records - 2022.04.01

Time	Key Words	Common
00:03:31 - 00:10:19	Design decision making	
00:10:19 - 00:10:49	Collaboration Process	Rebecca 和 Sean 也是属于以合作的方式工作，从这里我们可以看出一个设计师 background 的和 program background 的合作出现的问题是作为只负责 technical 的 programmer 在很多时候没办法 fellow designer 的思维和感觉，只能通过语言的描述来机械的执行命令，但很多时候 designer 是通过感觉来创作的，且这种感觉很难被语言和文字进行描述，所以从一定程度上来说这是 Rebecca 课题推进缓慢以及状况频出的原因之一。
00:11:38 - 00:14:41	Project management	或许可以对比一下这两种方式对合作过程，最终成品的影响，对 research 的影响 （可以被放到后续研究里去）
00:16:06 - 00:29:35	Collaborative design decision Collaboration Process	两个课题在这里再次产生的交错，在 viral making 课题中由于和 Jo 的合作而对模型做出的 development 被带回了课题中与 Rebecca 讨论，成为了下一步设计发展的基础。两个课题互相产生的影响似乎像是在课题中引入了另一个合作者，或者说是引入了另一个不与我们产生交流的独立的外部视角，是很有趣的一个合作的 role。这种角色独特的合作者的引入也是一种独特的合作方式，我认为是由于远距离合作的 falexiblity 所带来的，虽然不是远程合作所独有的，但是在远程合作中更容易产生这种角色，尤其是在两个相关的课题同时发生的时候，由于远程合作的时间的长短，完全的沉浸的缺失，从而允许了更多的外部因素的打扰，就给引入外部视角提供了独特的环境，这一点我认为是可以值得被讨论的。
00:19:17 - 00:24:55	Design decision making	
00:24:55 - 00:29:35	Collaborative design discussion	双方对于颜色，空间的不同理解
00:19:16	Design Process Design decision making	和之后讨论中提到的 对于 physical 和 digital 的理解有相关性
00:20:23 - 00:20:38		由于专业背景的不同对于材料，design element 和设计成果的理解是不同的，比如这个分离的空间，由于我是 deal with physical material 的，所以我就认为这是不可行的，在很多时候我会选择排除这种 design 或者采取某些方式来将他们的空间联系在一起。这样就会失去 design 原本应有的空间感和形态。但 Rebecca 是处理 digital 和 visual 的，这样的空间在 VR 或者视频中不仅不存在问题，反而会显得很有趣，所以她反而会对这个部分感到感兴趣并觉得可以进一步发展。这里就体现出不同专业背景对于 design element 以及 design decision making 所产生的不同的影响。

Analysis - Meeting Records - 2022.05.01

Time	Key Words	Common
00:00:01 - 00:03:58	Design Process Design Decision Making	因为识别和选取的 design element 不同，比如对 Rebecca 来说，乐曲中的小停顿是非常重要的 design element, 从而导致会遇到不一样的问题。
00:04:10 - 00:07:03		寻找合适的 design tool 来应对不同的 design elements 是很重要的，也是必然会面对的问题，尤其在不同的专业背景下会放大这个问题，甚至也可能产生矛盾？
00:07:14 - 00:08:14	Collaboration Process Documentation Multi-roles	Rebecca 对于 process documentation 是有选择的，比如看着就不对的东西，被立刻否决的东西就选择不做 documentation。这其实是很符合艺术家的思维的。对于这个 specific 的课题，是由于我带着研究的目的去做这个课题所以才有意识的去做了 documentation。不然的话一般来说我在很多时候也会在脑子里产生很多想法，但会做出筛选再进行下一步的 test，在 test 过程中也会即时的否定掉一些东西。我认为这是研究思维和 craft 实践思维的区别所在。
00:11:44 - 00:12:54	Collaboration Process	课题周期的长短影响了 stage 之间的界限
	Project Management	传统的沉浸式的线下课题合作的一个特点是由于课题周期短且集中，合作者在短时间内处在同一空间内进行集中且专注的针对合作课题的创作，总而可以使合作的双方更加 focus 在课题的制作上从而提高合作的效率。 但 online base 的远距离合作由于合作双方并非只专注于合作课题这一件事，空间和时间更为分离以及各自本来的 role 比如教学等，会更加受到其他事物的打扰。 但这样的时空分离会使课题在 manage 上拥有更好的自由度和更长的思考周期。尤其对于设计来说，灵感往往来源于生活甚至其他的课题和课程等。因此虽然看似打扰了课题的专注度但其实却带来新的灵感。 同时，由于并非专注于课题且是 long distance 所以可以缓解合作者之间的紧张从而获得更好的合作氛围 这是本课题区别于很多其他课题的地方
00:12:54 - 00:14:47	Collaboration Process Project Management	计划和实际 happened differently 是在 collaboration 中非常常见的，在长距离的合作中由于影响因素更多，所以可能受到的影响更多，如何 mange 是直的讨论的。
00:15:51 - 00:19:16	Collaboration Process	从 Rebecca 的角度看，她将合作的第二部分 co-design 类比共生，将合作关系类比共生关系。我认为是很有趣的。
00:19:16 - 00:21:56		合作方式的 positive 和 negative? 课题展开方式，实施方式的 positive 和 negative? Link 到 Diago 对于 true collaboration 的讨论？
00:29:20 - 00:30:00	Design Process Design Decision Making	专业 background 使 Rebecca 对于 AR 和 VR 技术有与我不同的更深层次的理解。我更多是是把它作为一个具象化模型的技术，而 Rebecca 会考虑虚拟空间和观众的关系，以及对观众在各种知觉上的影响。但我只把它作为模型视觉数字具象化的技术来使用。
00:30:00 - 00:31:28		由于我通常 deal with 的是 physical piece 所以 physical 的常见属性就是需要由观众来进行主动的 interaction，所以我的想法是由这个习惯性思维决定的，于是在处理 digital media 的时候也习惯性的将主动权交给观众。但 Rebecca deal with 的 digital media 是可以主动对观众发起 interaction 的，所以她会更希望能够让作品掌控一定的主动权来引导观众。这是由于专业背景的不同所产生的思维差异在设计元素运用和设计想法上产生的区别。
00:31:35 - 00:32:52		由于 background 的区别，我虽然在某种程度上也 get involved with digital media 和 digital knowledge & skill set，但我还是会优先 craft 思维，即制作实物的思维，digital 只被我认定为工具或者表现形式的一种，是对于具像化的 physical piece 的数字化版本-我在使用 digital 工具的时候也是，例如之前我讨论到我 get involved with digital technology 但我实际只是将 physical craft 数字化，我设计的本质还是 physical 的，只是为其建造了数字模型，或者说用数字的方式再现了。但 Rebecca 则的 field background 则让她以完全不同的视角来看待数字模型。
00:32:52 - 00:34:12		Rebecca 会考虑到数字模型与人的交互，而这种交互与我思考中的 piece 与人的交互是不同的。由于形式的自然属性与限制，physical 与人交互的主动权掌握在人的手里，但 digital 除了人与之主动交互之外，digital piece 也可以成为发起交互主动权的对象，即 piece 可以主动与人交互，甚至引导人与它的交互方式。这里很好的体现了基础思维的不一样如何影响创作方式的不一样以及成品的不一样，从过程的角度来讲可以很好的看到不同的 background 对于相同的 design element 的运用的区别以及这个问题在 collaboration 中的产生与解决。
01:07:38 - 01:08:34	Collaboration Process Project Management	Project step 顺序的改变有可能会影响到合作者的思维，尤其是像这种有 independent design 和 co- design 的课题，但由于我们一直在交流，其实也被互相影响了，所以这是值得 discuss 的地方。
01:09:21 - 01:09:59		Rebecca 的体会可以作为 interview 的问题之一

Appendix 16: Analytical tables from Data Review round 2.2

During round 2.2, the data was organized based on the thematic tables generated in the earlier round (2.1). This process involved not just a single document, but rather extended across all data files, sorting relevant data and cluster it into smaller datasets. The table above (figure 4.5-6 and 4.5-7) shows one example of such dataset, with each dataset containing critical information about the document in which the data is located. This includes the date of the meeting, the location of the original data (i.e., the time code), the content of the original data, and the annotations and discussions related to it. For further analysis in this round, selected raw data segments were translated, yet the original Chinese versions were kept for enhanced clarity of cross-referencing in later stages. Here I will provide all tables of been created during round 2.1.

Keywords: Collaboration Process & Design decision making: The production of Cross-disciplinary Jewellery	
Video/Time	Comments
2020.10.09 00:21:18 - 00:22:29	现在回过来看发现（从新回顾或者说以第三视角审视才发现）我的 design 采取的也是这种方式，是 create 了一个 system 来将乐谱转化为图形和空间，所以在某种程度上来说，我采取了类似 data visualization 的方式在做 design，那么是否意味着我创作的 jewellery sculpture 就已经成为了 cross disciplinary jewellery 了呢？是否是由于 collaboration 过程中受到对方 field 的影响从而产生了领域的融合，进而影响到我的 design thinking 于是产生了 cross disciplinary 呢？这种过程在目前来看似乎是无意识的，自然发生的，是由于合作者之间的交流所产生的自然影响和自发的领域交叉。所以 cross disciplinary jewellery 是否不仅仅可以在以跨领域首饰创作为目的的合作课题中产生，是否有可能是（无意识的）合作课题中的自然产物呢？
	因此我们得到了另一个值得讨论的点：cross disciplinary jewellery 产生的条件是什么？或者说什么情况下会产生，是自发的，还是必须有意识的去创造？目前来看有自发产生的可能性，是由于合作课题中不同领域的交流会对双方的设计思路产生影响从而导致领域界限的模糊，双方领域所拥有的独特的思维方式，知识和技能会自然的在交流中产生流动从而影响到最终设计成果的呈现。
	因此是否应该从另一个视角来分析跨领域首饰的定义及产生？是非目的性的，是思想，知识和技能在领域之间流动的自然产物？
2020.11.13 00:00:56 - 00:05:20	一开始我是试图按照 filed 来界定课题中我和 Rebecca 的部分，但实际上在各个阶段中我们的领域都产生了一定程度上的 overlap，并且我们的设计创作并非只被限定在自己的领域中（这和之后提出的跨领域首饰是否是合作的自然产物的讨论有一定的关联性），所以我们讨论之后决定以课题的阶段来分类（阶段时通过 time line 以及合作的方式 - individual？with feedback？or co-design？来区分的）
	回过头来看，跨领域首饰的属性在建立课题的初期其实就已经对课题的建立产生了某些方面的影响，但由于我 allow 课题完全的自由度去自然发展，所以在课题建立的过程中没有意识到这一点。

Keywords: Collaboration Process & Project management: Distribute - Long Distance / Online Collaboration	
Video/Time	Comments
2021.06.09 00:06:06 - 00:08:20	由于不是沉浸在一个固定的课题里，online 合作会受到很多其他因素的影响，比如手上的其他课题的 concept 有可能会影响到这个课题，但不能说是坏事，因为有可能会带来新的视角。对于 craft 来讲，一般来说都是沉浸在课题中，沉浸在与材料的 interaction 中来推进课题的进程，很少会受到其他课题的干扰。 特别是在音乐项目中，距离不仅使合作者无法同时在一个空间里沉浸在设计过程中并与材料互动，而且项目时间表的长度也增加了合作者被其他课题分散注意力的概率。
2022.02.17 00:46:27 - 00:53:32	两个课题在这里产生了 connection，music project 产生的模型被使用在 viral making 的课题中并产生了新的 development，产生的新的 develop 被拿回 music project 讨论，这符合之前讨论的，远程合作的特点，即由于远程课题的时间线很长，并且不是沉浸式的课题发展，会很容易受到其他课题的影响，甚至使不同的课题产生链接，比如之前 Rebecca 把课题 concept 转向 healing，把课题转向共生等，在这里是我的两个课题产生了联系。这样的发展是有好有坏的，在这里是好的，因为提供了课题的新视角，产生了联系和新的发展。
2022.04.01 00:16:06 - 00:29:35	两个课题在这里再次产生的交错，在 viral making 课题中由于和 Jo 的合作而对模型做出的 development 被带回了课题中与 Rebecca 讨论，成为了下一步设计发展的基础。两个课题互相产生的影响似乎像是在课题中引入了另一个合作者，或者说是引入了另一个不与我们产生交流的独立的外部视角，是很有趣的一个合作的 role。这种角色独特的合作者的引入也是一种独特的合作方式，我认为是由于远距离合作的 flexibility 所带来的，虽然不是远程合作所独有的，但是在远程合作中更容易产生这种角色，尤其是在两个相关的课题同时发生的时候，由于远程合作的时间的长短，完全的沉浸的缺失，从而允许了更多的外部因素的打扰，就给引入外部视角提供了独特的环境，这一点我认为是可以值得被讨论的。
2022.05.01 00:11:44 - 00:12:54	课题周期的长短影响了 stage 之间的界限
	传统的沉浸式的线下课题合作的一个特点是由于课题周期短且集中，合作者在短时间内处在同一空间内进行集中且专注的针对合作课题的创作，总而可以使合作的双方更加 focus 在课题的制作上从而提高合作的效率。 但 online base 的远距离合作由于合作双方并非只专注于合作课题这一件事，空间和时间更为分离以及各自本来的 role 比如教学等，会更加受到其他事物的打扰。 但这样的时空分离会使课题在 manage 上拥有更好的自由度和更长的思考周期。尤其对于设计来说，灵感往往来源于生活甚至其他的课题和课程等。因此虽然看似打扰了课题的专注度但其实却带来新的灵感。
	同时，由于并非专注于课题且是 long distance 所以可以缓解合作者之间的紧张从而获得更好的合作氛围 这是本课题区别于很多其他课题的地方
2022.05.01 00:12:54 - 00:14:47	计划和实际 happened differently 是在 collaboration 中非常常见的，在长距离的合作中由于影响因素更多，所以可能受到的影响更多，如何 mange 是直的讨论的。
2022.05.01 01:07:38 - 01:08:34	Project step 顺序的改变有可能会影响到合作者的思维，尤其是像这种有 independent design 和 co- design 的课题，但由于我们一直在交流，其实也被互相影响了，所以这是值得 discuss 的地方。
2022.05.01 01:09:21 - 01:09:59	Rebecca 的体会可以作为 interview 的问题之一？

