
On the Decision-making behind the Selection of Design Thinking Techniques for Software Development: An Interview Study

Study protocol & results

Context

- Software teams might face a span of challenges when applying DT, including [1,6]:
 - Difficulty of reaching end-users;
 - Sharing the results obtained in DT activities;
 - Dealing with the lack of participants' commitment, and;
 - *Selecting an appropriate and suitable set of DT techniques to use [2, 3].*
- Chasanidou et al. (2015) [10] argue that the DT techniques facilitate the creation of innovative software solutions. The authors highlight the **importance of selecting the methods and tools**, arguing that using appropriate techniques may improve the results generated for software engineering.
- Since there are many DT techniques [2], **choosing an appropriate set of techniques might involve a span of elements, which creates a decision-making problem.**
- Pessoto (2017) mentions: *“During the design thinking process, designers find themselves continuously in a situation where making a decision is fundamental to proceed and develop a solution. Conditions of certainty develop better-taken decisions; however, there are numerous cases where uncertainty dominates the choice”.*

Decision-making in a nutshell

- Decision-making (DM) is the process of selecting an option from a set of available options based on alternatives or actions, considering a set of criteria or strategies [5]
- DM = 3 essences (Wang and Ruhe, 2007, 2015)
 1. Decision goals – to select DT techniques to use in projects of software development
 2. Set of alternatives / choices – set of DT techniques used in the software development context
 3. Selection criteria or strategies - ???

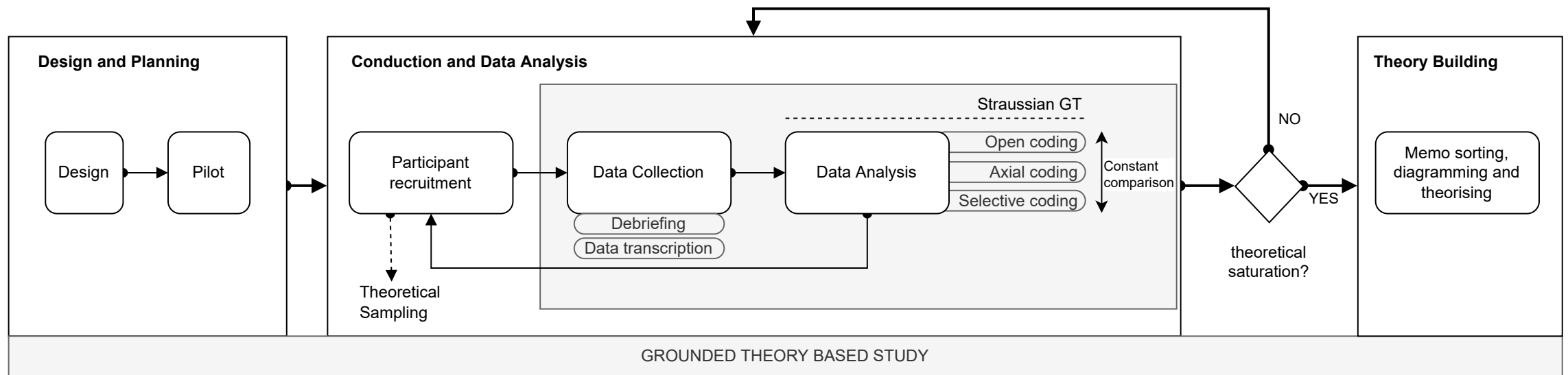
Research Goal & Questions

- RQ: How do DT facilitators make decisions for selecting DT techniques in software development?
- Goal: to investigate the decision-making of DT facilitators from 5 distinct dimensions

Question	Dimension
What do DT practitioners consider when selecting DT to use in their projects?	Decision-making elements: [4, 5]
Do the DT facilitators evaluate DT techniques after using them, and how does this evaluation contribute to the decision-making?	Decision-making based on techniques evaluation: [5]
What difficulty level do the practitioners consider to select DT techniques? The difficulty level changes as they gain experience in using DT?	Decision-making based on the DT practitioner's experience [2, 7]
Do the DT facilitators use the experience of other professionals for selecting DT techniques?	Decision-making based on the experiences of a community of practice [8]
What resources do the DT facilitators use for collecting data about DT techniques to select them?	Decision-making support resources and the difficulty associated [9]

Methodology

- Grounded Theory (GT) as research method ([11][12])
- Study Design
 - Design and Planning > Interview Conduction and Data Analysis > Theory Building



Pilot study: We interviewed a Ph.D. candidate in Computer Science who has more than 7 years of experience in the software development industry. She has been working as a DT facilitator for over 5 years.

