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# VISUAL COMMUNICATION OF DESIGN PRINCIPLES IN A COMPLEX KINETIC CONSTRUCTION

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**ABSTRACT**
Design students need to be able to build a bridge between their own practice and the various receivers of their messages. Studies in design practice confirm that visualisation is a powerful communication tool often used by artists and designers. Despite these studies, a knowledge gap was identified concerning how design principles of concepts and quantitative structures can be communicated to engineers concerning complex and kinetic art constructions. Through a case study of a cross-disciplinary collaboration, a complex and technological public art sculpture was developed cooperatively with various professionals. The main concept for the sculpture project was to use the airflow from two ventilation systems. Based on this process in a real-life situation with objects that can lead to a situation of failure in the materialisation of a project it is discussed how two different disciplines can have discipline specific languages and further it is discussed what kind of competence that can contribute to communicate in a productive way. The discussion concerns the representation of an idea through a tangible model in different traditions and cultures. Such a communication process was visualized as a pedagogical concept for cross-disciplinary communication. Students can benefit from being prepared for these kinds of situations in collaborative design practice.

*Keywords: Communication, cross-disciplinary collaboration, language games, cultural differences.*

## 1 INTRODUCTION: DISCIPLINE SPECIFIC LANGUAGES

Design students should be prepared for cross-disciplinary collaboration. Communication across professions is a challenge because each profession has a specific type of language [1]. The philosopher Wittgenstein introduced the idea that language alone can seldom capture the total meaning of a concept because language is often rooted in a certain kind of practice, and he therefore introduced the concept of ‘language games’ [2]. Language games are connected to how people act as a part of their communication. Collaboration in practice can promote creativity and innovation in professions such as design and engineering [3]. There are benefits of collaboration in design and engineering through cross-disciplinary communication, and these are connected to understanding language games in different work cultures. The anthropologist Geertz points to how we should try to enable competence to interpret other cultures and thus better understand cultural differences [4].

## 2 BACKGROUND: NOISE INTERVENES MESSAGE

Communication across different professions is essential for bringing an idea to materialisation, and various ways of enhancing the quality of the dialogue have been studied in participatory design [5]. In such communication, it has been claimed that noise intervenes with the message, and this makes the message from the sender difficult for the receiver to understand [6]. Donald Schön thinks that design students need to recognise this and understand how to build a bridge between their own practice and the various receivers of their messages [1]. Studies in creative methods in design practice confirm that visualisation can be a powerful communication tool, and it is often used by artists and designers [7-9].

### 2.1 From concepts to physical solutions

In the aim to understand creativity and how concepts can be connected to physical solutions, it is beneficial to learn from conceptual artist Joseph Kosuth and one of his main works, ‘One and three chairs’, where the concept chair is exhibited through means of a real wooden chair, an image of a chair on the wall and a verbal definition of a chair on a piece of paper on the wall. This demonstrates playfulness about what a chair is; is it a concept or is it a physical product? Kosuth’s play with

concepts is also reflected in another work, 'A Play – News From Kafka and a Quote', described by Dr. Gerald Silk, Professor of Modern and Contemporary Art [10]. The work is a newspaper article titled 'Americans are found "downright angry" at political powerlessness', and this article is repeated on several pages, where each page is combined with citations from 'Parables' by Franz Kafka [11]. Silk explains how Kosuth's art for the magazine Art Journal simultaneously can be read as both verbal and visual text. This combination of the verbal and the visual is a topic that is also relevant in creative processes in design and engineering collaborations. It also shows how conceptual art can use existing elements in society, such as a newspaper article or a chair, and how, through conceptual and physical interventions, everyday objects are transformed into art.

### 2.2 From representation to pragmatism

Another example of conceptual art is a work by the artist Serrano, who has been accused of being blasphemic. The artist put a crucifix in a glass container and then filled it with his own urine before depicting it in a photograph. The work was called 'Piss Christ' [12]. An intention from the artist was that it was actually his own urine, not coloured liquid, because the art should be authentic; it should not be a representation or only a symbol. It certainly created a lot of discussion, and demonstrations were organised against this work [12]. Merino's reflection on the work was that 'Euphemism has become established as a way of repressing ideas, and the meaning of things is becoming diluted. For this reason, beauty is not enough. Art should not be a pleasant, beautiful escape mechanism. It should not be a euphemism covering over the holes in society, but the light that makes us reflect upon that society. That is why art is and will always be uncomfortable for the system. Art must move closer to activism rather than to the purely aesthetic. There is no aesthetic without ethics.' [12]. The example shows how conceptual art aims to create a critical discussion in the public space by the use of both aesthetics, and also engagement in society, where provocation, discussion and demonstrations also become a part of the art concept. As such, there is no strict border that limits the work to the physical object separate from the discussion and communication that it creates; both the artwork and the communication are part of the conceptual work. This view has also been promoted in studies about public art [13].

