Application of Media Synchronicity Theory to Creative Tasks in Virtual Teams Using the Example of Design Thinking

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Abstract. Today in many industries it is common to work in virtual teams. At the same time companies must innovate to retain their market share and stay in the market. One possible method to come up with innovations is Design Thinking. However, this method is originally not intended to be used in a virtual team. The objective of this research is to provide a guideline on how to practice Design Thinking in a remote setup, thus travel expenses and planning efforts could be saved. This guideline is based on the media synchronicity theory which is applied to the process of Design Thinking. As a result, it is deduced that the diverging phases in Design Thinking are best supported with asynchronous media. In contrast to the converging phases which are supported best by synchronous media. These results could be used by practitioners to choose the best fitting media for each phase.

Keywords: Virtual Teams, Design Thinking, Media Synchronicity Theory, Creativity, Innovation

1   Introduction

To survive in a globalized market, companies have to come up with innovative services, new products and efficient processes [1]. Through constant innovation they can serve their customers better than the competition and even grow their market share. In order to innovate at scale, many companies started to work with creativity methods like Design Thinking to enhance their ability to come up with strong ideas [2].

At the same time, not only the markets became global markets, also the companies themselves opened locations all over the globe. For example, in the software industry, it is very common that teams are distributed over multiple locations and only communicate through information and communication technology. Such teams are called virtual teams. To communicate, they use, for example, e-mail, social networks, instant messaging, telephone conferencing and many more technologies. Nevertheless, also

virtual teams must solve creative tasks, to come up with innovations in their area of work.

This paper examines the intersection between these two fields. Therefore, we consider the usage of communication technology in virtual teams to solve creative tasks. As a method to solve creative tasks this paper employees Design Thinking, which enables a team to come up with innovative ideas. However, Design Thinking is originally a method, which is practiced in one location and not in a distributed set up. In this paper we develop a guideline on how a remote setup for virtual teams might look like. We apply the media synchronicity theory (MST), to analyze whether a certain medium fits to a task. With the perspective of the media synchronicity theory on Design Thinking, we focus on the research question "Which media capabilities should a tool for virtual Design Thinking have to enable high team performance?" The remainder of the paper is structured as follows. In the next section, we describe our methodological approach. In chapter three we explain how Design Thinking may be used to leverage creativity in teams and in chapter four we introduce the media synchronicity theory. After that we apply MST to the method of Design Thinking and we deduce recommend-dations for virtual teams. We conclude the paper with a discussion of our results and limitations.

2 Research Method

In this paper we apply a methodology from the domain of design science research [3–6]. We focus on the development of knowledge in information systems through the design of artifacts [7]. In our effort, we follow the guidelines for design science research as put forward by Hevner et al. [4]:

Design as an Artifact. The artifact that we develop in this paper is a concept that consists of guidelines for the application of specific types of media in virtual Design Thinking. The guidelines describe a category of media for every phase of Design Thinking which should enable a high task performance.

Problem Relevance. It is vital that research satisfies a strong business need. The business need for virtual Design Thinking originates from the conflict area between virtual teams, innovation needs and cost restrictions. As indicated above, Design Thinking can be used to come up with innovative solutions, however it is usually practiced in one place. In the case of a team with distributed team members, one solution is to travel to one place and to conduct the Design Thinking workshop there. This poses a large planning effort and it is rather expensive. This conflict between creativity and expenditure might be improved through the concept which we propose.

Design Evaluation. The artifact will be developed through the analysis and application of an existing theory (namely MST). We apply a deductive-argumentative approach using abstraction and reflection [8] when we relate MST to the different phases of Design Thinking.

Research Contribution. Our concept for virtual Design Thinking represents a first approach to make it possible to use Design Thinking in virtual teams. To the best of our

knowledge, there is currently no guidance available for practitioners to use Design Thinking remotely.