Participants

- **Ethics**
 - Before recruiting participants, we submitted our project to the Ethics Committee Board
- **Target audience:**
 - Professionals who manage, conduct, moderate, or facilitate DT workshops or projects
- **Recruitment:**
 - We searched for participants in our networking and on LinkedIn
- **Invitation:**
 - We sent an invitation by e-mail to 25 professionals from 20 software companies
 - **16** professionals voluntarily accepted to participate in the interviews (**participants** for simplification).

Participants

	ID	Role	Exp in IT (yrs)	Background in DT	Experience in DT	Years in Company	Company Type	Number of Employees
Iter. 1	P1	Facilitator/Moderator	30	School of DT	12	5	National	51-100
	P2	Agile Coach	19	DT open courses	7	7	Multinational	>1000
	P3	Agile Coach	5	In-company Training	2.5	2.5	Multinational	>1000
	P4	Facilitator	5	School of DT	2.3	1	National	51-100
	P5	Facilitator/Design Thinker	23	School of DT	4	4	National	1-10
Iter. 2	P6	Business Designer	3	School of DT	2.5	2.5	National	11-50
	P7	Product Owner	6	School of Design	7	2	Multinational	11-50
	P8	Support Analyst	8	In-company Training	5	8	Multinational	>1000
	P9	Solution Specialist	2	School of DT	4	1	Multinational	51-100
Iter. 3	P10	IT Analyst/DT coach	6	In-company Training	6	6	Multinational	>1000
	P11	Digital Product Manager	5	School of DT	10	3	Multinational	>1000
	P12	DT Analyst	5	School of DT	5	5	National	301-1000
Iter. 4	P13	Director of Customer Experience	25	In-company Training	25	25	Multinational	>1000
	P14	Designer	12	In-company Training	12	11	Multinational	>1000
	P15	User eXperience Designer	8	Design (graduation)	10	5	Multinational	>1000
	P16	DT Coach	23	In-company Training	23	4	Multinational	>1000