### 2.3 Communication about kinetic art constructions

This background demonstrates that communication across different professions is essential for bringing an idea to materialisation in practice and that there are various studies regarding enhancing the quality of the dialogue in art [7, 10, 12], participatory design [5] and engineering [1]. Despite these studies, a knowledge gap exists concerning a pedagogical concept of communication that can connect conceptual art, cross-disciplinary collaboration in design and engineering. Expanded knowledge of this can benefit collaboration in design and engineering. It is possible that design theory with design principles of concepts and quantitative structures [14] could be communicated to engineers in regard to complex and kinetic art constructions [15]. There is a need to know more about how such creative concepts are transformed into practice because knowledge about both pitfalls and potentials can transfer to other situations and contribute to multidisciplinary innovation [16]. The research question for the study, therefore, was how could design principles and quantitative structures be communicated to engineers concerning complex kinetic art constructions?

### 2.4 Method: Case study of the unique creative event

A suitable approach was a case study of a real project, where the research question were developed based on the experience and the emergence of the empirical data, as a retrospective stance [17]. With such a practice-based approach from research and enterprise, it was possible to document empirical data that could be analysed to inform design and engineering pedagogy [18]. Through a collaborative approach by the artist [5], a complex and technological public art sculpture had been developed cooperatively with other professionals, mainly engineers. Through the analysis, pedagogical [19], epistemological and ontological viewpoints were discussed. Such analyses were recommended by the art philosopher Juha Varto, who believes that there is an unused potential in artistic research to learn more from 'the unique creative event' [20]. The descriptive study is based on participatory observation and the prior understandings of the participant artist, and the intention is to aim for a fusion of horizons [21, 22] across professions.

## 3 FINDINGS: A KINETIC ART SCULPTURE

The case study presented in this article is a conceptual art project including a public sculpture funded by the municipality of Nesodden and Public Art Norway in connection with a new municipal building containing schools, libraries and municipal offices. The main concept behind the sculpture project was to use the airflow from two ventilation systems. To explain the concept for the engineering company, a simple three-dimensional model was produced to illustrate the different functions visualised in the study (Figure 1).

### 3.1 Part 1: 'Pulse' - a mock up of a conceptual artwork

The artwork was titled 'Pulse'. The title alludes to the artistic concept of enhancing the connection between the sculpture and the pulse of the house through the ventilation systems in the building. It was intended to be placed in an enclosed outdoor space, an atrium, so that it would be limited and not physically accessible to people. The sculpture was based on the draft from the two ventilation systems, which were dynamic and reflected the activity in the building. Many people in the building lead to more pressure in the building. The sculpture would respond to this and work according to the activity in the different parts of the house. It was a kinetic sculpture that was functional and operated by air from two separate ventilation systems. Physically, it consisted of two main parts (Figure 1). One was a vertical aluminium cylinder rotated by using the air from one of the ventilation systems. The second part was driven by the second ventilation facility to lift and pull up a 'hammer', which was jacked up until it reached a certain point, after which it would fall down and leave a mark on the cylinder. This mark would, in principle, not hit the same place twice and would, over time, change the cylinder's appearance and shape.