Keywords: Collaboration Process & Project management: Documentation / Multi-Roles - Craft/Design and Research Role	
Video/Time	Comments
2020.10.09 00:00:46 - 00:01:20	对于在 practice project 中 research purpose 相关的 method - 即 documentation process 的初步讨论。
2020.11.13 00:08:38 - 00:09:39	Rebecca 建议分离 practice 和 research 的 aims，这里可以和之后提出的 craft and design 背景的 researcher 在一个带有 research 目的的 practice project 里如何去平衡，界定和 manage 两个不同的 role 的讨论联系起来。
	同样的，在合作课题中同时扮演多重角色的（设计师和研究者）的问题在一开始建立课题的时候就有一定的显现，并在之后课题发展的过程中对课题的展开产生了极大的影响。
2021.06.09 00:36:20 - 00:37:13	所以会不停的有想法的 shift, design decision 的 shift，会沉浸在 design thinking 里而忽略 research
2021.06.09 00:37:16 - 00:38:37	
2021.06.09 00:42:19 - 00:44:21	对于 process record 的 thinking
2021.06.09 00:57:40 - 01:00:19	
2021.06.09 01:03:41 - 01:05:05	
2021.07.06 00:07:05 - 00:08:32	
2021.08.03 00:19:26 - 00:22:57	
2021.08.03 00:26:05 - 00:26:51	
2021.09.09 00:17:26 - 00:19:48	Artist 往往更沉浸在设计与材料的感知中，会快速的在不同的工具，材料之间产生 shift，而沉浸所带来的的往往是只针对于 project outcome 和 process 的关注。这是 craft practice 的一大特点，也是区别于 research 的地方。也可能是为什么 craft research 难以使用普通 research 方法来推进的地方。Artist 的工作方式决定了他们在沉浸在课题的过程中很难转换 researcher 的思维，两者不同的 focused 的点决定了他们工作方式和关注点的不同，很难兼顾。会对 process 产生影响。也是为什么我选择采取沉浸式的 practice process 并通过不影响沉浸体验的 recording 方式来获取数据，在 practice 结束之后再重新 review 数据的原因。这种方法论的使用的在这里得到了验证。
2021.11.04 00:30:21 - 00:30:39	如何去定义值不值得？是从什么角度来判定是否值得？从 craft role 还是 research role？是否是 craft 的思维导致的这样的判断？应该用哪种思维判断？如何选择？
2021.11.04 00:31:03 - 00:31:33	是否应该在一开始就提出问题？我采用的 free 的方式和这种有目的性的存在的区别？可以 discuss。
2021.11.17 00:10:37 - 00:10:51	Craft researcher 如何平衡 research 和 project，以及这两部分是如何相互影响是值得探讨的，比如 craft base 的人由于以往的沉浸式 project 习惯，会很难介入 research 的元素，比如 Rebecca 不习惯 record，比如我对于沉浸式的 project method 的选择就是尝试在解决这个问题，尝试减少 research 对于 project 发展的影响

2021.11.17 00:31:02	很多 craft 的人，包括设计师，由于我们习惯工作方式的原因，之前文献有提到，design 是一个在过程中发现问题再解决问题的模式，所以很难有'大局观'会等待问题自然产生在针对解决，这也许是产生这个 gap 的原因，是没有相关理论指导的原因，因此很难有一个理论去总结这种类型多样且繁复独特的过程。也许并不需要产生 common 理论而是告诉大家存在这个问题？告诉大家通过我的观察发现由于 craft 的属性这个理论是很难产生的，应该具体问题具体解决的，并解释原因？
2021.11.17 00:33:32 - 00:34:13	也是同样的原因，导致我的 manage 会与别人不一样，所以我觉得 craft 是否应该遵循一般的 research 步骤来做 research 是很值得讨论的，拥有 craft 背景的人在同时身兼 researcher 的时候是否应该采取独特的研究方法来 approach craft 研究呢？当一个 craft research 身兼数职的时候，是应该以 craft 的视角还是 research 的视角来做呢，我认为以纯 research 的视角会丢失 craft 的独特性，但以纯 craft 的视角是不适合做研究的，那既然这样又是否存在一个中间值呢？是否有一种方法可以以 craft 的思维来做 research 呢？
	包括是不是 stay with plan，plan 的 flexibility 都有 craft base decision 的影子
2021.11.17 00:36:32 - 00:36:57	有很多研究 collaboration 的书，也有很多讲 collaboration process 的书，既然有很多相关研究，我是否应该把研究重点放在 jeweller 如何通过 collaboration 来做 research？或者说在尝试定义和检验定义以及为 create cross- disciplinary jewellery through collaboration 提供案例研究的过程中，由于我的多重身份，从而可以讨论这类研究中的身份定义，身份转换等？
2022.02.17 00:55:03 - 00:58:15	
2022.03.21 00:00:29 - 00:00:44	
2022.03.21 00:02:14 - 00:02:38	
2022.03.21 00:27:54 - 00:29:16	
2022.03.21 00:30:20 - 00:33:04	
2022.04.01 00:11:38 - 00:14:41	或许可以对比一下这两种方式对合作过程，最终成品的影响，对 research 的影响 （可以被放到后续研究里去）
2022.05.01 00:07:14 - 00:08:14	Rebecca 对于 process documentation 是有选择的，比如看着就不对的东西，被立刻否决的东西就选择不做 documentation。这其实是很符合艺术家的思维的。对于这个 specific 的课题，是由于我带着研究的目的去做这个课题所以才有意识的去做了 documentation。不然的话一般来说我在很多时候也会在脑子里产生很多想法，但会做出筛选再进行下一步的 test，在 test 过程中也会即时的否定掉一些东西。我认为这是研究思维和 craft 实践思维的区别所在。
Sean & Rebecca Audio Record 01 00:13:45 - 00:14:33	Sean 通过对油画的创作过程特点的引入及类比，表现出 Rebecca 和他对于 documentation 的选择，和之前 Rebecca 提到的值不值得记录可以结合讨论。同时也体现出了 visual art 领域的创作特点，和 craft 领域的创作过程有很大的区别，visual 领域会通过 program 快速的 produce 大量的图像，所以无法做到记录所有，而更倾向于快速筛选而只保留对艺术家有意义的图片，craft 则由于 test piece 等制作繁琐，用时长，数量有限所以几乎可以记录所有的过程与步骤。所以 Rebecca 以及我对于 documentation 的方式和内容的选择是与我们的专业背景相关的。

Keywords: Collaboration process, Project management & Design decision: Distribute - Connection between projects

Video/Time	Comments
2021.06.09 00:12:14 - 00:18:22	Rebecca speaks about 为什么会想要 link 到 healing
2022.02.17 00:46:27 - 00:53:32	两个课题在这里产生了 connection，music project 产生的模型被使用在 viral making 的课题中并产生了新的 development，产生的新的 develop 被拿回 music project 讨论，这符合之前讨论的，远程合作的特点，即由于远程课题的时间线很长，并且不是沉浸式的课题发展，会很容易受到其他课题的影响，甚至使不同的课题产生链接，比如之前 Rebecca 把课题 concept 转向 healing，把课题转向共生等，在这里是我的两个课题产生了联系。这样的发展是有好有坏的，在这里是好的，因为提供了课题的新视角，产生了联系和新的发展。
2022.04.01 00:16:06 - 00:29:35	两个课题在这里再次产生的交错，在 viral making 课题中由于和 Jo 的合作而对模型做出的 development 被带回了课题中与 Rebecca 讨论，成为了下一步设计发展的基础。两个课题互相产生的影响似乎像是在课题中引入了另一个合作者，或者说是引入了另一个不与我们产生交流的独立的外部视角，是很有趣的一个合作的 role。这种角色独特的合作者的引入也是一种独特的合作方式，我认为是由于远距离合作的 flexibility 所带来的，虽然不是远程合作所独有的，但是在远程合作中更容易产生这种角色，尤其是在两个相关的课题同时发生的时候，由于远程合作的时间的长短，完全的沉浸的缺失，从而允许了更多的外部因素的打扰，就给引入外部视角提供了独特的环境，这一点我认为是可以值得被讨论的。
2022.05.01 00:15:51 - 00:19:16	从 Rebecca 的角度看，她将合作的第二部分 co-design 类比共生，将合作关系类比共生关系。我认为是很有趣的。
2022.05.01 00:19:16 - 00:21:56	合作方式的 positive 和 negative? 课题展开方式，实施方式的 positive 和 negative? Link 到 Diago 对于 true collaboration 的讨论？

Keywords: Design decision making & Design discussion between collaborators

Video/Time	Comments
2020.10.09 00:03:08 - 00:08:17	对于 visual music 的 beginning interest
2020.10.09 00:09:18 - 00:09:49	Rebecca 认为 arabesque 合适的原因
2020.10.09 00:24:56 - 00:26:41	Why Rebecca pick this music
2021.06.09 00:34:15 - 00:37:13	Effect between collaborators in step 1
2021.07.06 00:05:04	Rebecca's concept shifting
	回过头看，这里的交流可能影响了我的整体造型的塑造，我也选择采用层叠的通道空间
2021.07.06 00:08:32 - 00:10:20	
2021.07.06 00:10:20 - 00:11:35	我的设计的整体形态在讨论的过程中受对方思维的影响产生了变化
2021.09.23 00:08:22 - 00:08:54	
2021.09.23 00:13:01 - 00:16:19	对于 display 的讨论
2021.09.23 00:16:19 - 00:18:10	对于内外空间区分的讨论
2021.09.23 00:19:02 - 00:21:02	对于成品形态/展示的讨论
2021.11.04 00:04:16 - 00:10:45	
2021.11.04 00:15:53 - 00:17:46	
2022.02.17 00:00:00 - 00:13:03	
2022.02.17 00:13:03 - 00:15:33	
2022.03.21 00:00:00 - 00:17:11	Rebecca 对于色彩，空间，元素等的选取和理由
2022.03.21 00:20:21 - 00:27:54	
2022.03.21 00:36:53 - 00:37:14	

Keywords: Design Process & Design decision making: Design elements / Design Thinking in different fields

Video/Time	Comments
2020.10.09 00:13:22 - 00:14:21	How Rebecca feel the music - 这奠定了她的 design decision 的基础，比如她选择的 color range 就是基于此决定的
2020.10.09 00:15:52 - 00:20:42	同一种表现方式或者说设计的手法在不同领域里的呈现完全不同，首饰设计和制作的过程，在 visual 领域里成为了 performance art。在首饰领域中敲击，声音等这些只是技巧或者通向成品的过程，但在 visual 领域却可以输出成为作品的一部分，是很有意思的。
2020.10.09 00:40:17 - 00:42:39	回过来看可以发现，这可能是设计和合作的过程中 Rebecca 对于 flow，time 等属性和元素特别的强调的原因。
2021.06.09 00:21:17 - 00:21:44	Rebecca 通过找寻和 vr 相似的感觉去理解 physic piece 的方式让我想到之后我们的讨论，我通过 physic 的思维去看待 digital model，这是我们被自己专业背景和专业惯性思维所影响的结果。
2021.09.23 00:11:16 - 00:12:22	这个关于 display 的讨论在我第一部分的最终设计中也有所体现，最终的呈现是受到讨论影响的