Data collection and analysis

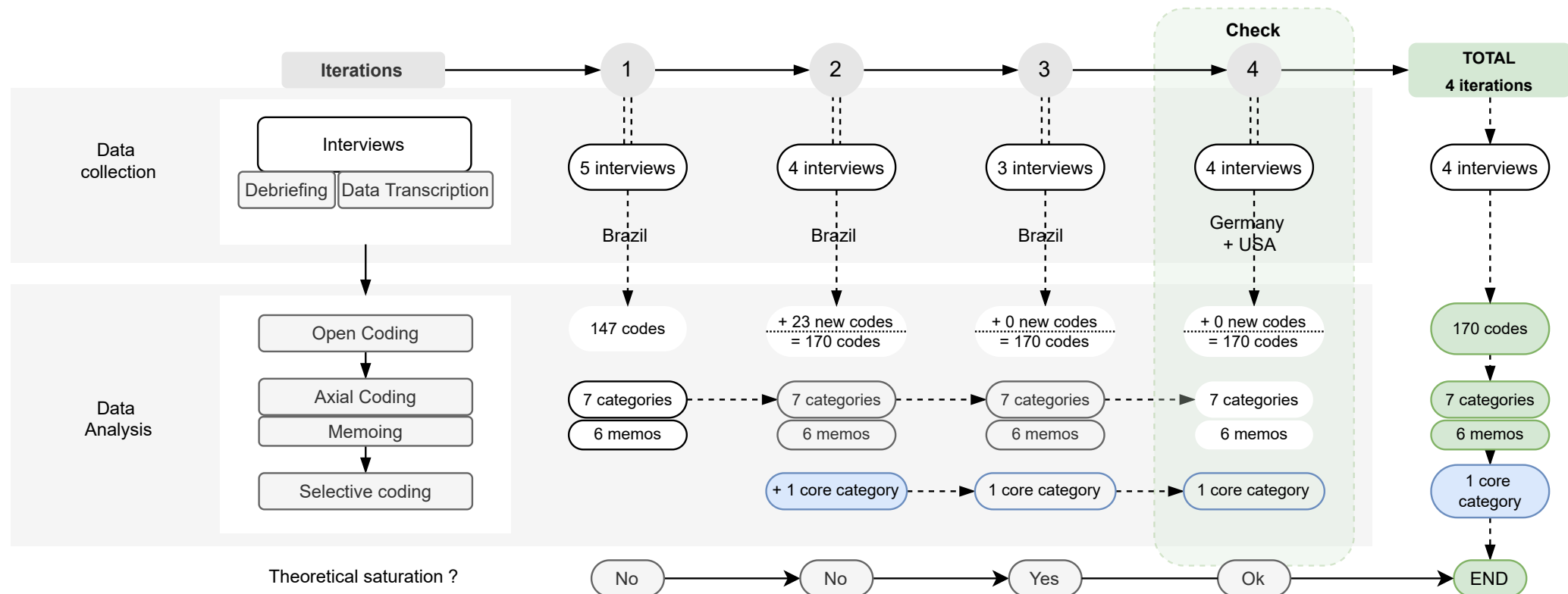


- Data collection instrument:

- Interviews
 - Average time: ~38min

Theoretical Sampling
Theoretical Saturation

Portuguese
English



Data Analysis

- **Open Coding:**

- We started the Open Coding right at the end of each interview. **We analyzed each interview transcript, line by line and sentence by sentence.** We used Atlas.ti (academic web version) to assign codes to the transcripts.
- During the data analysis, we applied the **constant comparison method** [20]. We compared the codes assigned to the interview being analyzed with the codes we assigned to other interviews previously analyzed.
- We also analyzed the codes by looking at the interviews' debriefings. As a result, in **Iteration 1 we generated 147 codes**, and **in Iteration 2 we added 23 codes**. In Iterations 3 and 4 we did not add any new code during the Open Coding step.

- **Axial Coding:**

- We created an affinity diagram (**network**) to relate codes generated in the Open Coding activity obtaining categories that cluster similar codes.
- **In Iteration 1 we generated 6 categories of codes.** Then, we started **writing memos (memoing)** for each category that we identified. Each memo contains snippets to help us to generate a descriptive decision-making model which represents the selection of DT techniques.
- **In iterations 2 and 3, we refined the 6 categories and also the content of each memo.**

- **Selective Coding:**

- After concluding the Axial Coding for the 9 interviews (Iteration 1 plus Iteration 2), **we searched for the core category obtained by Axial Coding** (Selective Coding).
- In Iteration 3 we re-analyzed the core category based on the new data collected through the 3 new interviews we conducted, while in iteration 4, we verified if the new data changed the categories.

Results

- Analysis:

Group 1: Elements and strategies of DM for selecting Design Thinking techniques

Codes	P#
Technique selection by goal and phase	P1, P2, P4, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16
Technique selection based on time available	P2, P3, P8, P10, P12, P14, P16
Technique selection by challenge	P1, P4, P6, P8, P13, P16
Technique selection based on the moderator's knowledge	P1, P4, P7, P11, P13, P14, P16
Technique selection by the knowledge of stakeholders and the organization's maturity level	P1, P3, P6, P7, P11, P12, P14, P15, P16

Results

- Analysis:

Group 2: Influence of the DT techniques evaluation over the DM for selecting Design Thinking techniques

Codes	Sub-codes	P#
Explicit feedback collection with participants	Questionnaire/Satisfaction form	P1, P2, P3, P13, P15
Moderator analysis of the participants' perception	Experience to the participants	P1, P10, P13, P14, P15, P16
	Participant's understanding on using techniques	P1, P3, P6, P7, P10
	Participant's engagement	P1, P4, P5, P11, P12, P15
DT techniques results comparison	Application time	P2, P14
	Technique effectiveness (reaching the goal)	P1, P2, P7, P9, P13, P14, P15

Results

- Analysis:

Group 3: Experience in Design Thinking over the DM for selecting Design Thinking techniques