Research Rigor. The contribution builds on the knowledge base in virtual team research, and Design Thinking. Therefore, a take a closer look on MST, and Design Thinking. Our approach is aligned with the research category of "design and action" which was proposed by Gregor [5].

Design as a Search Process. The starting point is the relevant practical problem, to which we apply a well-documented theory. The proposed concept is deduced from the application of MST to the Design Thinking process. In doing so, we analyze which capabilities are required to support each phase of the Design Thinking process. Hence, we are able to identify appropriate media for each phase.

Communication of Research. To communicate our research, we have designed this paper in a way that it addresses technology-oriented as well as management-oriented researchers. Furthermore, it is suited as a guideline for practitioners.

3 Leveraging Creativity in Teams Through Design Thinking

In the last decade, Design Thinking has evolved into a method, not only to support innovation, but also to offer a process to improve and to accelerate the creativity of teams [9]. Thus, Design Thinking isn't limited to the design space anymore. It can be used in different fields and for different applications. As it has evolved over time, multiple definitions of Design Thinking were developed [10]. Here we use the commonly accepted definition of Tim Brown (CEO of the innovation consulting firm IDEO): "Design Thinking is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success." [11] This definition highlights that Design Thinking should aim at the intersection between the human desirability, the technical feasibility and business viability. If all these factors are given, an idea has the potential to be a break through innovation [12].

After a first glance on the purpose of Design Thinking, we describe the process. This process is iterative, so it is possible to cycle back, or to revisit the results of earlier phases and improve them again [10]. We use the Stanford Design Thinking Model (see Fig. 1), because that model allows to classify the phases according to the communication processes of the MST. In other models the phases are starting and ending at different times. That would make a matching to MST more difficult.
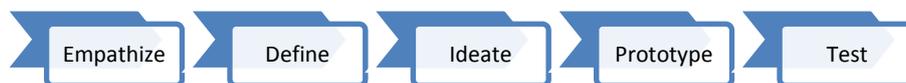
Figure 1: Stanford Design Thinking Model [13]

Empathize. The goal of this phase is to explore the problem and to get a common understanding [14]. An essential part of this phase is the knowledge transfer between the team members. Design Thinking teams should consist of experts from different

areas to provide diverse inputs and to ensure a good result [15]. After the team members developed a common understanding of the problem and its context, the user research may be started. The goal of the user research is to develop empathy for the user. Therefore, the behaviors and feelings in the problem context have to be observed [13].

Define. The *definition* phase starts with the end of the phase *empathize*. The goal of this phase is to specify the problem and the context more precisely [14]. Furthermore, the user for whom the problem should be solved, will be defined. In a discussion about the results of the phase *empathize*, the team can find patterns in the data and also detect anomalies. Thus, the data can be framed into a narrow problem description [13].

Ideate. The *ideation* phase is the core of Design Thinking, in this phase most of the creativity and innovation takes place. In the first two phases, the empathy for the user is developed to guide the idea generation process in a good direction. Primarily, group brainstorming is used to generate new ideas in this phase [16]. However, also other smaller creativity methods are used in this phase.

Prototype. The *prototype* phase has two main goals. One is to concretize the generated ideas and the second is to make it possible to validate the concept with the user in the testing phase [13]. The prototype is helping the team and the customer to better understand the generated ideas [14]. Hence, possible constraints or limitations might be found in the testing phase and they might be used to improve the concept in a next iteration.

Test. The *test* phase is all about feedback from users and stakeholders. The ideas are presented to them with the help of the prototype. This allows a precise feedback [13]. The team will observe the customers' behavior while interacting with the prototype and ask them for feedback. Based on the feedback they are able to decide if the concept is ready for implementation yet.