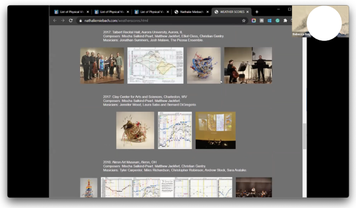
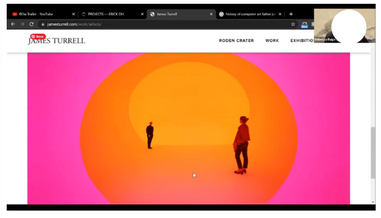
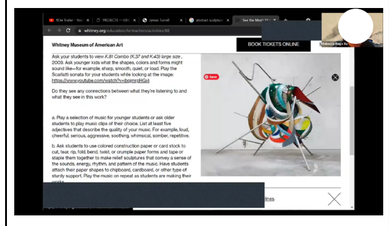
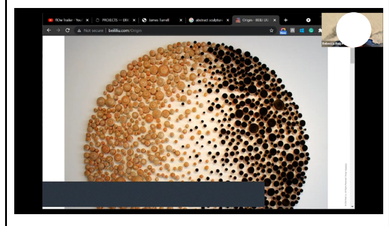
2021.11.17 00:22:39 - 00:25:47	Rebecca 在整个设计中最在乎的属性是 time，她认为音乐是 time base 的所以一定要想办法去体现音乐的时间属性，这也是她不停的做测试的点。我的 design，每一片是一个小结的总和/积累/留存，整个通道就是整个音乐的积累，我是通过这种方式来体现音乐的时间属性的，可以思考是不是因为 background 的原因，这是通过 physical 来固化时间属性的方式？是否是因为 physical piece 是无法变化的所以才采取固化的方式来体现时间属性？Rebecca 由于不同的 background 采取了不同的方式来体现音乐的时间属性。由于 digital video 或者 vr 是可以变化的，所以采取了不同的方式体现时间属性？）
2021.11.17 00:26:27 - 00:27:12	或许这是合作的其中一个方向？我表现乐谱，Rebecca 表现细节？
2022.02.17 00:17:18 - 00:37:21	关于我的 design 的颜色的讨论，这部分虽然 Rebecca 提出了自己的建议，但由于我们 design 方式的不同产生了分歧，但在这次的讨论中我们并没有影响到对方的 design thinking，而是双方都坚持了自己原本的看法
2022.02.17 00:37:21 - 00:38:06	我和 Rebecca 在颜色的选取方面产生了分歧，我觉得是由于我们的设计方式以及设计思维不同造成的，Rebecca 通过 emotional 的方式来感知音乐所以会对乐曲的 color range 有一个界定，但我并非通过感知的方式来获取对于音乐 piece 的 design idea，所以乐曲的颜色属性对我来说并不重要。
2022.03.21 00:00:00 - 00:17:11 2022.03.21 00:20:21 - 00:27:54	Rebecca 对于色彩，空间，元素等的选取和理由
2022.03.21 00:48:51 - 00:50:13	不同的 media 导致作品有不同的呈现方式，这是和专业背景相关的讨论
2022.04.01 00:19:15	和之后讨论中提到的 对于 physical 和 digital 的理解有相关性
2022.04.01 00:20:23 - 00:20:38	由于专业背景的不同对于材料，design element 和设计成果的理解是不同的，比如这个分离的空间，由于我是 deal with physical material 的，所以我就认为这是不可行的，在很多时候我会选择排除这种 design 或者采取某些方式来将他们的空间联系在一起。这样就会失去 design 原本应有的空间感和形态。但 Rebecca 是处理 digital 和 visual 的，这样的空间在 VR 或者视频中不仅不存在问题，反而会显得很有趣，所以她反而会对这个部分感到感兴趣并觉得可以进一步发展。这里就体现出不同专业背景对于 design element 以及 design decision making 所产生的不同的影响。
2022.04.01 00:24:55 - 00:29:35	双方对于颜色，空间的不同理解
2022.05.01 00:00:01 - 00:03:58	因为识别和选取的 design element 不同，比如对 Rebecca 来说，乐曲中的小停顿是非常重要的 design element, 从而导致会遇到不一样的问题。
2022.05.01 00:04:10 - 00:07:03	寻找合适的 design tool 来应对不同的 design elements 是很重要的，也是必然会面对的问题，尤其在不同的专业背景下会放大这个问题，甚至也可能产生矛盾？
2022.05.01 00:30:00 - 00:31:28	由于我通常 deal with 的是 physical piece 所以 physical 的常见属性就是需要由观众来进行主动的 interaction，所以我的想法是由这个习惯性思维决定的，于是在处理 digital media 的时候也习惯性的将主动权交给观众。但 Rebecca deal with 的 digital media 是可以主动对观众发起 interaction 的，所以她会更希望能够让作品掌控一定的主动权来引导观众。这是由于专业背景的不同所产生的思维差异在设计元素运用和设计想法上产生的区别。
2022.05.01 00:31:35 - 00:32:52	由于 background 的区别，我虽然在某种程度上也 get involved with digital media 和 digital knowledge & skill set，但我还是会优先 craft 思维，即制作实物的思维，digital 只被我认定为工具或者表现形式的一种，是对于具像化的 physical piece 的数字化版本-我在使用 digital 工具的时候也是，例如之前我讨论到我 get involved with digital technology 但我实际只是将 physical craft 数字化，我设计的本质还是 physical 的，只是为其建造了数字模型，或者说用数字的方式再现了。但 Rebecca 则的 field background 则让她以完全不同的视角来看待数字模型。
2022.05.01 00:32:52 - 00:34:12	Rebecca 会考虑到数字模型与人的交互，而这种交互与我思考中的 piece 与人的交互是不同的。由于形式的自然属性与限制，physical 与人交互的主动权掌握在人的手里，但 digital 除了人与之主动交互之外，digital piece 也可以成为发起交互主动权的对象，即 piece 可以主动与人交互，甚至引导人与它的交互方式。这里很好的体现了基础思维的不一样如何影响创作方式的不一样以及成品的不一样，从过程的角度来讲可以很好的看到不同的 background 对于相同的 design element 的运用的区别以及这个问题在 collaboration 中的产生与解决。
Sean & Rebecca Audio Record 01 00:13:45 - 00:14:33	Sean 通过对油画的创作过程特点的引入及类比，表现出 Rebecca 和他对于 documentation 的选择，和之前 Rebecca 提到的值不值得记录可以结合讨论。同时也体现出了 visual art 领域的创作特点，和 craft 领域的创作过程有很大的区别，visual 领域会通过 program 快速的 produce 大量的图像，所以无法做到记录所有，而更倾向于快速筛选而只保留对艺术家有意义的图片，craft 则由于 test piece 等制作繁琐，用时长，数量有限所以几乎可以记录所有的过程与步骤。所以 Rebecca 以及我对于 documentation 的方式和内容的选择是与我们的专业背景相关的。

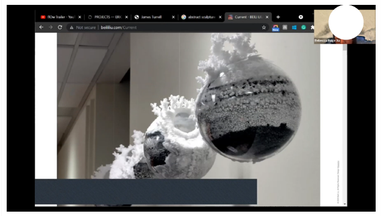
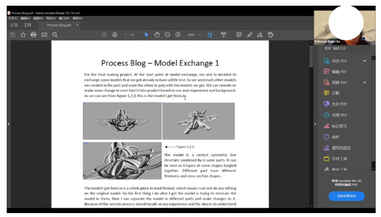
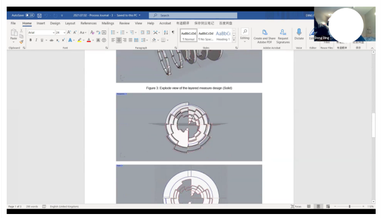
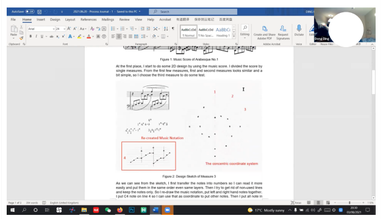
Appendix 17: Analytical tables from Data Review round 3.1

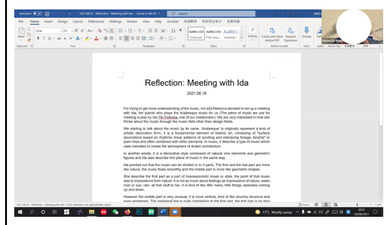
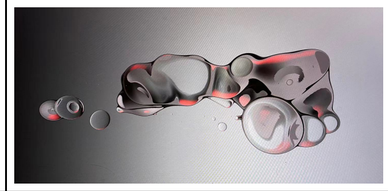
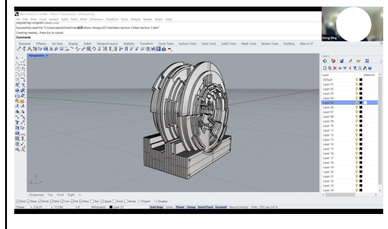
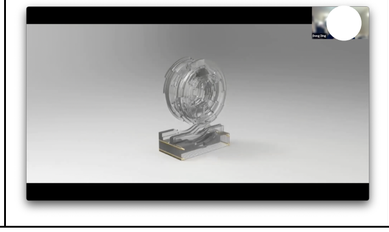
Subsequent to several data review rounds (from 1.1 to 2.2), most potential themes further analysis was pinpointed. However, some themes not previously discussed in the literature review section prompted a revisit to the literature review after round 2.2. An interesting potential theme - 'Boundary Objects' had emerged as intriguing and deserving of discussion. This discovery initiated round 3.1 of data review, focusing on a new thematic dataset titled 'Boundary Objects.' The goal for this round was to identify all boundary objects involved in the collaborative process and delineate the roles they played throughout the collaborative process.

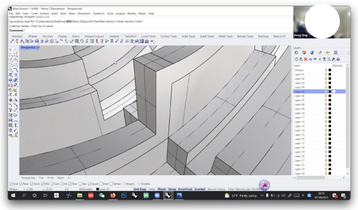
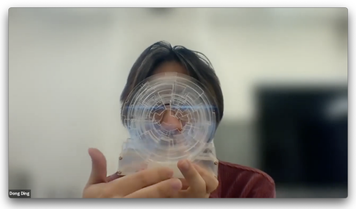
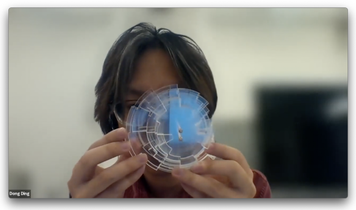
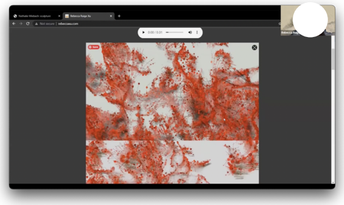
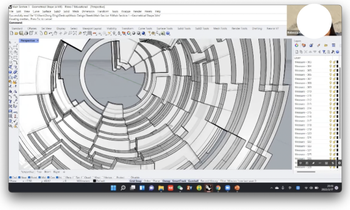
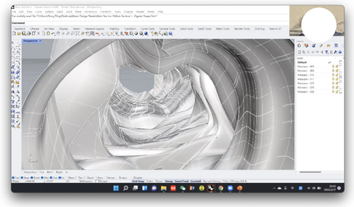
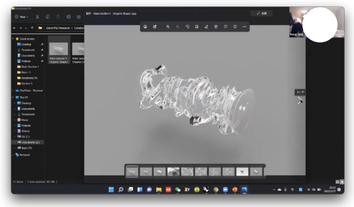
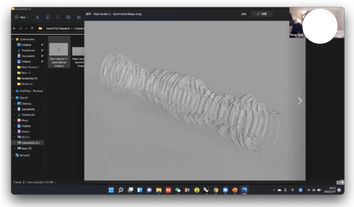
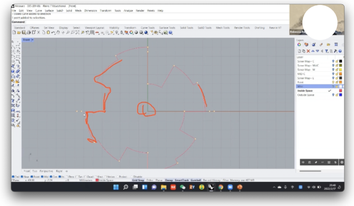
During round 3.1, I went back to all meeting transcripts to locate all the 'boundary objects' involved (totalling 37). These were systematically recorded in a table detailing the date of the meeting, the location of the boundary objects (i.e., time codes), the types of boundary objects (such as contextual examples, journals, digital models, among others), and any comments or discussions pertaining to the original data.

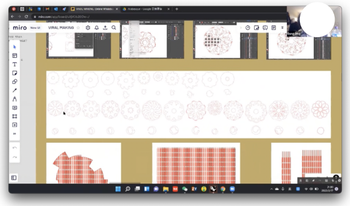
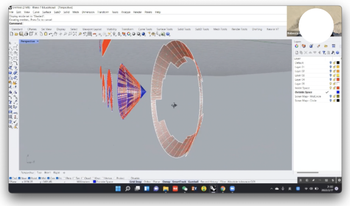
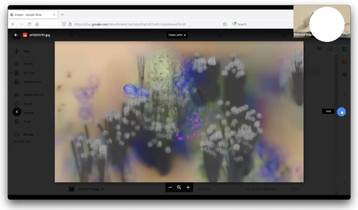
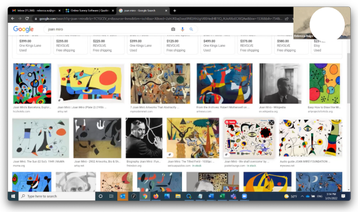
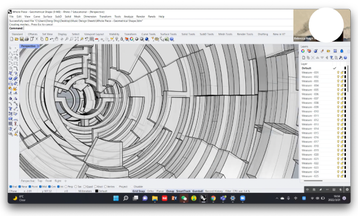
Keywords: Boundary Objects