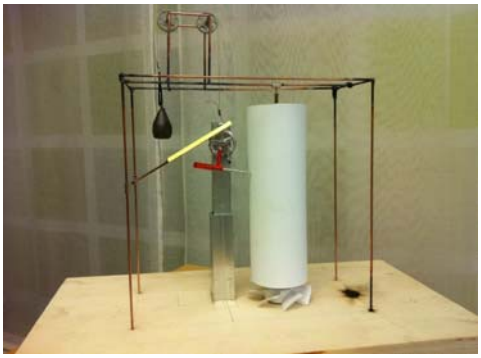

*Figure 1. Step one 'Pulse': A mock-up of the public art sculpture in paper, steel and polypropylene; a hammer that leaves marks on a cylinder*

The model was a visualisation on a fundamental level, and the intended meaning was to demonstrate different functions. The model was performed on a scale of about 1:10 and consisted of welded steel and other metals, plastics and paper. Its height was 25 cm. The design was simple and transparent, based on the intention that people should be able to read what happens between the house and sculpture. The model was intended as a description of the functions and not as solutions to them.

### 3.2 Part 2: An impossible solution

The model was presented for a big Norwegian engineering company, which in its advertising claims to specialise in leading 'ideas into a finished product'. The mock-up model was seen and analysed by people in the company, and the idea of the 'solution' in the model was discarded as an 'impossible principle'. In particular, there was one part where friction would occur, and thus it would not function in relation to the air pressure/flow from the building. Therefore, they started with a completely new concept for this part of the sculpture. Given this, two things happened. Firstly, the firm took more responsibility to solve this problem, and secondly, the artist was put off this part of the process because this was outside the artist's area of expertise.

In connection with the production of part one (the cylinder) and the supporting structure, no problems emerged; there was a good dialogue. This solution was close to the model's expression, and the process was conducted in full compliance with the artist. Dialogue with people with different competences was both necessary and desirable for this type of project, where the artist did not have the necessary competence. It also meant that through this partnership, unexpected solutions to specific

problems could emerge. It was a situation where the artist gave up some of the control in respect for others' expertise and professionalism. At this stage, therefore, based on the model, one of the main parts was interpreted as an impossible solution.


*Figure 2A and 2B: 2A: Step two 'Pulse' real-size installation on site; first version. It was a failure because the air from the ventilation system did not move the hammer. Figure 2B: Step three: 'Pulse' real-size installation on site; second version, including a frictionless bellows, and where all functions were safeguarded and resolved according to the original concept*

Pictured above is the solution initiated by the artist and completed by the engineering company, as it appeared when it had been delivered in full scale onsite. The blue cylinder part in aluminium was as intended, while the other part was a solution that was complicated and expensive but not fully functional. It contained two chambers scheduled for pulling and lifting the 'hammer', intended to turn into the cylinder at different heights. When it turned out that it was impossible to get it to work as intended, new layers of new parts were gradually added to compensate for the lacking function. All this happened without success. It all took a very long time, and gradually recognition grew in the engineering company that it would not be possible to construct and produce the project as intended. The conclusion was that the artist took over the project again and involved new partners for further development.

### 3.3 Part 3: Conceptual consciousness in collaboration

The process moved back to its starting point. The dialogue with a new engineering firm from Denmark turned out differently. The artist experienced more mutual respect because the collaborative partner approached the problem in a different way. The firm employed more responsive communication. It was a more conceptually conscious company that showed a strong desire to communicate during the process. In addition, there was the failed experiment as an example. Discussions immediately started on a subordinate issue, a dialogue that happened in an informal setting. It was in a café, as opposed to the former dialogues, which all happened in more formal environments. Through conversations and drawings, a solution emerged. This was the approach that improved the failed main part of the sculpture. Based on the initial model, the artist and the second engineering company developed a frictionless bellows inside a form with a built-in control. Combined with pulleys and weights, it provided an optimal solution that could function and had very good sensitivity to minor fluctuations in airflow. The functional principles of this part were redefined in accordance with the overall art concepts and were manufactured successfully to work as intended.

The communication between the sender and recipient [6] emerged in a good way, where noise that disturbed the message was reduced based on mutual respect through participatory design methods [5] and by gradually and collaboratively establishing a common understanding of the problem that should be solved. Instead of starting off with a rejection, the collaborative approach headed for the core of the problem, and in this way a functional solution was found. The picture (Figure 3) shows the finished result, in which all functions were safeguarded and resolved according to the original concept.