4   Media Synchronicity Theory

In reviewing the literature about the media selection of virtual teams, we could find seminal relevant theories. According to the media richness theory (MRT), richer media should be used for tasks with high equivocality and simpler media should be used for standard tasks [17]. However, research has found that MRT does not explain the media choice well enough, because there are more factors that influence the media choice and different subtasks might have different media requirements [18]. The second theory considered was the task/technology fit theory. This theory explores the fit between a task and a medium on an individual [19] and group level [20]. The theory defines five different task types, which are supported by three different dimensions of media. This was an improvement on the issue of subtasks, however the research doesn't address if experience within the group might have an influence on the performance. MST tries to overcome these limitations and proposes the necessity of a fit between the communication processes, the appropriation factors and the capability of the medium to support synchronicity [21].

In MST there are two kinds of communication processes. Conveyance processes transport new and diverse information, so the receiver needs time to process and understand them [22]. In contrast, convergence processes transmit already known, or familiar information and the goal is to negotiate a shared understanding. MST proposes that conveying communication needs low media synchronicity and converging communication needs high media synchronicity [23]. Nevertheless, as shown in the model (see Fig. 2) also the appropriation factors, like familiarity with the medium and past collaborations between the team members have influence on the media fit. In the next sections, all factors will be discussed in more detail, so a good understanding of the theory can be developed.
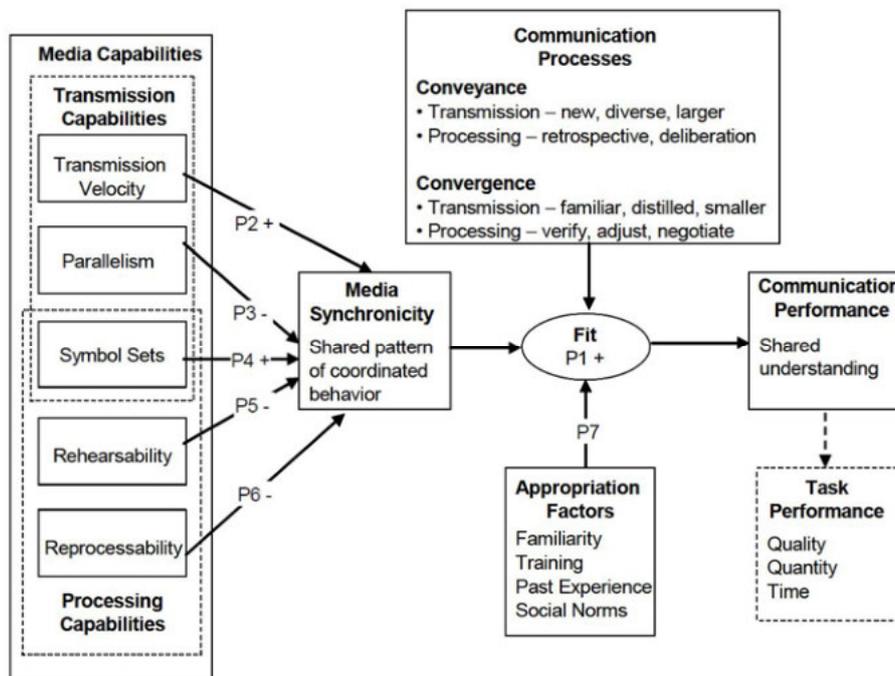

Figure 2: Media Synchronicity Theory [22]

4.1 Communication Processes

There are two types of communication processes. First, conveyance processes are used to deliver a large amount of new and diverse information to the receiver. This might be information like a report, but also a collection of raw information. So the receiver has to process the information and to interpret the meaning [24]. To fulfill this task the receiver needs time to go through the heap of information. For the receiver this task gets easier, if he has the possibility to revisit the content of the message multiple times and to make sense out of it [25]. On the other hand, the sender could support the receiver by carefully crafting the messages [26].

Second, in contrast, converging communication deals with already familiar information or preprocessed information [22]. In this case the participants of the conversation already have given an own meaning to the information. Hence, the goal is to discuss towards a common understanding of the information [27]. Therefore, only small quantities of information are transmitted. The receiver doesn't need much time to process the information. A high transmission velocity could ensure that sender and receiver have a smooth and fast communication [28].