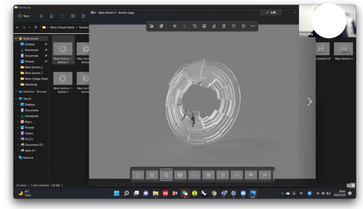
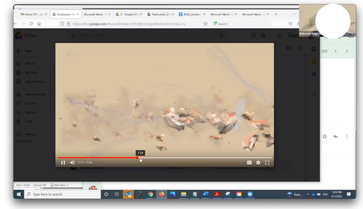
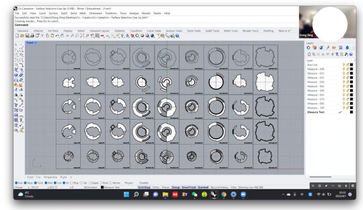
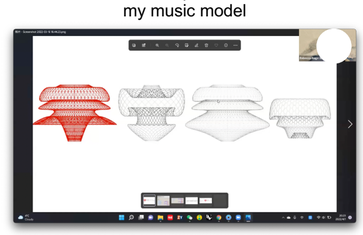
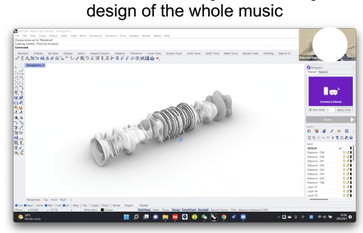
Video/Time	Boundary Object Kinds	Specific Boundary Object		Comments
2020.10.09 00:12:25 - 00:14:21	Contextual Example	Example of artist: Kandinsky		在讨论音乐转化的过程中引入 Kandinsky 的例子，从而让我联想到‘通感’，进一步理解到 Rebecca make design decision 的基础，比如她选择的 colour range 就是基于此决定的。为之后我理解和 accept 她的 design decision 奠定了一部分的基础
2020.10.09 00:15:52 - 00:20:42	Contextual Example	Rebecca	Example of artist: John Cage，Sol Lewitt	Rebecca 解释了同一元素 - 首饰制作过程在两个领域的不同，Rebecca 认为首饰制作过程在 visual 领域可以被视为一种 performance art。通过对于 John Cage 作品的例子，展现了 visual 领域中 performance art 的形态，让我发现在首饰领域中敲击，声音等这些只是技巧或者通向成品的过程，而在 visual 领域却可以输出成为作品的一部分。从而形成了 brief 中对于 outcome 的想法。Rebecca 举出的艺术家的例子让我想到了首饰领域中有艺术家以相似的方式创作作品，通过这种类比我理解了 Rebecca 做解释的这种 performance art 的形式。 两个来自外部领域的相似的例子互相作用，增强了对于将音乐转化为实体/数字形式的理解。
		David	Example of artist: Japanese jewellery artist make her piece followed by 3 steps	
2020.10.09 00:20:52 - 00:24:56	Contextual Example	Rebecca: Example of Natalie Miebach's piece 		在讨论的过程中，Rebecca 认为我初步的想法和艺术家 Natalie Miebach 的作品有相似指出，却又是他的 opposite。通过他的作品，Rebecca 展现了 visual music 领域中的一中设计方式 - 即通过一个自己 design 的 system 来形成设计元素和视觉元素之间的转换。这才某种程度上影响了我采取的设计方式和设计过程（但这是在分析过程中对于 data 的 review 过程中才被识别出的，在实际的 practice 过程中我并没有这个意识受到了对方设计方式的影响）在回顾中发现我的 design 采取的也是这种方式，是 create 了一个 system 来将乐谱转化为图形和空间，所以在某种程度上来说，我采取了类似 data art 的方式在做 design。
2020.06.09 00:12:04 - 00:25:16	Contextual Example	Rebecca: Example of James Terrell's work 		Rebecca 通过 James Terrell 的作品来展现她对于想展现的数字空间的颜色的感觉 - 包裹感，无边界的颜色空间。
2020.06.09 00:25:16 - 00:38:37	Contextual Example	Rebecca: Example of Artist and game design		基于这两个不同的 piece，Rebecca 展现了她对于数字空间中元素的初步思考 - 元素的动态，流动等。 Base 在 contextual 的例子上，我们进一步讨论了数字空间中的元素，对我来说直观的感受到她想要感觉，也对数字空间产生了进一步的理解。
				Erick Oh - Symphony  Game - Flow 
2020.06.09 00:39:59 - 00:41:57 2020.06.09 00:55:20 - 00:57:40				对于数字空间的理解的增强（包括对 Rebecca 想要的颜色空间和数字元素的动态）对之后和 co-design 过程是有利的，因为可以更好的理解设计元素在数字空间中的表达而做出相应的 design decision making。（这在这次和后续的关于 codesign step 的讨论中都有体现）
2020.06.09 00:44:21 - 00:55:20	Contextual Example			Rebecca: Example of Kandinsky's work  Rebecca 展示了 visual music 的先驱 Kandinsky 的作品，但在这里我并不认为发挥了 boundary object 的作用，因为并没有辅助交流知识，也不与任意一方领域的代表知识相关，只是与课题相关的 contextual research。 同样是 Kandinsky 的作品的引入，前期对于他作品的引入起到了引导了了解 visual music 领域的作用，但在这里对于他作品的再次引用对于双方的设计决策以及合作进程都没有很大的作用。 Rebecca: Example Beili Liu's work  之后 Rebecca 由于我之前对于金属的处理和塑形的想发想到了表面纹理相关的 concept，通过 Beili Liu 的作品展现出她对于实体作品表面纹理塑造的理解，虽然没有交流她自己的知识，但可以看到我的知识进入她的领域所展现的初步形态（展现出在交流发生的过程中，她对于我的知识的即时的初步理解），可以促成我对于她对知识的解构和理解程度的了解，进而促成进一步的知识分享（我可以针对她的理解进一步分享和讨论）。

			
		Rebecca: Example Beili Liu's work Beili Liu	Rebecca 再次使用了 Beili Liu 的作品为例讨论了她认为的 layer 问题以及她认为的'jewellery sense'，在这里我认为虽然这个 例子部分发挥了 boundary object 的作用 - 尝试沟通 Rebecca 的理解，但我并没有很接收到她想要表达的东西，所以并没有促进任何知识的分享。
2020.06.09 00:58:22 - 01:04:40	Journal	David: Journal form my other project 	通过以另一个课题的过程日志为例，来讨论本课题中的 documentation process，Rebecca 通过过程日志的示例理解并在之后进一步发展了本课题中的 documentation process。 本课题中的 boundary object 不仅仅用作知识分享，也并非只有参与了知识分享或者影响了课题设计决定和最终成品的物品才被称之为边界物体。 在这里，来自另一个课题的过程日志作为边界物体发挥的作用同样是沟通，但作用于合作的合作流程的管理，辅助了课题的运作，帮助了 research 的目的并保证课题的运转。
2021.08.03 00:15:53 - 00:18:17	Journal Digital model screenshot	David: Journal including the first 5 measure digital model design process screenshot image Process Journal - design process of the first 5 measures of the music. Screen shot of the Rhino 3D digital model - including line structure, node points (this will show how the 3D shape has been built) and shaped 3D model (this will show the final 3D shape of the model). 	通过 digital 3d 模型在软件建模过程中的截图来展现部分设计的过程和结果 - 模型可以直观的展现设计的过程与结果，让对方更好的理解我的设计想法。
2021.08.03 00:19:26 - 00:20:55	Journal Sketch & design process image	David: Journal of design process including sketches and design process Process Journal - Primarily design process Design sketch in the process journal - design principle of the piece 	以本课题过程中的过程日志和会议反馈为例，再次沟通交流 documentation 的问题。
2021.08.03 00:20:55 - 00:22:57	Journal	David: Journal of meeting reflection with Ida Reflection of the meeting - including Ida's	

		understanding of the music and my reflection on Ida's understanding 	
2021.09.09 00:06:01 - 00:09:03	Process image	Rebecca: Screenshot of design process Process image - Rebecca takes screenshots when she is doing design in the computer software. The program can generate lots of pictures in short times so she just picks some and takes screenshots as process image recordings. 	Rebecca 通过 process image 来展现她的设计过程。 这可以帮助我了解 Rebecca 试图寻找的感觉，对理解她后续的设计决定以及 codesign process 有积极影响。 （会发现往往在分享的过程中，就会形成新的 co-design 的想法，会形成新一轮的讨论。）
2021.09.23 00:00:08 - 00:21:02	Digital model (Rhino 3D model)	David: Digital model in Rhino software Digital model in Rhino software - can show in different formats and perspective. Including design sketch line, nodes, wireframe, 3D shape, rendering, different colour coded layers. Models can be shift angles to look at in software and even change design in advance during online meeting screen share. 	基于模型进行过程的解释，可以展示模型的各个角度和不同的层，甚至可以通过调用线稿等还原部分设计建模的过程。可以展现对于模型各个不同部分和层的不同运用前景，以及多层叠加之后的空间感觉。更全面和具体的解释设计决策和设计思考。从而进行更为详细的进一步讨论。
2021.10.07 00:07:36 - 00:09:37	Digital model (Rhino 3D model)	David: Digital model in Rhino software 	基于 1-25 小节的整体的模型来展示我的设计对于空间的塑造，之前是单一小节的，只能看到每个小节的细节，但缺乏对与一段音乐的整体空间的感知。通过这个模型我得以展示和分享我对于整体空间的想法。
2021.10.07 00:09:37 - 00:12:26	Digital model (Rendered image)	David: Rendered Digital model image 	基于电脑软件的渲染，我得以将我的材料选择进行展示，我的材料选择（透明亚克力）是基于我的材料经验，知道透明亚克力可以塑造我需要的空间效果（即其透光性可以很好的展示我的设计中复杂的内部空间结构），通过渲染的材料模拟，Rebecca 得到了类似的材料感知。虽然在这里我的知识没有影响 Rebecca 的设计，但作为边界物体，其帮助我交流了我的想法，展示了我的材料经验知识，帮助了 Rebecca 的理解，并为 后续讨论 display 提供了基础。

2021.10.07 00:15:06 - 00:16:41	Digital model (Rhino 3D mode and Rendered image)	David: Digital model in Rhino software and Rendered Digital model image	基于 1-25 小节的整体模型和渲染效果，Rebecca 对于我现有的设计和空间有了更清晰的感知，帮助她进一步想象整个 finish piece 可能的样子，并基于这个我们讨论了可能的成品展示方式。
2021.10.07 00:12:26 - 00:13:52	Digital model (Rhino 3D model)	David: Digital model in Rhino software 	基于基于 1-25 小节的整体的模型，得以进一步的讨论 co-design 的 idea。在 rhino 中展示模型的好处是可以 zoom in 和 zoom out，甚至拆解模型，这更好的利用了模型进行交流，可以从不同的角度 access 模型，从而进行更全面的讨论。这里就是放大了模型来观察其内部空间的细节，从而进一步讨论了我所塑造的模型在现实中的形态（与观众的互动）以及在下一个阶段被运用于数字空间中的各种可能性。
2021.11.04 00:01:50 - 00:17:46	Physical Model	David: Physical model of first main section (first 25 measures) made by Laser cut Acrylic  	通过过程中的模型来展示可能的成品效果，模型可以更家清晰的展示设计方案在现实中的内外部空间效果。和渲染的模型相比，实际的模型能够更好的展现材料的效果。并且由于镭射切割了实际的亚克力材料，中间的多余部分也被发现了新的可能性。这是首饰专业工作的方式带来的，我们通过和实际的模型，材料的互动来发展设计和想法的可能性。在这里得到了体现，这个也被 Rebecca 所发现和认可，通过基于两个模型的讨论她也进一步发现了另一个模型的新的可能性。 并且基于实体的模型可以感受设计概念中的物体的大小，从而对设计做出相应的调整。
2021.11.17 00:11:33 - 00:15:22	Contextual Example	Rebecca: Example of artist: Nataile Miebach David: Example of visual music projects: silent music & seeing sound	通过类似的艺术家作品的分享，进一步讨论音乐和雕塑两种形态之间的转换，为 co-design 提供想法。
2021.11.17 00:20:24 - 00:28:52	Contextual Example	Rebecca: Example of her previous projects 	Rebecca 分享了她之前的作品，通过这个系列的作品来 link 我的 design 的方式，都是通过某种形式来固化时间。但由于背景不同，采取的体现音乐的时间属性的方式不同，但本质都是为了体现音乐的属性。通过这个例子的分享，我们得以 link 和理解我们对于同一设计元素的不同 apply，即使表现形式不同，但不同的方式表现出相同的属性，与各自的专业背景和经验知识相关，边界物体在这里体现了翻译和 link 的作用。
2021.02.17 00:00:00 - 00:07:42	Digital model (Rhino 3D model)	David: Digital model in Rhino software Digital model in Rhino software - Geometric Structure design of the rest part of the first main section 	以第一个主部分的模型为基础讨论我的设计，基于模型的讨论可以更清晰的看到细节，增强了理解。 并且，基于模型的讨论可以细节的讨论到每个小节的图形的变化，加深 Rebecca 对于我的设计的理解，从而分享她的想法并对我的后续设计产生作用。
2021.02.17 00:07:04 - 00:09:57	Digital model (Rhino 3D model)	David: Digital model in Rhino software Digital model in Rhino software - Organic Structure design of the first main section 	对于第一部分的另一个版本的设计，这是基于之前 Ida 对于音乐的描述做建立的，基于几何和有机两个不同的形态的模型，更好的产生对比，进而讨论我的 deign 想法和之后的 co-creation 的可能性。
2021.02.17 00:08:29 - 00:09:59	Digital model (Rendered image)	David: Rendered Digital model image 	被得加材质渲染的模型可以在没有实体的基础上感知材料的视觉效果和空间效果。 基于渲染给出的整体和细节效果，我们认为整体的通道设计在小体量的时候无法突出细节，所以在小体量设计的情况下，认为应该采取分片展示的方式来体现细节。
2021.02.17 00:09:59 - 00:15:33	Digital model (Rendered video)	David: Rendered Digital model video 	
2021.02.17 00:17:18 - 00:42:29	Contextual Example Digital model (Rhino 3D model) Rhino Software	David: Contextual Example, The use of Rhino Software to communicate and 3D model in Rhino Contextual Example - Artist who uses coding systems to transform human movement into colour and graphic. the use of Rhino Software to communicate and 3D model in Rhino - to communicate based on the function of rhino software and the model in it. Which allowed model building during communication so it can shows our idea in advance and easy to point which part we are refer to. Make more effective communication. 	以 rhino 为媒介进行实时的讨论，由于可以即时在 rhino 里建模来展现当时的想法，增强了沟通和理解。 这部分是关于颜色的合作过程颜色 apply 方式的讨论，基于模型，和一个例子，对可能的颜色的想法和 approach 进行了详细的讨论。其中有分歧，可以进行更为具体的分析（分歧是否建立在不同专业背景和经验知识的基础之上？）
2021.02.17 00:46:27 - 00:48:26	Journal	David: Jo's Process journal form my other project Process Journal - Jo's process about modified my music model	基于 jo 的过程日志和我由于 jo 的过程日志所产生的新的 design 想法而做出的模型来交流我的新设计可能性。

			由于音乐模型被跨课题使用，所以引入了来自 jo 的新视角。她对模型进行了平面化的图形处理，这激发了我对于模型的新的设计想法，并与 Rebecca 进行交流，可以激发进一步的设计思考和合作想法的出现。
2021.02.17 00:48:26 - 00:53:32	Digital model (Rhino 3D model)	David: Digital 3D Model generated form my other project Digital model in Rhino software - my modified model inspired by Jo's process. 	
2021.03.21 00:00:44 - 00:06:49	Process images	Rebecca: Screenshot of process images Screenshot of process images - Different versions of design process development images show Rebecca's design division making 	基于大量的过程图片，Rebecca 展现了她的设计的发展过程，以及发展过程中对于各种设计元素，设计想法，色彩感觉的取舍以及原因。基于图片和 Rebecca 对于图片所作出的解释，我得以详细的了解 Rebecca 设计背后的原因和她对于设计元素的理解（颜色，空间等），这某种程度上影响了我们 codesign 部分的设计决策。
2021.03.21 00:08:52 - 00:30:01			
2021.03.21 00:06:49 - 00:08:52	Contextual Example	Rebecca: Example of Joan Miro's work 	Rebecca 结合 Joan Miro 的 work 来描述自己对于设计元素的色彩和律动的需求。
2021.03.21 00:33:04 - 00:38:22	Digital model (Rhino 3D model)	David: Digital model in Rhino software Digital model in Rhino software - Geometric Structure design of the rest part of the whole music 	基于模型和渲染图片的设计分享，本次讨论了音乐剩余的所有部分，包括与之前的 part 的区别等等。
2021.03.21 00:43:15 - 00:54:59			
2021.03.21 00:54:59 - 00:55:29	Digital model (Rendered image)	David: Rendered Digital model image	