Code Group	Codes	P#
Facilitator's experiences in conducting sessions	Decreasing the difficulty in technique selection	P1, P2, P4, P5, P6, P7, P8, P10, P11, P13, P14, P15, P16
	Making decisions together with other professionals	P8, P10, P11, P14
	Allocating time to understand the technique	P7, P13, P16
	Knowing the participants' profile	P1, P2, P3, P4, P5, P8, P9, P10, P12, P16
	Knowing the availability of the participants as a selection criterion	P2, P9, P10
	Understanding the maturity of the team/organization	P1, P3, P6
Participants experience in DT	Know what will be done as a DT activity	P1, P6, P16

Results

- Analysis:

Group 4: DT facilitator's difficulty for selecting DT techniques

Codes	P#	P#	Experience in DT (years)	Difficulty level (scale 1 - 10)	Status getting experience in DT
Time and workshop context	P2, P7, P9, P10, P11, P13	P1	12	5	➡
Participants' misunderstanding or lack of knowledge (including facilitators)	P1, P8, P12, P13, P15	P2	7	8	➡
Virtual format	P1, P2, P3, P5, P12	P3	2,5	9	➡
Solution type (product improvement is easier than creating new products)	P2, P8, P14	P4	2,3	3	➡
DT session complexity	P8	P5	7	3	➡
Lack of exchange of experiences of fellow facilitators	P4	P6	2,5	7	➡
		P7	7	4	➡
		P8	5	7	➡
		P9	4	5	➡
		P10	3	7	➡
		P11	10	2	➡
		P12	5	7	➡
		P13	25	2	➡
		P14	12	easy*	➡
		P15	8	7	➡
		P16	23	easy*	➡

➡ Difficulty decreased after getting experience in DT.

➡ Difficulty kept similar even after getting experience in DT.

➡ Difficulty decreased after getting experience in DT

* The participant did not indicate a numeric level of difficult

Results

- Analysis:

Group 5: Resources used by facilitators to support the selection of DT techniques

Codes	P#
Books of DT when less experienced	P1, P3, P4, P7, P9, P11, P14, P16
Book of other topics (Agile, Lean)	P4, P7
DT toolkit/templates	P6, P9, P11, P12, P13, P14, P15
DT training	P2, P8
Digital media (LinkedIn, Groups)	P2, P3, P5, P6, P10, P14, P16
DT model (working spaces processes)	P1, P2, P4, P6, P8, P11, P12, P13, P14, P15, P16
DT practitioners	P1, P4, P6, P7, P8, P10, P12, P14, P15, P16