Almost every task involves a mix between the two communication types. Thus, the theory can be applied to the dominant part of the communication processes. Or multiple media types can be combined to support the communication best [22]. Larger tasks like the development of a concept by using Design Thinking can be divided into subtasks. So, the subtasks might be analyzed, and appropriate media can be used.

4.2 Media Capabilities

In this section we describe the media capabilities which define the media synchronicity. A medium with high media synchronicity, like video conferencing, allows its participants to communicate almost synchronously [29]. In contrast, there are media with low synchronicity, for example, e-mail. According to MST there are five media capabilities, which build the medium's capability to support synchronicity. These capabilities are transmission velocity, parallelism, symbol set, rehearsability and reprocessability [23]. The first three media capabilities are adopted from the Shannon and Weaver communication theory [30]. Rehearsablity and reprocessability were added to describe the influence of encoding and decoding in the communication theory [22].

Transmission velocity describes, if the medium supports a fast feedback on the understanding and the meaning of the last message [25]. As indicated by the plus symbol next to P2 in figure 2 a high transmission velocity causes a higher media synchronicity. The opposite is the case for parallelism here the minus symbol indicates that high parallelism causes lower media synchronicity.

Parallelism describes the capability of a medium to support multiple conversations at a time [26]. The media synchronicity is lower, because the participants aren't focusing on one conversation.

Symbol set describes the mediums capabilities to encode a message [28]. For example, in phone calls there is only sound to transport the information, but video conferencing additionally has the video and as a consequence a larger symbol set.

Rehearsability describes the mediums capability to rephrase the message before sending it [31]. A high rehearsability indicates a low media synchronicity.

Reprocessability describes the mediums capabilities to replay or show the received message multiple times [22]. So, the receiver can reread the message while making sense out of it in conveyance processes.

Table 1 sums up, which media supports high synchronicity and which media supports low synchronicity.

4.3 Appropriation Factors

The appropriation factors are the third part which has to fit to ensure a high communication performance. The appropriation factors describe whether the group already has experience working together, working on a similar task, or working with a certain communication medium [22]. The idea behind the appropriation factors is: If the team has no experience with one, or more aspects out of *people*, *task* and *media* there is more coordination required [21]. Consequently, a higher media synchronicity is required, since coordination mainly involves convergence processes. Nevertheless, over time the team develops a shared understanding of the task, the media and the people on the team [22]. As a result, the need for synchronous media out of the appropriation factors decreases over time.

Table 1: Classification of various media regarding MST's media capabilities [31]

Media	Immediacy of feedback	Symbol variety	Paral-lelism	Rehears-ability	Reprocess-ability
Face-to-face	High	High	Low	Low	Low
Video conference	Med.-High	Medium	Low	Low	Low
Telephone conference	High	Medium	Low	Low	Low
Instant messaging	Med.-High	Low-Med.	Low-Med.	Medium	Med.-High
Synchronous electronic conferencing	Med.-High	Low-Med.	Low-Med.	Low-Med.	Medium
Asynchronous bulletin board	Low-Med.	Low-Med.	High	High	High
Asynchronous e-mail	Low-Med.	Low-Med.	High	High	High

5 Application of Media Synchronicity Theory on Design Thinking

In this chapter MST is applied to the Design Thinking process. However, Design Thinking involves both conveyance and convergence communication processes. In order to get a more specific result, the Design Thinking process phases will be classified into categories. As discussed by Lindenberg et al., there are diverging and converging thinking phases. Figure 4 shows, that the *empathize* and the *ideation* phase are divergent phases and the phases *define*, *prototype* and *test* are convergent phases [32, 33]. The small circles represent the ideas which are created in the diverging phases and afterward are chosen by the group to work on further, or not. For example, in the phase *empathize* the team explores multiple problems and user groups, which are involved in the design challenge. In this stage, they create choices, by exploring many options. In the following definition phase, the team must take the choices and for example decide for a user group. As the example shows at first the team have to think diverse, to explore all the possibilities and afterwards they have to converge to a group point of view [34]. For the ideation, followed by prototyping and test, the argumentation is analogous. At

first, a large amount of ideas is created and then the team selects the best one for a prototype.