			
2021.04.01 00:03:31 - 00:10:49	Process video	Rebecca: Process video (Model) Process video - This process video is the 'Model' for Rebecca's design process, like the images the program generated and screenshotted as process image, this is just a different format. 	通过设计过程中产生的'模型'视频，Rebecca 展现了她现阶段的设计过程，以及她对于模型中设计元素的判断。展现出她对于颜色，空间等的理解。
2021.04.01 00:16:06 - 00:23:58	Digital model (Rhino 3D model)	David: Digital 3D Model generated form my other project Digital model in Rhino software - my modified model inspired by Jo's process. 	基于来自另一个课题所创建的模型的分享，讨论的过程体现了双方领域对于实体空间和数字空间的不同理解。也由于模型的不同角度的发展，双方进一步讨论了课题在未来更多的可能性。
2021.04.01 00:16:06 - 00:24:55	Journal	David: Jo's Process journal form my other project Process Journal - Jo's process about modified my music model 	
2021.05.01 00:47:10 - 00:58:38	Digital model (Rhino 3D model)	David: Digital model in Rhino software Digital model in Rhino software - Combined Geometric Structure design and the organic design of the whole music 	基于整体模型对于合作方案的讨论。建立在 ida 对于音乐的理解上，将集合和有机形态的模型进行结合，进一步讨论了合作的方案。

Appendix 18: Analytical tables from Data Review round 3.2

Round 3.2 maintains its focus on boundary objects, building on the identifications made in round 3.1. In this round, a detailed features for each identified 'boundary object' was mapped. The analysis continues to utilize tabular formats to organize the data systematically. For each boundary object, ten feature categories were outlined, including: the date of the meeting, the location of the boundary objects existed (i.e. the time code), the kinds of the boundary objects, used by which collaborator, the specific object, whether it plays boundary role, which field it rooted in, effect on which filed, contribute to what, and the role it plays during the collaboration process.

Keywords: Boundary Objects								
Video/Time	**Object Kinds**	**Used by**	**Specific Object**	**Work as a Boundary Object or not (Playing Boundary role?)**	**Rooted in**	**Effect on**	**Knowledge, Understanding or process**	**Role it plays during the collaboration process**
2020.10.09 00:12:25 - 00:14:21	Contextual Example	Rebecca	Example of the artist: Kandinsky	Yes	Outside Visual	Jewellery Field	Understanding	Introduce me into the visual music field, (deconstruct) to get a rough idea about how visual artists' work. Increasing understanding of Rebecca's design decision after
2020.10.09 00:15:52 - 00:20:42	Contextual Example	Rebecca	Example of the artist: John Cage, Sol Lewitt	Yes	Outside Visual	Both fields	Understanding	Increasing understanding of different ideas about transferring music into physical or digital formats. (Similar example from outside, one raised by another, belongs to the two fields, interact each other)
		David	Example of the artist: Japanese jewellery artist make her piece followed by three steps	Yes	Outside Jewellery			
2020.10.09 00:20:52 - 00:24:56	Contextual Example	Rebecca	Example of the artist: Natalie Miebach	Yes	Outside Visual	Jewellery Field	Knowledge	Deconstruct knowledge and working way of the visual field Effected on my design decision and my final piece
2020.06.09 00:12:04 - 00:25:16	Contextual Example	Rebecca	Example of the artist: James Terrell	Yes	Outside Visual	Both fields	Knowledge Understanding	Increasing understanding of Rebecca's design decision after Effected on Rebecca's design decision and co-design ideas
2020.06.09 00:25:16 - 00:38:37	Contextual Example	Rebecca	Example of Artist and game design: Erick Oh – Symphony & Game - Flow	Yes	Outside Visual	Both fields	Understanding	Increasing understanding of Rebecca's design decision after Effected on Rebecca's design decision and co-design ideas
2020.06.09 00:44:21 - 00:55:20	Contextual Example	Rebecca	Example of the artist: Kandinsky	No	Outside Visual	/	/	Bring up as examples of visual-music transfer, but not effect on any process or design, not provide knowledge flow
	Contextual Example	Rebecca	Example of the artist: Beili Liu	Yes	Outside Visual	Both fields	Knowledge Understanding	The introduce of this piece is based on Rebecca's understanding of pattern making, this helps me understand how she understands physical pattern Shows how she gets my shared knowledge, and we can further discuss based on this.
	Contextual Example	Rebecca	Example of the artist: Beili Liu	No	Outside Visual	/	/	Provide Rebecca's understanding of 'jewellery feel' (Try to communicate but provide knowledge flow)
2020.06.09 00:58:22 - 01:04:40	Journal	David	Process Journal form Viral making project (Model Exchange 1 Process Journal - David)	Yes	Outside	Both fields	Process	Affect documentation process of the project Introduce process journal as documentation way into the project.
2021.08.03 00:15:53 - 00:18:17	Journal & Digital model screenshot	David	Process journal including the first 5 measure digital model design process screenshot image : Process Journal - design process of the first 5 measures of the music. Screen shot of the Rhino 3D digital model - including line structure, node points (this will show how the 3D shape has been built) and shaped 3D model (this will show the final 3D shape of the model).	Yes	Jewellery	Understanding	Understanding	(Deconstruct knowledge) Show my design process and result more visually - increasing understanding of my design decision Effected on co-design ideas
2021.08.03 00:19:26 - 00:20:55	Journal & Sketch & design process image	David	Process journal of design process including sketches and design process: Process Journal - Primarily design process Design sketch in the process journal - design principle of the piece	Yes	Jewellery	Both fields	Process	Affect documentation process of the project Through the context of the process journal, to discuss the documentation process during the project - to discuss what and how Rebecca may document through her design process (Although this document also shows the process of my design including sketches and explanation of my design process, but this part is not use through this context, only the format of the documentation has been discussed)
2021.08.03 00:20:55 - 00:22:57	Journal	David	Reflection Journal of meeting reflection with Ida: Reflection of the meeting - including Ida's understanding of the music and my reflection on Ida's understanding	Yes	Jewellery	Both fields	Process	Effects on documentation process of the project: Through the context of the reflection journal, to discuss the documentation process during the project - to discuss what Rebecca can document her process and finding other ways more suitable for her to document her design process (Audio record instead of writing record)
2021.09.09 00:06:01 - 00:09:03	Process image	Rebecca	Screenshot of design process: Process image - Rebecca takes screenshots when she is doing design in the computer software. The program can generate lots of pictures in short times so she just picks some and takes screenshots as process image recordings.	Yes	Visual	Understanding	Understanding	(Deconstruct knowledge) Show Rebecca's design process and result more visually - increasing my understanding on her design decision Bring up new design ideas and facilitate further discussion. Effect on co-design decision (shows the knowledge flow)
2021.09.23 00:00:08 - 00:21:02	Digital model (Rhino 3D model)	David	Digital model in Rhino software: Can show in different formats and perspective. Including design sketch line, nodes, wireframe, 3D shape, rendering, different colour coded layers. Models can be shift angles to look at in software and even change	Yes	Jewellery	Visual Field	Knowledge Understanding	A more comprehensive and specific explanation of design decisions and design thinking. Deconstruct my knowledge, increasing understanding of my design decision Leads to a more detailed discussion. Effect on co-design decision (shows the knowledge flow)

			design in advance during online meeting screen share.					
2021.10.07 00:07:36 - 00:09:37	Digital model (Rhino 3D model)	David	Digital model in Rhino software	Yes	Jewellery	Visual Field	Knowledge Understanding	A more comprehensive and specific explanation of design decisions and design thinking. Deconstruct my knowledge, increasing understanding of my design decision Leads to a more detailed discussion. Effect on co-design decision (shows the knowledge flow)
2021.10.07 00:09:37 - 00:12:26	Digital model (Rendered image)	David	Rendered Digital model image	Yes	Jewellery	Visual Field	Knowledge Understanding	A comprehensive and visual explanation of design material using decisions. Deconstruct my knowledge on material, increasing understanding of my design decision Leads to a more detailed discussion. Effect on co-design decision and display/exhibition plan (shows the knowledge flow)
2021.10.07 00:15:06 - 00:16:41	Digital model (Rhino 3D mode and Rendered image as above)	David	Digital model in Rhino software and Rendered Digital model image (Same one as above)	Yes	Jewellery	Visual Field	Knowledge Understanding	A more comprehensive and visual explanation of design decisions and material using decisions. Deconstruct my knowledge, increasing understanding of my design decision Leads to a more detailed discussion.
2021.10.07 00:12:26 - 00:13:52	Digital model (Rhino 3D model)	David	Digital model in Rhino software	Yes	Jewellery	Visual Field	Knowledge Understanding	A more comprehensive and specific explanation of design decisions and design thinking. Deconstruct my knowledge, increasing understanding of my design decision Leads to a more detailed discussion. Effect on co-design decision (shows the knowledge flow)
2021.11.04 00:01:50 - 00:17:46	Physical Model	David	Physical model of first main section (first 25 measures) made by Laser cutted Acrylic	Yes	Jewellery	Both Fields	Knowledge Understanding	A more comprehensive and visual explanation of design material using decisions. Deconstruct my knowledge on material, increasing understanding of my design decision Leads to a more detailed discussion. Effect on co-design decision and display/exhibition plan (shows the knowledge flow)
2021.11.17 00:11:33 - 00:15:22	Contextual Example	Rebecca	Example of artist: Nataile Miebach	Yes	Outside Visual	Both fields	Knowledge Understanding	Increasing understanding and future discuss on co-design ideas (Similar example from outside, one raised by another, belongs to the two fields, interact each other)
		David	Example of visual music projects: silent music & seeing sound	Yes	Outside Visual			
2021.11.17 00:20:24 - 00:28:52	Contextual Example	Rebecca	Example of Rebecca's previous projects	Yes	Visual	Jewellery Field	Knowledge Understanding	Help link my design with the visual field Deconstruct bothfield knowledge Increasing understanding of my design decision and the field of data visualisation
2021.02.17 00:00:00 - 00:07:42	Digital model (Rhino 3D model)	David	Digital model in Rhino software Geometric Structure design of the rest part of the first main section	Yes	Jewellery	Visual Field	Knowledge Understanding	A more comprehensive and specific explanation of design decisions and design thinking. Deconstruct my knowledge, increasing understanding of my design decision Leads to a more detailed discussion. Effect on co-design decision (shows the knowledge flow)
2021.02.17 00:07:04 - 00:09:57	Digital model (Rhino 3D model)	David	Digital model in Rhino software Organic Structure design of the first main section	Yes	Jewellery	Visual Field	Knowledge Understanding	A more comprehensive and specific explanation of design decisions and design thinking. Deconstruct my knowledge, increasing understanding of my design decision Leads to a more detailed discussion. Effect on co-design decision (shows the knowledge flow)
2021.02.17 00:08:29 - 00:09:59	Digital model (Rendered image)	David	Rendered Digital model image	Yes	Jewellery	Visual Field	Knowledge Understanding	A comprehensive and visual explanation of design material using decisions. Deconstruct my knowledge on material, increasing understanding of my design decision Leads to a more detailed discussion. Effect on co-design decision and display/exhibition plan (shows the knowledge flow)
2021.02.17 00:09:59 - 00:15:33	Digital model (Rendered video)	David	Rendered Digital model video	Yes	Jewellery	Visual Field	Knowledge Understanding	A comprehensive and visual explanation of design material using decisions. Deconstruct my knowledge on material, increasing understanding of my design decision Leads to a more detailed discussion. Effect on co-design decision and display/exhibition plan (shows the knowledge flow)
2021.02.17 00:17:18 - 00:42:29	Contextual Example	David	Example of artist projects: Artist who uses coding systems to transform human movement into colour and graphic.	Yes	Outside	Both fields	Knowledge Understanding	Help on discuss colour co-design concepts Deconstruct both field knowledge through the discussion Leads to a more detailed discussion and co-design ideas Effect on co-design decision ideas (shows the knowledge flow)
	Digital model (Rhino 3D model) Rhino Software	David	The use of Rhino Software to communicate and 3D model in Rhino: To communicate based on the function of rhino software and the model in it. Which allowed model building during communication so it can show our idea in advance and easy to point which part we are referring to. Make more effective communication.	Yes	Jewellery	Both fields	Knowledge Understanding Process	A more visual and effective way of communication during discussion (Help on communication process) Deconstruct both field knowledge through the discussion Leads to a more detailed discussion and co-design ideas Effect on co-design decision ideas (shows the knowledge flow)
2021.02.17 00:46:27 - 00:48:26	Journal	David	Process journal form Viral Making project: Jo's process journal about modified my music model (Model Exchange 2)	Yes	Outside	Both fields	Knowledge Understanding	Introduce/provide a external view of the design model/concept Leads to a more detailed discussion and co-design ideas Effect on co-design decision ideas (shows the knowledge flow)
2021.02.17 00:48:26 - 00:53:32	Digital model (Rhino 3D model)	David	Digital 3D Model generated form Viral Making project Digital model in Rhino software - my modified model inspired by Jo's process.	Yes	Jewellery	Visual Field	Knowledge Understanding	A more comprehensive and specific explanation of design decisions and design thinking. Deconstruct my knowledge, increasing understanding of my design decision Leads to a more detailed discussion and co-design ideas Effect on co-design decision (shows the knowledge flow)
2021.03.21 00:00:44 - 00:06:49	Process images	Rebecca	Screenshot of process images: Different versions of design process development images show Rebecca's design division making	Yes	Visual	Jewellery Field	Knowledge Understanding	(Deconstruct knowledge) Show Rebecca's design process and result (knowledge) more visually - increasing my understanding on her design decision Bring up new design ideas and facilitate further discussion.