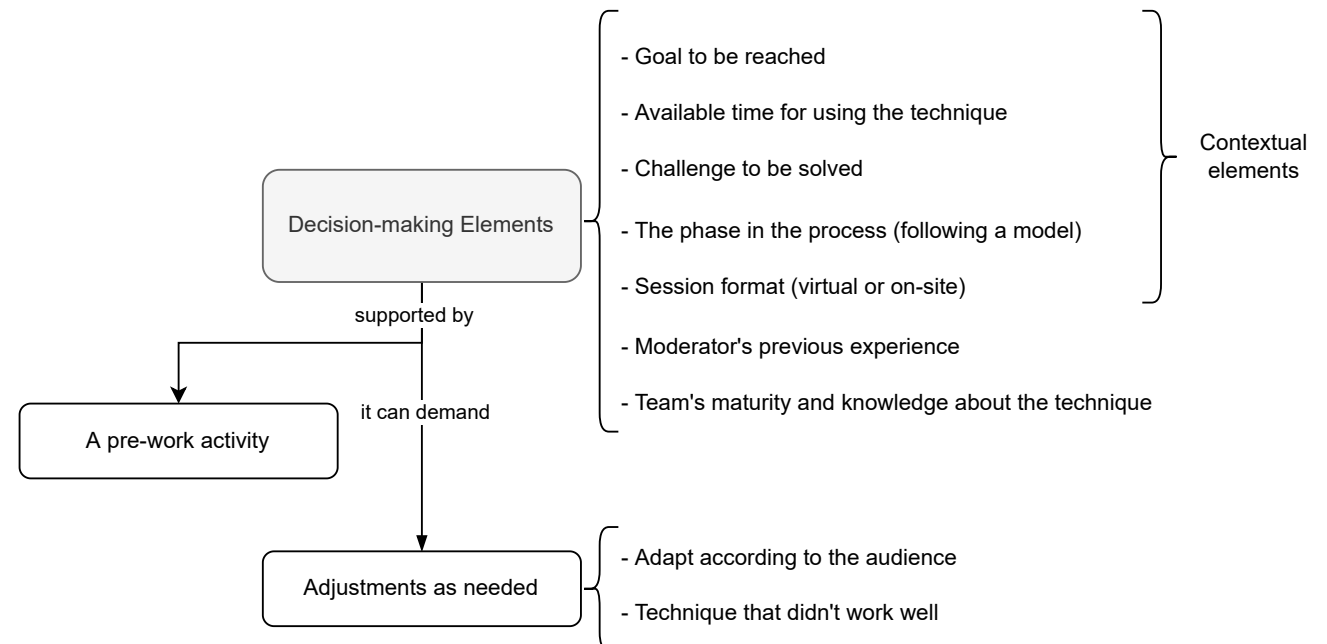
Discussions

The decision-making of DT techniques is composed of decision-making elements, and it is **context-driven**.

Decision-making connects a creative design mindset to traditional business thinking based on rational problem-solving [257].

When selecting DT techniques in software development, DT facilitators consider **5 contextual elements**:

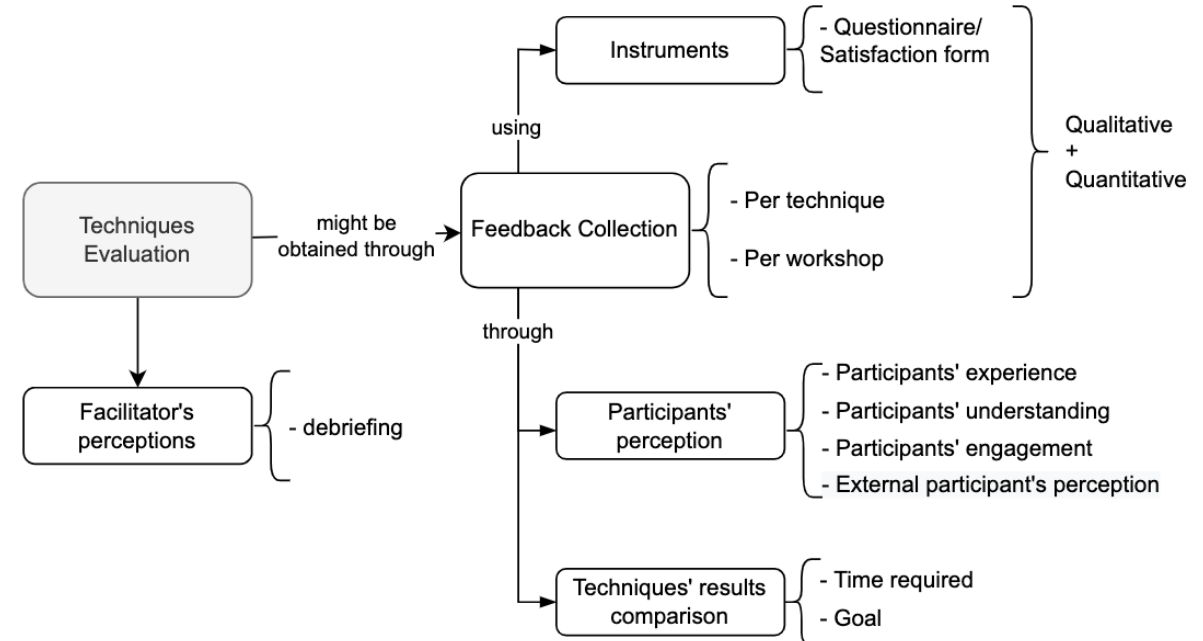
- Time
- Goal
- Challenge
- Phase in the process
- Session format (virtual or in-person)



Decision-making

The decision-making of DT techniques is supported by techniques evaluation.