In a kickoff meeting before the *empathize* phase the team has the chance to get a first impression of the *task*, the *people* and the *media*. In most situations one of the factors is new, even when the team is used to work in a remote setup. However, in many cases either an entirely new team is formed, or the group is complimented with experts from different areas and Design Thinking coaches. The kickoff meeting should be used to discuss the process, the media which should support every phase and to introduce the team members. The meeting should give the team the chance to discuss questions, get to know each other and negotiate the working mode. All these tasks involve convergent communication processes and are therefore best supported by synchronous media.
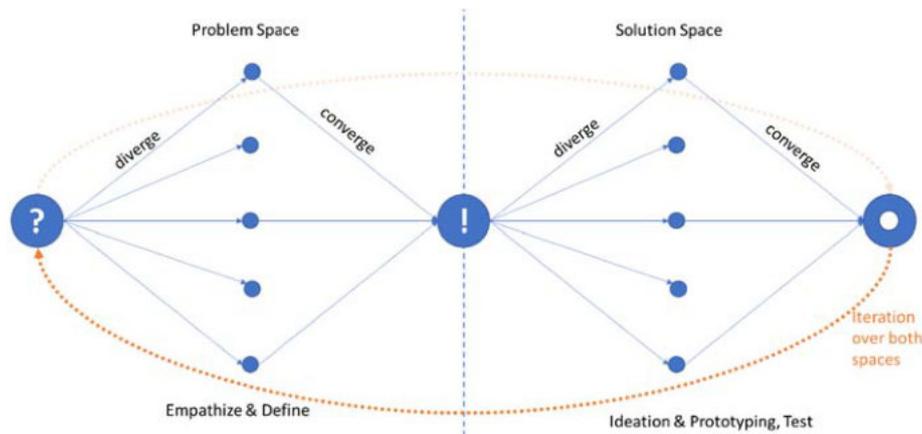

Figure 3: Problem and solution space in Design Thinking adopted to the Stanford Design Thinking model [32, 33]

5.1   Diverging Phases

As described in the section on Design Thinking, in the phase *empathize* the different experts sharing their views on the problem space. Additionally, the user research takes place. These two exercises mainly involve conveyance communication, because a large part of it is sharing the different points of views. For this the team could use a digital whiteboard, which allows to work in a similar mode as in an onsite workshop. In the virtual setup the team shouldn't only capture the thought in a few words, but also add some explanation to make it easier for others make sense out of it. Nevertheless, there are also some convergence processes involved. Thus, it could be beneficial to do a video conference before the user research takes place. This enables the team to discuss a common questionnaire and work on the appropriation factors. Afterwards each team members can interview people at their location and convey the information back to the team. Consequently, there are synchronous and asynchronous media capabilities required in the phase *empathize*, with a tendency to asynchronous media.

In the *ideation* phase, the main goal is to create as many ideas as possible. In this phase, all participants share their ideas and build new ideas on top of ideas from other participants. The shared information is mainly new and diverse information, which should be considered by the other participants. According to the MST these are the characteristics of conveyance communication, resulting in a bigger need for asynchronous media. By using this type of media, the team could make use of the high rehearsability and reprocessability. The team would carefully craft the messages so that the ideas are easy to understand. In addition, there would be always the possibility to revisit an earlier message.

When there are multiple time zones involved, the divergence phases *ideation* and *empathize*, also allow to work at different times. Thereby, the duration of the work will increase due to less parallel work. The working time on the tasks itself should be comparable to onsite workshops. However, in the first phases the team might need some more time to find a proper working mode.