2021.03.21 00:08:52 - 00:30:01								Effect on co-design decision (shows the knowledge flow)
2021.03.21 00:06:49 - 00:08:52	Contextual Example	Rebecca	Example of the artist: Joan Miro	Yes	Outside	Both fields	Understanding	Increasing understanding of Rebecca's design decision after Effected on Rebecca's design decision and co-design ideas
2021.03.21 00:33:04 - 00:38:22 2021.03.21 00:43:15 - 00:54:59	Digital model (Rhino 3D model)	David	Digital model in Rhino software: Geometric Structure design of the rest part of the whole music	Yes	Jewellery	Visual Field	Knowledge Understanding	A more comprehensive and specific explanation of design decisions and design thinking. Deconstruct my knowledge, increasing understanding of my design decision Leads to a more detailed discussion. Effect on co-design decision (shows the knowledge flow)
2021.03.21 00:54:59 - 00:55:29	Digital model (Rendered image)	David	Rendered Digital model image for the rest part of the whole music	Yes	Jewellery	Visual Field	Knowledge Understanding	A comprehensive and visual explanation of design material using decisions. Deconstruct my knowledge on material, increasing understanding of my design decision Leads to a more detailed discussion. Effect on co-design decision and display/exhibition plan (shows the knowledge flow)
2021.04.01 00:03:31 - 00:10:49	Process video	Rebecca	Process video (Model) Process video - This process video is the 'Model' for Rebecca's design process, similar to the images the program generated and screenshotted as process image, this is just a different format.	Yes	Visual	Jewellery Field	Knowledge Understanding	(Deconstruct knowledge) Show Rebecca's design process and result (knowledge) more visually - increasing my understanding on her design decision Bring up new design ideas and facilitate further discussion. Effect on co-design decision (shows the knowledge flow)
2021.04.01 00:16:06 - 00:23:58	Digital model (Rhino 3D model)	David	Digital 3D Model generated form Viral Making project: Digital model in Rhino software - my modified model inspired by Jo's process.	Yes	Jewellery	Visual Field	Knowledge Understanding	A more comprehensive and specific explanation of design decisions and design thinking. Deconstruct my knowledge, increasing understanding of my design decision (Deconstruct knowledge) Shows a different understanding of space (physical and digital) between the two fields. Leads to a more detailed discussion. Effect on co-design decision (shows the knowledge flow)
2021.04.01 00:16:06 - 00:24:55	Journal	David	Process journal form Viral Making project: Process Journal - Jo's process about modified my music model (Model Exchange 3)	Yes	Outside	Both fields	Knowledge Understanding	Introduce/provide a external view of the design model/concept Leads to a more detailed discussion and co-design ideas Effect on co-design decision ideas (shows the knowledge flow)
2021.05.01 00:47:10 - 00:58:38	Digital model (Rhino 3D model)	David	Digital model in Rhino software: Combined Geometric Structure design and the organic design of the whole music	Yes	Jewellery	Visual Field	Knowledge Understanding	A more comprehensive and specific explanation of design decisions and design thinking. Deconstruct my knowledge, increasing understanding of my design decision Leads to a more detailed discussion. Effect on co-design decision (shows the knowledge flow)

Appendix 19: Analytical Tables from Data Review round 3.3

In round 3.3, each category of boundary objects was further clustered, and their distinct features were more finely identified. Continuing with the tabular format, all 37 boundary objects were categorized into 8 types, including: Contextual Examples, Journals, Process Images, Process Videos, Digital Models (Rhino 3D Models), Digital Models (Rendered Images), Digital Models (Rendered Videos), and Physical Models.

Boundary Mediums - Contextual Example

Number	Video/Time	Used by	Specific Object	Boundary object?	Rooted in	Effect on	Contributed to	Picked up?	Effects	Role	Comments
1	2020.10.09 00:12:25 - 00:14:21	Rebecca	Example of the artist: Kandinsky	Yes	Outside Visual	Jewellery	Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design. Introducing me into the visual music field through artist works, gives a rough idea about how visual artists work. (This gives me the basis of how Rebecca make her design decisions, such as colour range) (Knowledge deconstruct, picked up and effected on my understanding, but not flow into jewellery field - didn't show any different apply of the deconstructed knowledge)	Introduction collaborator into the field Deconstruct (Music - visual transfer / Colour / Design Thinking) knowledge Increasing understanding of design decision	The introduction of Kandinsky's example during the discussion of musical transformation led me to associate it with 'synaesthesia' and to further understand the basis on which Rebecca made her design decision, for example, the colour range she chose was based on this decision. This laid part of the foundation for me to understand and accept her design decision later on.
2	2020.10.09 00:15:52 - 00:20:42	Rebecca	Example of the artist: John Cage, Sol Lewitt	Yes	Outside & Visual	Both fields	Understanding	Yes	Effect on understanding different ideas of transferring music into physical or digital formats. (Two similar example from outside, one raised by another, belongs to the two fields, interact each other)	Increasing understanding of design decision Deconstruct (Music - physical/digital) knowledge	Rebecca explained the difference between the two fields in terms of the same element - the jewellery making process, which Rebecca believes can be seen as a form of performance art in the visual field, and by using the example of John Cage's work to show how performance art can take in the visual field, I discovered that in the jewellery field, tapping, sound and so on are just techniques or processes that lead to the finished piece, whereas in the visual field they can be output as part of the work. That leads to further co-design ideas during the process (these ideas didn't become the final process but it may happen in the future). Rebecca's use of artist examples also reminded me of an artist in the field of jewellery who creates work in a similar way, and through this analogy I understood the form of performance art that Rebecca was explaining. These two similar examples from the outside of our project process interacted to enhance the understanding of the translation of music into physical/digital form.
3		David	Example of the artist: Japanese jewellery artist make her piece followed by three steps	Yes	Outside & Jewellery						
4	2020.10.09 00:20:52 - 00:24:56	Rebecca	Example of the artist: Natalie Miebach	Yes	Outside Visual	Jewellery	Knowledge	Yes	Effect on understanding my design process but not effect on Rebecca's process or design Example bringing up based on my design decision, through the example to link my way of design to a excited visual artist (Rebecca think my way of design is doing the opposite of Natalie Miebach's pieces)	Increasing understanding of design decision Translate and Deconstruct (Music - physical/digital) knowledge Provide link between design decisions form two fields	During the discussion, Rebecca thought that my initial idea was similar to Natalie Miebach's work but the opposite side. Through Natalie's work Rebecca was demonstrating a design approach in the field of visual music - to create a system to form the transition between design elements and visual elements. This influenced my design approach and process to some extent (but this was only identified during the review of the data in the analysis process, I was not aware of the influence of the other design approach in the actual practice process) - during data review, I found that my design took a similar approach, creating a system to translate the music score into graphics and space, so in a way I took a similar approach to data art field in my design process.
5	2020.06.09 00:12:04 - 00:25:16	Rebecca	Example of the artist: James Terrell	Yes	Outside Visual	Both fields	Knowledge Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design. This gives me ideas about what Rebecca is looking for the colour feeling (A flowing colour space) of her pieces. This further affects our co-design ideas (Coloured Space)	Increasing understanding of design decision Deconstruct (Visual colour / Space) knowledge Leads to more design discussion and co-design ideas Effect on co-design decision	Rebecca uses James Terrell's work to show how she feels about the colour of the digital space she wants to show in her piece- an enveloping, borderless space of colour.
6	2020.06.09 00:25:16 - 00:38:37	Rebecca	Example of Artist and game design: Erick Oh - Symphony Game - Flow	Yes	Outside Visual	Both fields	Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design. (Knowledge deconstruct, picked up and effected on my understanding, but not flow into jewellery field - didn't show any different apply of the deconstructed knowledge)	Increasing understanding of design decision Deconstruct (Music - visual transfer / Colour / Design Thinking) knowledge	Based on these two different pieces, Rebecca presented her initial thoughts on elements in digital space for her design - the dynamics, flows (and etc.) of the elements. Based on the contextual example, we further discussed the elements in digital space. For me this provide me a intuitive feeling about what she wanted in her design and this is also gaining a further understanding of digital space for me.
	2020.06.09 00:39:59 - 00:41:57										The increased understanding of digital space (including the colour space and the flow of the digital elements that Rebecca wanted) this was beneficial to the subsequent co-design process, as it allowed for a better understanding of the representation of design elements in digital space for making design decisions accordingly (this is reflected in this meeting and subsequent discussions for the co-design step)
	2020.06.09 00:55:20 - 00:57:40		/								
7	2020.06.09 00:44:21 - 00:55:20	Rebecca	Example of the artist: Kandinsky	No	Outside Visual	/	/	No	Bring up as examples of visual-music transfer, but not effect on any process or design, not provide knowledge flow	/	Rebecca presents the work of Kandinsky, a pioneer of visual music, but here I do not see it as a boundary medium, as it does not aid in the exchange of knowledge, nor does it relate to representative knowledge of either field, but only to the contextual research of the subject. For Kandinsky's work, the introduction of the work in the early stages of the project (Meeting 2020.10.09) served as a interdiction for me to the field of visual music, but the re-referencing of his work here did not contribute significantly to the design decisions or the collaborative process between the two collaborators.
8		Rebecca	Example of the artist: Beili Liu	Yes	Outside Visual	Both fields	Knowledge Understanding	Yes	Shows Rebecca's understanding of physical material and pattern - in construct with my understanding	Increasing understanding of design decision Deconstruct (Music - visual transfer / Colour / Design Thinking) knowledge	Rebecca then came up with a concept related to surface textures as a result of my previous discussion on how I can shape the metal. Through Beili Liu's work she is trying to show her understanding of creating surface textures on physical pieces. Although the example didn't communicate her own knowledge, but this shows the initial form of my knowledge entering her field (showing her immediate

									Provide me how Rebecca understands pattern making on physical material through examples	leads to further discussion and co-design ideas	and initial understanding of my knowledge as the communication took place), which can lead to my understanding of the extent of her deconstruction and understanding of the knowledge, which in turn can lead to further knowledge sharing (I can share and discuss further based on her understanding).
9		Rebecca	Example of the artist: Beili Liu	No	Outside Visual	/	/	No	Provide Rebecca's understanding of 'jewellery feel' (Try to communicate but provide knowledge flow)	/	Rebecca again uses Beili Liu's work as an example to discuss the 'multi-layer' concept and what her understanding of 'jewellery sense', where I think that although the example partly functions as a boundary medium - attempt to communicate Rebecca's understanding - but I didn't quite pick up on what she was trying to say and so didn't facilitate any knowledge sharing.
10	2021.11.17 00:11:33 - 00:15:22	David	Example of visual music projects: silent music & seeing sound	Yes	Outside Visual	Both fields	Knowledge Understanding	Yes	Effect on Co-design ideas: Leads to discussion on different visual-music transfer ideas that can be further developed. (Two similar example from outside, one raised by another, belongs to the two fields, interact each other)	Leads to more design discussion and co-design ideas Effect on co-design decision	Further discussion on the transition between music and sculpture through the sharing of similar artists' work, also providing co-design ideas.
11		Rebecca	Example of artist: Natalie Miebach	Yes	Outside Visual						
12	2021.11.17 00:20:24 - 00:28:52	Rebecca	Example of Rebecca's previous projects	Yes	Visual	Jewellery	Knowledge Understanding	Yes	Effect on understanding of design decisions form both fields Link my design way with Rebecca's (Both try to use some way to 'curing' time) - shows the different apply in two fields for the same design elements and design thinking	Increasing understanding of design decision Translate and Deconstruct (Music - physical/digital) knowledge Provide link between design decisions form two fields	Rebecca shared her previous work, through the series of work, it links my way of design - both trying to cure time through some ways. However, due to the different subject background, different approaches were taken to reflect the temporal properties of the music but are all essentially to reflect the properties of the music. Through the sharing of this example, we were able to link and understand our different approaches to the same design element apply, even though the expressions are different but expressing the same properties, which the way we are using is related to our respective professional backgrounds and experiential knowledge, where the boundary medium embody the role of translation and link two collaborators together.
13	2021.02.17 00:17:18 - 00:42:29	David	Example of artist projects: Artist who uses coding systems to transform human movement into colour and graphic.	Yes	Outside	Both fields	Knowledge Understanding	Yes	Effect on Co-design ideas: Leads to discussion on the colour of my physical piece and Rebecca's digital space Show the difference between understanding of colour through the discussion	Increasing understanding of design decision Deconstruct (Music - visual transfer / Colour / Design Thinking) knowledge leads to further discussion and co-design ideas	Through an example of an artist who uses a coding system to translate human movement into colour and graphic, leads to a discussion on colour usage approach which also implications for both independent and co-design ideas.
14	2021.03.21 00:06:49 - 00:08:52	Rebecca	Example of the artist: Joan Miro	Yes	Outside visual	Both fields	Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design. This gives me ideas about what Rebecca is looking for for the colour feeling (A flowing colour space) of her pieces.	Increasing understanding of design decision Deconstruct (Visual colour / Flow) knowledge	Rebecca describes her ideas for colour and rhythm in her design through Joan Miro's work.