## 4 DISCUSSION: VISUAL COMMUNICATION IN A KINETIC SCULPTURE PROJECT

In this case study, there was a need to connect examples from contemporary art [10, 12], collaborative approaches in design [5] and engineering [3] to fully understand the project. It was a connection of several research fields, which, according to Varto, is called imprinting—how a research study of a unique creative event needs to borrow concepts from other research fields to explain a process where the aim is to create an expanded understanding for the reader [20]. Such an epistemological perspective in this study is that there are a variety of knowledge fields to consider in a practical project. Varto further elaborated on the need to identify the view of man in practice, with an aim to position examples of education in an ontological perspective [20]. In this case study, a topic was how communication could happen with mutual respect and an expanded understanding of each other's competence in a collaboration process. The learning outcome for design students is to understand the need to encounter various different cultures with a worldview of knowing how to contribute to a dialogue with mutual attentiveness and respect. A further learning outcome for students is to have the general competence to find information from research fields with different traditions. The study shows how a real process in a real-life situation with real objects can lead to failure in the materialisation of a project. The practice showed how different disciplines can have different 'language games', as introduced by Wittgenstein [2], where prior understandings [21] and professional competence can make it hard to communicate in a productive way across professions [1].

### 4.1 The degree of abstraction versus the risk of misinterpretation

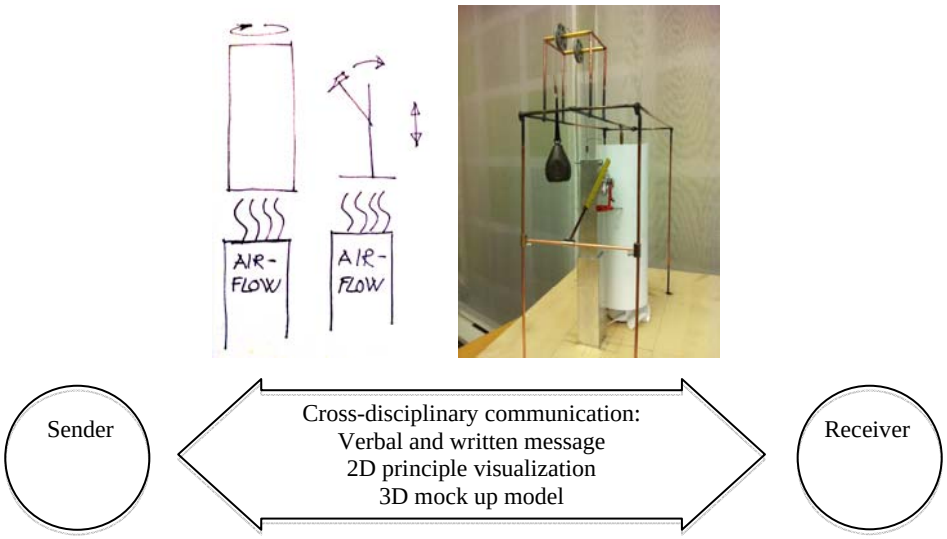


*Figure 3. A pedagogical concept: Abstraction versus the Risk of Misinterpretation (ARM): A combination of a principle model + a physical mock-up model to be implemented in the communication process. The sketched drawing is on a principle level for the first stages of development*

It would be only speculation to conclude that the second approach was better than the first because there was an unsuccessful attempt to take the final dialogue into account. Instead, the answer to the research question 'how could design principles and quantitative structures be communicated to engineers concerning complex and kinetic art constructions?' concerns a topic that emerged from the process: the degree of abstraction versus the risk of misinterpretation. In this case, the process documentation demonstrated how the artist underestimated how literally the recipient interpreted the visual representations. This may have been due to a mutual lack of understanding of each other's professional cultures [4] and each other's prior understandings [21]. In the first dialogue, the model was understood as a functional solution, although it was intended as a physical representation of a principle structure. By using the Tjalve method of principles and quantitative structures, one would be able to increase the abstraction level, and the visual representation would not hinder a more conceptual interpretation [14]. This could have been done, for example, in combination with the initial physical mock-up, as shown in the visualisation of the pedagogical concept Abstraction versus the Risk of

Misinterpretation (ARM) (Figure 4). The study shows that there was a need for extended understanding of the non-verbal communication that can happen through visual expressions. For designers, it is essential to be aware of these challenges in meeting other professionals. Students would benefit from being prepared for these kinds of situations in collaborative design practice by handling conceptual consciousness and how it is reflected in art, design and engineering. Product design students will in such cases benefit from being able to make conceptual visualisations as well as physical mock-ups.

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