5.2   Converging Phases

After multiple problem areas and user groups were explored in the phase *empathize*, the team has to specify a smaller subset in the *definition* phase to go on with. Such decisions require a lot of coordination and interactions between the team members [22]. They involve a quick back and forth between the team members, as they discuss which problem should be prioritized. This dominant part of the conversation is optimally supported by synchronous media, since it involves mainly convergence communication. Synchronous media provides the team with a high immediacy of feedback and a rich symbol variety. For example, by using a video conferencing each team member becomes fast feedback on the arguments used and will observe additional facial or gestural reactions. However, it can be argued, that a combination with a form of asynchronous media could be also helpful in this stage. An asynchronous medium, like a digital whiteboard, could support the team in this stage by providing an overview on the results of the last session and give the group guidance in this session.

Similar to the *definition* phase also in *prototyping* and *test* the team has to make some decisions. Furthermore, the group has to build the prototype and discuss the results in the testing step. Prior to building the prototype the group has to select the best solution to prototype. Analogously to the *definition* phase this requires a lot of discussion and coordination, which makes it a converging communication. On the other hand, the team also has to build a prototype, which could involve more inputs from one of the experts. So again, a mix between synchronous and asynchronous media is needed.

5.3   Media Capabilities for a Tool to Support Virtual Design Thinking

This section summarizes the results of the analysis and give some guidance, which media types might be used to reach a good team performance in virtual Design Thinking. Summarized in one sentence: Asynchronous media are appropriate for the diverging thinking phases and synchronous media are better suited for the converging thinking phases.

More precisely, the start of a virtual Design Thinking workshop is best supported by a synchronous medium. It supports the participants best in getting to know each other and to get a common understanding of the way of collaborating. Therefore, a medium like video conferencing, which supports a high immediacy of feedback and offers a high symbol variety, would be appropriate. As the team begins to work on the first task (*empathize*), a more asynchronous medium will be appropriate, like a digital whiteboard (cp. the asynchronous bulletin board in table 1). This allows the team to profit from high parallelism, rehearsability and reprocessability. As described in Redlich et al. [35] a digital whiteboard and a chat could be used permanently. With that combination the distributed Design Thinking teams almost reached the performance of the onside Design Thinking teams [35].

In the *definition* phase, the team could be using video conferencing again to profit from the synchronicity of the medium. At the same time the whiteboard could be used for documenting the results and facilitate the session. Afterwards, in the *ideation* phase the team goes back to using an asynchronous medium. Finally, the team will reach the *prototyping* and *testing* phase, which again requires a synchronous media, like telephone conferencing.

6   Conclusion and Outlook

In Design Thinking there are two main styles of thinking, the converging thinking and the diverging thinking. Hence, the research question "Which media capabilities should a tool for virtual Design Thinking have to enable high team performance?" had to be answered for both thinking styles. For phases, which involve diverging thinking a medium with low synchronicity will lead to a higher team performance. And on the other hand, for phases which involve converging thinking synchronous media should be preferred. A medium which supports high synchronicity has the following media capabilities: It has high transmission velocity, low parallelism, a large symbol set, low rehearsability and low reprocessability. Media which support low synchronicity have the opposite media capabilities. By transferring the media synchronicity theory to the domain of Design Thinking we propose recommendations of which media type is suited in different phases of virtual Design Thinking. Therefore, we were able to answer the initial research question in an argumentative and deductive approach. However, as any research, this study comes with some limitations: So far, there is no empirical evidence for the results yet. To the best of our knowledge Redlich et al. [35] is currently the only study, which indicates that virtual Design Thinking might be successful. Yet, this study used a digital whiteboard in combination with a messenger. In contrast, the guideline proposed in this paper also employs synchronous media in convergence communication phases, which should increase the task performance further. To validate the approach of our work, future research could validate the general approach of our work in case studies. In addition, a bigger empirical evaluation with different team setups involving multiple time zones could be done to provide further evidence.

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