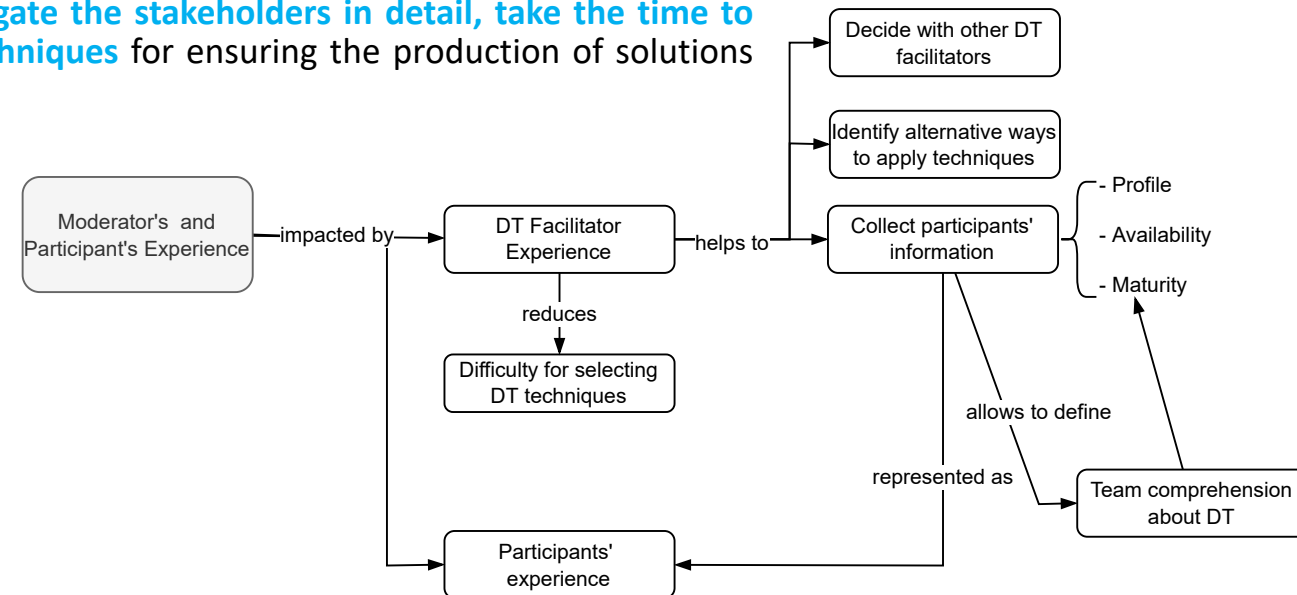
- Tello (2019) defines the evaluation of alternatives as part of the decision-making process [253].
- In the software development context, DT facilitators evaluate DT techniques:
 - **Collecting feedback from the participants.**
 - The feedback might be collected after the technique is used or after the workshop is completed
 - The **DT facilitator's perception of the participants' experience, understanding, and engagement are implicit feedback** of each technique that supports the selection of that technique in future workshops.
- **A technique is seen as good if the goal was reached or if the time required was feasible.**
- **A workshop was effective if it supported building the product backlog.**



Decision-making

The decision-making of Design Thinking techniques relies on DT practitioners and participants' experiences.