Boundary Mediums - Journal

Number	Video/Time	Used by	Specific Object	Boundary object?	Rooted in	Effect on	Contributed to	Picked up?	Effects	Role	Comments
1	2020.06.09 00:58:22 - 01:04:40	David	Process Journal form Viral making project (Model Exchange 1 Process Journal - David)	Yes	Outside	Both fields	Process	No	Effects on documentation process of the project: Introduce process journal as documentation way into the project.	Managing Collaboration (documentation) process	The documentation process in this project is discussed through the example of a process journal from another project (the 'Viral Making' project), which provide Rebecca a example to understand my thinking of the documentation process through this journal and this also helps develop and form the data collection approach for this project further. The boundary medium in this project is not only used for knowledge sharing, nor is it only the mediums that are involved in knowledge sharing or influence the design decisions and final product of the project that are called boundary mediums. In this case, the process journal from another project plays a similar role as a boundary medium to communication, but only effect on the management of the collaborative process, aiding the operation of the project, helping the research purpose and keeping the project running.
2	2021.08.03 00:15:53 - 00:18:17	David	Process journal including the first 5 measure digital model design process screenshot image: Process Journal - design process of the first 5 measures of the music. Screen shot of the Rhino 3D digital model - including line structure, node points (this will show how the 3D shape has been built) and shaped 3D model (this will show the final 3D shape of the model).	Yes	Jewellery	Understanding	Understanding	Yes	Effect on understanding my design process but not effect on Rebecca's process or design. (Knowledge deconstruct, picked up and effected on Rebecca understanding, but not flow into visual field - didn't show any different apply of the deconstructed knowledge)	Deconstruct (Technical / Digital software / Music - Space/Structure transfer) knowledge Increasing understanding of design decision	A screenshot of the digital 3d model during the Rhino modelling process to show part of the design process and results - the model gives a visual representation of the design process and results which allows the collaborator to better understand my design process and ideas. Here, in this case, the journal does not act as a unique role, but only exists as a form of documentation of the digital models, which works in the same way as the digital models (as boundary medium), this is because the data collection methods established in the early stages of the project were developed in the form of a journal. In the later stages of the project, this type of documentation method was replaced by 'a direct sharing of the digital model and discussion based on the models through online meetings'.
3	2021.08.03 00:19:26 - 00:20:55	David	Process journal of design process including sketches and design process: Process Journal - Primarily design process Design sketch in the process journal - design principle of the piece	Yes	Jewellery	Both fields	Process	No	Effects on documentation process of the project: Through the context of the process journal, to discuss the documentation process during the project - to discuss what and how Rebecca may document through her design process (Although this document also shows the process of my design including sketches and explanation of my design process, but this part is not use through this context, only the format of the documentation has been discussed)	Managing Collaboration (documentation) process	Using the process journal and meeting reflection journal as example to communicate again about documentation process.
4	2021.08.03 00:20:55 - 00:22:57	David	Reflection Journal of meeting reflection with Ida:	Yes	Jewellery	Both fields	Process	Yes	Effects on documentation process of the project: Through the context of the reflection journal, to discuss the documentation process during the project - to discuss what Rebecca can document		

			Reflection of the meeting - including Ida's understanding of the music and my reflection on Ida's understanding						her process and finding other ways more suitable for her to document her design process (Audio record instead of writing record)		
5	2021.02.17 00:46:27 - 00:48:26	David	Process journal form Viral Making project: Jo's process journal about modified my music model (Model Exchange 2)	Yes	Outside	Both fields	Knowledge Understanding	Yes	Effects on further design ideas and co-design ideas: Introducing Jo's modification on my design - a pattern transformation of my design, this leads to a discussion on further co-design idea possibilities.	Introduce/provide a external view Leads to deconstruct and sharing of each other's (Digital/Physical Space) knowledge Leads to more design discussion and co-design ideas Effect on co-design decision	Based on Jo's Miro board (her format of 'process journal') and the models I made based on Jo's process to communicate new possibilities of my design. As the music model was used across projects, through the sharing of journals form the 'viral making' project, a new perspective - Jo was introduced in to this project. Her graphic manipulation of the model in a 2D format inspired new design ideas for the model and the exchange with Rebecca of idea from the 'Viral Making' project could stimulate further design thinking and collaborative ideas to emerge.
6	2021.04.01 00:16:06 - 00:24:55	David	Process journals form Viral Making project: Process Journal - Jo's process about modified my music model (Model Exchange 3)	Yes	Outside	Both fields	Knowledge Understanding	Yes	Effects on further design ideas and co-design ideas: Introducing Jo's modification on my design - a rhino-grasshopper script to transfer my model into a waving pattern, this leads to a discussion on physical and digital space and further co-design idea possibilities.		

Boundary Mediums - Process Image

Number	Video/Time	Used by	Specific Object	Boundary object?	Rooted in	Effect on	Contributed to	Picked up?	Effects	Role	Comments
1	2021.09.09 00:06:01 - 00:09:03	Rebecca	Screenshot of design process: Process image - Rebecca takes screenshots when she is doing design in the computer software. The program can generate lots of pictures in short times, so she just picks some and takes screenshots as process image recordings.	Yes	Visual	Understanding	Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design. (Knowledge deconstruct, picked up and effected on my understanding, but not flow into jewellery field - didn't show any different apply of the deconstructed knowledge)	Deconstruct (Technical / Digital software) knowledge Increasing understanding of design decision	Rebecca shows her design process through the process image. This helps me to get a sense of what Rebecca is trying to find and has a positive impact on understanding her subsequent design decisions and the co-design process. (It is found that during the sharing process, new ideas for co-design are formed and a new round of discussion is created.)
2	2021.03.21 00:00:44 - 00:06:49	Rebecca	Screenshot of process images: Different versions of design process development images show Rebecca's design division making	Yes	Visual	Jewellery	Knowledge Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design. Effects on co-design ideas: Discussion on how to combine geometric and organic parts together Bring up ideas about combing Rebecca's visual design elements with my designed space in a VR/Digital space	Deconstruct (Technical / Digital software / Colour-music transfer / Digital Space) knowledge Increasing understanding of design decision Leads to more design discussion and co-design ideas Effect on co-design decision	Based on a large amount of process images, Rebecca shows the development of her designs and the trade-offs between design elements, design ideas, colour sensations and the reasons for them. Based on the images and Rebecca's interpretation of them, I was able to gain a detailed understanding of the reasons behind Rebecca's designs and her understanding of the design elements (colour, space, etc.) that have influenced our design decisions of the co-design ideas in some way.
3	2021.03.21 00:08:52 - 00:30:01										

Boundary Mediums - Process Video

Number	Video/Time	Used by	Specific Object	Boundary object?	Rooted in	Effect on	Contributed to	Picked up?	Effects	Role	Comments
1	2021.04.01 00:03:31 - 00:10:49	Rebecca	Process video (Model) Process video - This process video is the 'Model' for Rebecca's design process, like the images the program generated and screenshotted as process image, this is just a different format.	Yes	Visual	Jewellery	Knowledge Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design. (Knowledge deconstruct, picked up and effected on my understanding, but not flow into jewellery field - didn't show any different apply of the deconstructed knowledge)	Deconstruct (Technical / Digital software / Colour-music transfer / Digital Space) knowledge Increasing understanding of design decision	Through the 'model' video produced during the design process, Rebecca shows the current stage of her design process and her judgement of the design elements in the model. Showing her understanding of colour, digital space etc.

Boundary Mediums – Physical Model

Number	Video/Time	Used by	Specific Object	Boundary object?	Rooted in	Effect on	Contributed to	Picked up?	Effects	Role	Comments
	2021.11.04 00:01:50 - 00:17:46	David	Physical model of first main section (first 25 measures) made by Laser cut Acrylic	Yes	Jewellery	Both Fields	Knowledge Understanding	Yes	Effects on co-design ideas and exhibition ideas: Find out what the designed space looks like in reality - The space as a whole is very interesting, but it is too complex in small scale pieces for people to look at (it may only work as a human size scale for such a complex inside space) Single layer shows more interesting details of the design in small scale; Spots the possibility of the 'spare part' model (the inside space model); Bring up the idea of exhibiting both 'positive' and 'negative' parts	Deconstruct (material) knowledge Increasing understanding of design decision Leads to more design discussion and co-design ideas Effect on co-design decision and display plan	

Boundary Mediums - Digital Model (Rhino 3D Model)

Number	Video/Time	Used by	Specific Object	Boundary object?	Rooted in	Effect on	Contributed to	Picked up?	Effects	Role	Comments
1	2021.09.23 00:00:08 - 00:21:02	David	Digital model in Rhino software: Can show in different formats and perspectives. Including design sketch line, nodes, wireframe, 3D shape, rendering, different colour coded layers. Models can be shifting angles to look at in software and even change design in advance during online meeting screen share.	Yes	Jewellery	Visual	Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design - A more comprehensive and specific explanation of design decisions and design thinking. (Knowledge deconstruct, picked up and effected on my understanding, but not flow into jewellery field - didn't show any different apply of the deconstructed knowledge)	Deconstruct (Technical / Digital software; Space; Design Thinking) knowledge Increasing understanding of design decision Leads to more design discussion	The interpretation of the design process based on the digital model can show the various angles and layers of the model, it is even possible to restore parts of the design modelling process by using wireframes mode of the digital model (part of the function of the Rhino software). Potential use of different parts and layers of the model can be shown, as well as the spatial perception of how multiple layers layered together. Design decisions and design thinking can be explained more fully and concretely. Which can allows and bringing further discussion in more detail.
2	2021.10.07 00:07:36 - 00:09:37	David	Digital model in Rhino software	Yes	Jewellery	Visual	Understanding	Yes			This model is based on the whole measure 1-25 to show how my design shapes the space, previously model shared with Rebecca was single measure designs and could only see the details of each measure but lacked a sense of the overall space as a piece of music. With through this model I was able to show and share my idea of the overall space.
3	2021.10.07 00:15:06 - 00:16:41	David	Digital model in Rhino software and Rendered Digital model image (Same one as above)	Yes	Jewellery	Visual	Knowledge Understanding	Yes			Based on the model and renderings of measure 1-25, Rebecca had a clearer sense of my existing design and the 'space' I create, which helped her to further imagine what the whole finish piece might look like, and based on this we discussed possible ways of presenting the finished product.
4	2021.10.07 00:12:26 - 00:13:52	David	Digital model in Rhino software	Yes	Jewellery	Visual	Knowledge Understanding	Yes	Bringing up thinking of showing single piece or as whole - we think the design detail of a single piece is beautiful	Leads to co-design ideas and effect on co-design decision and display plan	Based on the model of measure 1-25, co-design ideas are further discussed. The benefit of presenting the model in rhino is that it can be zoomed in and zoomed out, and even disassembled, which allows for better use of the model to communicate. Rhino allow us to access the model from different perspectives, which allows us a more comprehensive discussion. Here the model is zoomed in to look at the details of its internal space, thus furthering the discussion of how the model I have created would look in reality (interacting with the viewer) and the various possibilities for its use in digital space at the next stage(Co-design ideas).
5	2021.02.17 00:00:00 - 00:07:42	David	Digital model in Rhino software Geometric Structure design of the rest part of the first main section	Yes	Jewellery	Visual	Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design - A more comprehensive and specific explanation of design decisions and design thinking. (Knowledge deconstruct, picked up and effected on my understanding, but not flow into jewellery field - didn't show any different apply of the deconstructed knowledge)	Deconstruct (Technical / Digital software; Space; Design Thinking) knowledge Increasing understanding of design decision Leads to more design discussion	Using the model of the first main section as a basis for discussing my design, the model-based discussion allowed for a clearer view of the details and enhanced understanding between each other. Also, the model-based discussion allowed for a more detailed discussion of the variations in the graphics of each measure, deepening Rebecca's understanding of my design and thus facilitate the sharing of her ideas and thus influencing my subsequent designs.
6	2021.02.17 00:07:04 - 00:09:57	David	Digital model in Rhino software Organic Structure design of the first main section	Yes	Jewellery	Visual	Knowledge Understanding	Yes	Discuss on organic shape model - Bring up discussion on how to use the two different types of design	Leads to co-design ideas and effect on co-design decision and display plan	This is the sharing of another design version of the first main part, which is based on the previous description of the music by Ida - two different forms, geometric and organic. It is better to produce a contrast and thus to discuss my idea of design and the possibilities of co-design ideas afterwards.
7	2021.02.17 00:17:18 - 00:42:29	David	The use of Rhino Software to communicate and 3D model in Rhino: To communicate based on the function of rhino software and the model in it. Which allowed model building during communication so it can show our idea in advance and easy to point which part we are referring to. Make more effective communication.	Yes	Jewellery	Both fields	Knowledge Understanding Process	Yes	Effect on understanding both design processes and decisions - A more comprehensive and specific explanation of design decisions and design thinking. By using a real-time model modifying software - allow collaborators to communicate their ideas more accurately and effectively.	Deconstruct (Technical / Digital software; Space; Design Thinking) knowledge Transform and increasing understanding of design decision Increase the accuracy and efficiency of communication Leads to more design discussion and co-design ideas Effect on co-design decision	Real time discussions using rhino as a medium enhance communication and understanding as the ideas can be modelled in rhino instantly to show what is going on at the time. This part is a discussion of the collaborative process of colour apply approaches. Based on models and example, a detailed discussion of possible colour ideas and approaches happened. There are disagreements, which might interest to analysed more specifically (are the disagreements based on different professional backgrounds and experiential knowledge?)
8	2021.02.17 00:48:26 - 00:53:32	David	Digital 3D Model generated form Viral Making project Digital model in Rhino software - my modified model inspired by Jo's process.	Yes	Jewellery	Visual	Knowledge Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design - A more comprehensive and specific explanation of design decisions and design thinking. Effects on further design ideas and co-design ideas: Shows my new design ideas based on Jo's modification on my design - a pattern transformation of my design, this leads to a discussion on further co-design idea possibilities.	Introduce/provide a external view Deconstruct (Technical / Digital software; Space; Design Thinking) knowledge Leads to deconstruct and sharing of each other's (Digital/Physical Space) knowledge Leads to more design discussion and co-design ideas Effect on co-design decision	Based on Jo's Miro board (her format of 'process journal') and the models I made based on Jo's process to communicate new possibilities of my design. As the music model was used across projects, through the sharing of journals form the 'viral making' project, a new perspective - Jo was introduced in to this project. Her graphic manipulation of the model in a 2D format inspired new design ideas for the model and the exchange with Rebecca of idea from the 'Viral Making' project could stimulate further design thinking and collaborative ideas to emerge.
9	2021.03.21 00:33:04 - 00:38:22	David	Digital model in Rhino software: Geometric Structure design of the rest part of the whole music	Yes	Jewellery	Visual	Knowledge Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design - A more comprehensive and specific explanation of design decisions and design thinking. (Knowledge deconstruct, picked up and effected on my understanding, but not flow into jewellery field - didn't show any different apply of the deconstructed knowledge) Discuss on physical material using - how to distinguish inside and outside space (Different colour code edges) and this leads to more discussion on further design ideas and co-design decisions	Deconstruct (Technical / Digital software; Space; Design Thinking) knowledge Increasing understanding of design decision Leads to more design discussion and co-design ideas Effect on co-design decision	Based on the sharing of the model and rendered images, this time I am sharing the design of the rest parts of the music, discussion also including the differences from the previous parts, etc.
10	2021.03.21 00:43:15 - 00:54:59							Yes			

11	2021.04.01 00:16:06 - 00:23:58	David	Digital 3D Model generated form Viral Making project: Digital model in Rhino software - my modified model inspired by Jo's process.	Yes	Jewellery	Visual	Knowledge Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design - A more comprehensive and specific explanation of design decisions and design thinking. Effects on further design ideas and co-design ideas: Shows my new design ideas based on Jo's modification on my design - a rhino-grasshopper script to transfer my model into a waving pattern, this leads to a discussion on further co-design idea possibilities.	Introduce/provide a external view Deconstruct (Technical / Digital software; Space; Design Thinking) knowledge Leads to deconstruct and sharing of each other's (Digital/Physical Space) knowledge Leads to more design discussion and co-design ideas Effect on co-design decision	Based on the sharing of a model created from another subject, the discussion process reflected the different understanding of physical and digital space in both fields. Due to the development of different perspectives of the model, both collaborators further discussed the possibilities of the project in the future.
12	2021.05.01 00:47:10 - 00:58:38	David	Digital model in Rhino software: Combined Geometric Structure design and the organic design of the whole music	Yes	Jewellery	Visual	Knowledge Understanding	Yes	Effect on understanding Rebecca's design process but not effect on my process or design - A more comprehensive and specific explanation of design decisions and design thinking. (Knowledge deconstruct, picked up and effected on my understanding, but not flow into jewellery field - didn't show any different apply of the deconstructed knowledge) Bringing up thinking of showing single piece or as whole - we think the design detail of a single piece is beautiful	Deconstruct (Technical / Digital software; Space; Design Thinking) knowledge Increasing understanding of design decision Leads to more design discussion and co-design ideas Effect on co-design decision	A discussion of collaboration options based on the holistic model. Building on ida's understanding of music, geometric from and organic form models are combined to further discuss the options for co-design ideas.

Boundary Objects - Digital Model (Rendering Image)

Number	Video/Time	Used by	Specific Object	Boundary object?	Rooted in	Effect on	Contributed to	Picked up?	Effects	Role	Comments
1	2021.10.07 00:09:37 - 00:12:26	David	Rendered Digital model image	Yes	Jewellery	Visual	Understanding	Yes	Bringing up the idea of how can provide colour design on my physical piece Effect on understanding my design process but not effect on Rebecca's process or design (Knowledge deconstruct, picked up and effected on my understanding, but not flow into jewellery field - didn't show any different apply of the deconstructed knowledge) Bringing up thinking of showing single piece or as whole - we think the design detail of a single piece is beautiful	Deconstruct (material) knowledge Increasing understanding of design decision Leads to more design discussion and co-design ideas Effect on co-design decision and display plan	Based on the computer software rendering, I was able to present my material choice (clear acrylic) based on my material knowledge (experience working with material), knowing that clear acrylic could present the spatial effects I needed (i.e. its translucency would show the complex internal spatial structure of my design very well), and through the material simulation of the rendering, Rebecca was receiving a similar material perception. Although my knowledge here did not influence Rebecca's design, its use as a boundary medium to helped me communicate my ideas, demonstrated my empirical knowledge of materials, aided Rebecca's understanding and provided the basis for a subsequent discussion of display and exhibition ideas.
2	2021.10.07 00:15:06 - 00:16:41	David	Digital model in Rhino software and Rendered Digital model image (Same one as above)	Yes	Jewellery	Visual	Understanding	Yes			Based on the model and renderings of measure 1-25, Rebecca had a clearer sense of my existing design and the 'space' I create, which helped her to further imagine what the whole finish piece might look like, and based on this we discussed possible ways of presenting the finished product.
3	2021.02.17 00:08:29 - 00:09:59	David	Rendered Digital model image	Yes	Jewellery	Visual	Knowledge Understanding	Yes	Effects on co-design ideas and exhibition ideas: Getting ideas of what the designed space looks like in transparent materials - The space as a whole is very interesting but it may be too complex in small scale pieces for people to look at. Single layer shows more interesting details of the design. Bringing up display plan discussion - single layer may be better for showing the beauty of the design details		Models rendered by superimposed materials can perceive the visual and spatial effects of the materials on a nonphysical basis. Based on the overall and detailed effects given by the rendering, it is considered that the overall access design does not highlight details in single piece, so it might consider appropriate to adopt a piece-by-piece presentation to reflect the details depending on different exhibition plans.
4	2021.03.21 00:54:59 - 00:55:29	David	Rendered Digital model image for the rest part of the whole music	Yes	Jewellery	Visual	Understanding	Yes			Based on the sharing of the model and rendered images, this time I am sharing the design of the rest parts of the music, discussion also including the differences from the previous parts, etc.

Boundary Objects - Digital Model (Rendering Video)

Number	Video/Time	Used by	Specific Object	Boundary object?	Rooted in	Effect on	Contributed to	Picked up?	Effects	Role	Comments
1	2021.02.17 00:09:59 - 00:15:33	David	Rendered Digital model video	Yes	Jewellery	Visual	Knowledge Understanding	Yes	Effects on co-design ideas and exhibition ideas: Getting ideas of what the designed space looks like in transparent materials - The space as a whole is very interesting but it may be too complex in small scale pieces for people to look at. Single layer shows more interesting details of the design. Bringing up display plan discussion - single layer may be better for showing the beauty of the design details	Deconstruct (material) knowledge Increasing understanding of design decision Leads to more design discussion and co-design ideas Effect on co-design decision and display plan	Models rendered by superimposed materials can perceive the visual and spatial effects of the materials on a nonphysical basis. Based on the overall and detailed effects given by the rendering, it is considered that the overall access design does not highlight details in single piece, so it might consider appropriate to adopt a piece-by-piece presentation to reflect the details depending on different exhibition plans.

Appendix 20: Boundary Objects in This research

Boundary Objects	Boundary Objects in this research				
Definition and Features	**Definition and Features (Role) 1**		**Definition and Features (Role) 2**	**Definition and Features (Role) 3**	**Definition and Features (Role) 4**
❖ An object that lives in multiple social worlds and which has different identities in each. (Star and Griesemer, 1989) ❖ A 'practical artefact' that can represent both the knowledge of the respective field and the knowledge shared between fields (Sapsed & Salter, 2004; Star & Griesemer, 1989; Suib et al., 2020:116) ❖ Nicolini et al. (2012:614) argues that the concept of a boundary object is considered most suitable to use in the context of "shed light on how, through an object that resides amid different social worlds, groups cooperate without con- sensus, tacking 'back-and-forth between both forms of the object'" (Star, 2010: 605) ❖ Inhabit several intersecting social worlds and satisfy the information requirements of each of them. (Star and Griesemer, 1989:393)	Contextual Example	❖ Introduction collaborator into the field ❖ Deconstruct different kinds of knowledge: · Music - visual transfer · Design Thinking · Music - Physical/Digital transfer ❖ Understanding in different design elements: · (Visual) Colour and Space · (Physical) material and Space · Musical and visual flow ❖ Increasing understanding of design decision ❖ Provide translation of ideas / design thinking between fields ❖ Provide link between (similar) design decisions from two fields ❖ Leads to more design discussion and co-design ideas. ❖ Effect on co-design decision		❖ It is not necessary to live in several different worlds at the same time but can be a medium who lives only in one world, playing its original role in its own field, but can be led to appear at the boundaries of the domain or knowledge when needed. ❖ It also can be a medium that from outside the collaborative environment be directed to the field/knowledge boundaries to represent the knowledge of the field or contribute to the management of the collaborative process.	
	Journal	❖ Managing Collaboration (documentation) process ❖ Deconstruct different kinds of knowledge: · Technical · Digital software · Music - Space/Structure transfer ❖ Increasing understanding of design decision ❖ Introduce/provide a external view ❖ Leads to deconstruct and sharing of each other's (Digital/Physical Space) knowledge. ❖ Leads to more design discussion and co-design ideas. ❖ Effect on co-design decision	❖ Introduction collaborator into the field ❖ Introduce/provide an external view ❖ Increase and transform understanding of design decision ❖ Increase the accuracy and efficiency of communication. ❖ Provide translation of ideas/ design thinking between fields ❖ Provide link between (similar) design decisions form two fields ❖ Leads to more design discussion and co-design ideas. ❖ Effect on co-design decision and display plan ❖ Managing Collaboration (documentation) process ❖ Deconstruct different kinds of knowledge: • Design Thinking • Technical • Digital software • Music - visual transfer • Music - Physical/Digital transfer • Music - Colour transfer • Music - Space/Structure transfer ❖ Understanding in different design elements: • Visual/Digital colour and space • Physical material and space • Musical and visual flow	❖ (In the early stages of the project) to provide other collaborators in the collaborative environment with background knowledge of one's repressive field and to create the basis for the flow of knowledge within the collaborative environment. ❖ (When design elements from the collaborative project are used across projects and as be used as boundary medium at the same time) to introduce an external perspective to the collaboration ❖ Acts as a 'bridge' in the communication of collaborators, building better understanding between the collaborators by increasing the accuracy and efficiency of communication. ❖ Provide a translation medium for the exchange of knowledge between the two collaborators, aiding deconstruction, capturing and reconstructing the personal and field knowledge of both collaborators. ❖ Advances the project development process, generating more design discussions and co-design ideas based on building understanding. ❖ Aids in managing the collaborative process (data collection). ❖ Provides translation of design ideas and decisions between the collaborators through several interrelated boundary mediums, thus enhancing mutual understanding.	❖ Objects that are rooted in a field, or live across fields (It also can be a medium that from outside the collaborative environment), play their original role in their own field, but can also be directed to the field/knowledge boundaries when needed (to represent the knowledge of the field or contribute to the management of the collaborative process). ❖ Carries information about the knowledge, skills or characteristics from the represented field. ❖ The role of a object in collaboration is not a property it carries in itself but is given by its interaction and relationship with other mediums or people in the process of collaboration. Its position in the collaboration and the issues it deals with determine its function. ❖ Boundary objects carry details or functions that are familiar to both fields and thus act as bridges and translators through which collaborators from other fields can access and use knowledge and skills that are unfamiliar to them. ❖ There is sometimes interaction between boundary objects, i.e. the interaction of multiple boundary mediums chosen by both collaborators to enhance their understanding or to stimulate further discussion of design ideas ❖ The effect of boundary objects in this research on knowledge is a discrete and diverse process. Although boundary media mostly act at the field/knowledge boundaries, but they may also act across the boundaries or only function at the field boundaries. ❖ The boundary objects in this research is mainly act the three areas - knowledge, understanding and collaborative processes: • The deconstruction, capture and reconstruction of knowledge • Increasing understanding of the design decisions of the collaborators • Management of the collaborative process and the data collection process
❖ First, is the capability to represent different knowledge domains. ❖ Second, are its aids to learning similarities and differences among domains (e.g., terminology), as well as their dependencies and contradictions, and, ❖ Third it allows current knowledge to be transformed into something new (or different) through a collective effort. (Carlile, 2002; Suib, 2020:116) ❖ Boundary Objects come with details that are understood by both fields, so that collaborators can use the knowledge without fully understanding them and context behind them. Boundary objects regulate the limits of using knowledge and allow the researcher to work with partial ignorance. (Nicolini et al., 2012:617) ❖ It can work as translation operator. (Star and Griesemer, 1989:393)	Process image	❖ Deconstruct different kinds of knowledge: · Technical · Digital software · Colour - Music transfer · Digital Space ❖ Increasing understanding of design decision ❖ Leads to more design discussion and co-design ideas. ❖ Effect on co-design decision		
	Process video	❖ Deconstruct different kinds of knowledge: · Technical · Digital software · Colour - Music transfer · Digital Space ❖ Increasing understanding of design decision			
	Digital Model (Rhino 3D Model	❖ Deconstruct different kinds of knowledge: · Technical · Digital software · Colour - Music transfer · Digital/Physical Space · Design Thinking ❖ Increasing understanding of design decision ❖ Leads to more design discussion. ❖ Leads to co-design ideas and effect on co-design decision and display plan. ❖ Transform and increasing understanding of design decision. ❖ Increase the accuracy and efficiency of communication. ❖ Effect on co-design decision ❖ Introduce/provide an external view. ❖ Leads to deconstruct and sharing of each other's (Digital/Physical Space) knowledge			
	Digital Model (Rendered image)	❖ Deconstruct (material) knowledge. ❖ Increasing understanding of design decision ❖ Leads to more design discussion and co-design ideas. ❖ Effect on co-design decision and display plan			
	Digital Model (Rendered video	❖ Deconstruct (material) knowledge. ❖ Increasing understanding of design decision ❖ Leads to more design discussion and co-design ideas. ❖ Effect on co-design decision and display plan			
	Physical Model	❖ Deconstruct (material) knowledge. ❖ Increasing understanding of design decision ❖ Leads to more design discussion and co-design ideas. ❖ Effect on co-design decision and display plan			