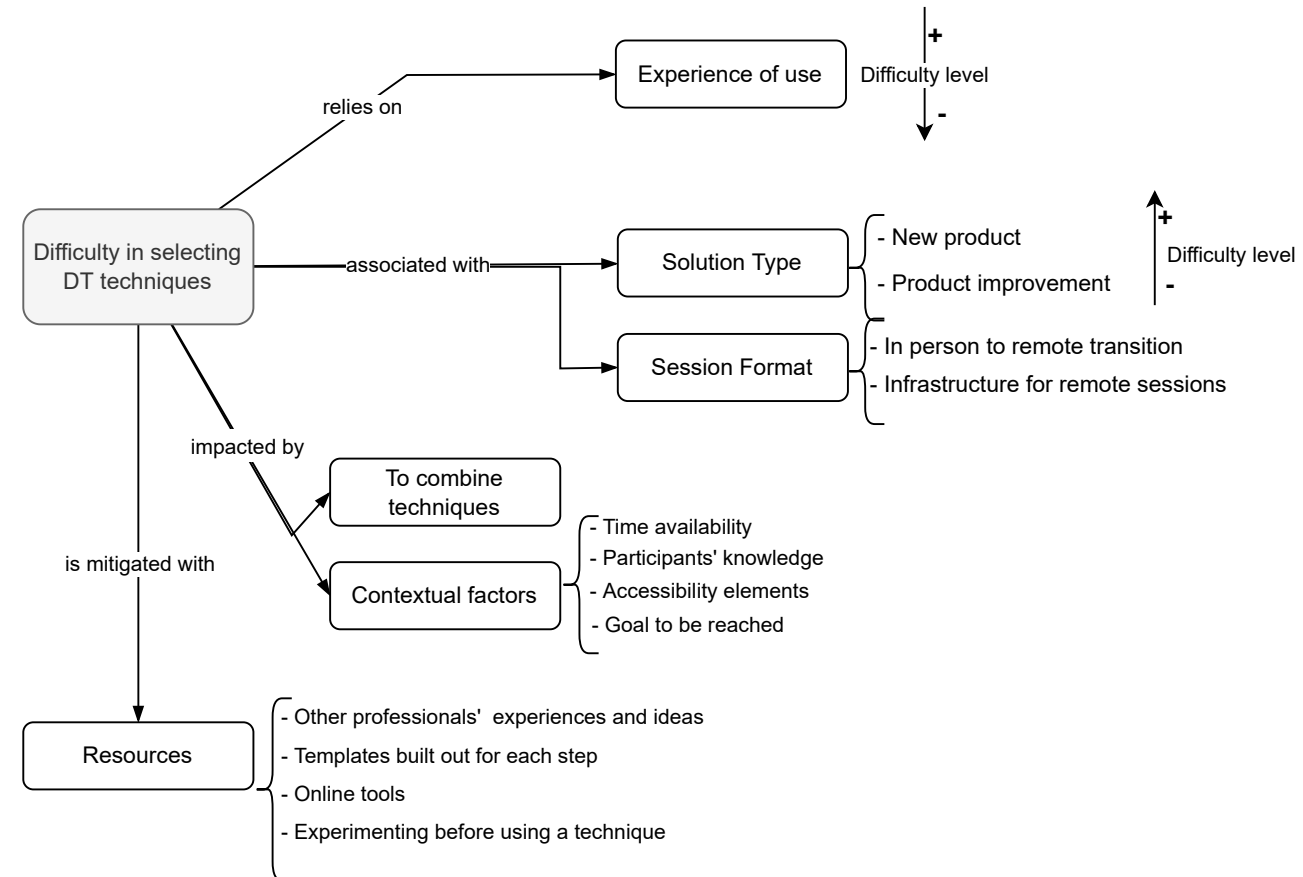
- **Experience in using DT supports the** decrease in the difficulty of DT practitioners in selecting DT techniques
- DT facilitators make decisions by **allocating time to understanding a technique and profiling the participants**.
- DT facilitators are aware that DT techniques are **time-dependent** and that the techniques also require a pre-work activity to well-establish the set of techniques to be used.
- Thus, before selecting DT techniques, it is necessary to **investigate the stakeholders in detail, take the time to know their needs, and choose the appropriate innovation techniques** for ensuring the production of solutions meeting the user's expectations [64]



Decision-making

Less experienced DT facilitators perceive the decision-making of DT techniques as a hard task.

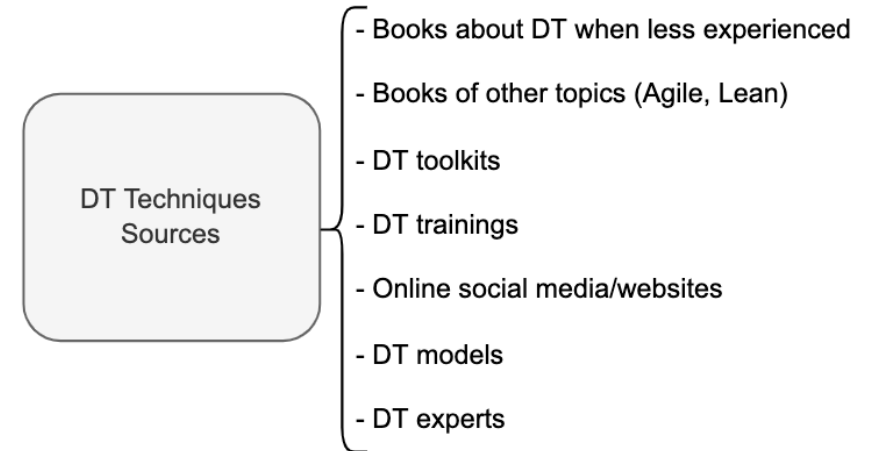
- Literature points out that lack of employee commitment, collaboration and knowledge make the decision of what techniques to use in an endeavor [194].
- DT facilitators associate the **product type as a factor that impacts the difficulty of selecting DT techniques**. Using DT for proposing new products is considered harder than working on improving a known solution. This definition takes into account that when improving an already known product, the user's needs are already known too.
- The **session format** also collaborates with the DT techniques decision-making endeavor. DT facilitators indicated that the **transition from in-person to remote (virtual) DT sessions increased the difficulty** of selecting what DT techniques to use and also how to use them.
- DT facilitators consider the **availability of time** (time destined to run a workshop and the techniques the facilitator has chosen), **the participants' knowledge of DT** (and about the techniques), and the accessibility required to provide the participants' experience when running a DT workshop as decision factors. Therefore, the facilitator has to know what techniques to use to cope with some participants' disabilities if it is the case.
- **Combining different techniques** also makes it hard to select DT techniques. DT facilitators pointed out that combining techniques is challenging since they do not know how the participants will attend to that combination. This challenge fosters DT facilitators to explore alternative resources that provide information about DT techniques, including other professionals' experiences, ideas, and trial and error. **Online social media and digital DT toolkits** are tools that provide mechanisms to find DT experiences.



Decision-making

The decision-making of DT techniques is based on different sources of techniques and powered by a community of DT practitioners

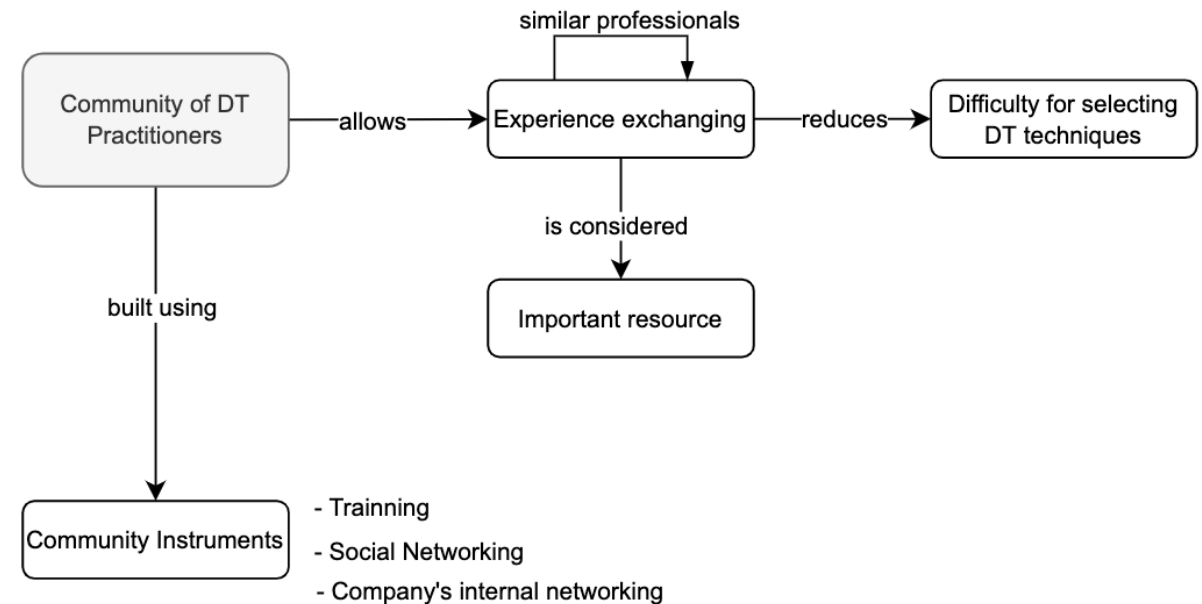
- DT facilitators aim to be not behind the times. They often look for new techniques and work against the clock to get more information about how to apply DT techniques.
- Such information can be gathered by practicing DT or by consulting other DT facilitators.
- Books, DT toolkits, and training are also sources of information about DT techniques. However, given the dynamic nature of DT, DT facilitators also use books from other subjects, such as Agile and Lean Inception. It means that DT in software development is seen as an approach that can be infused into SE activities [64].



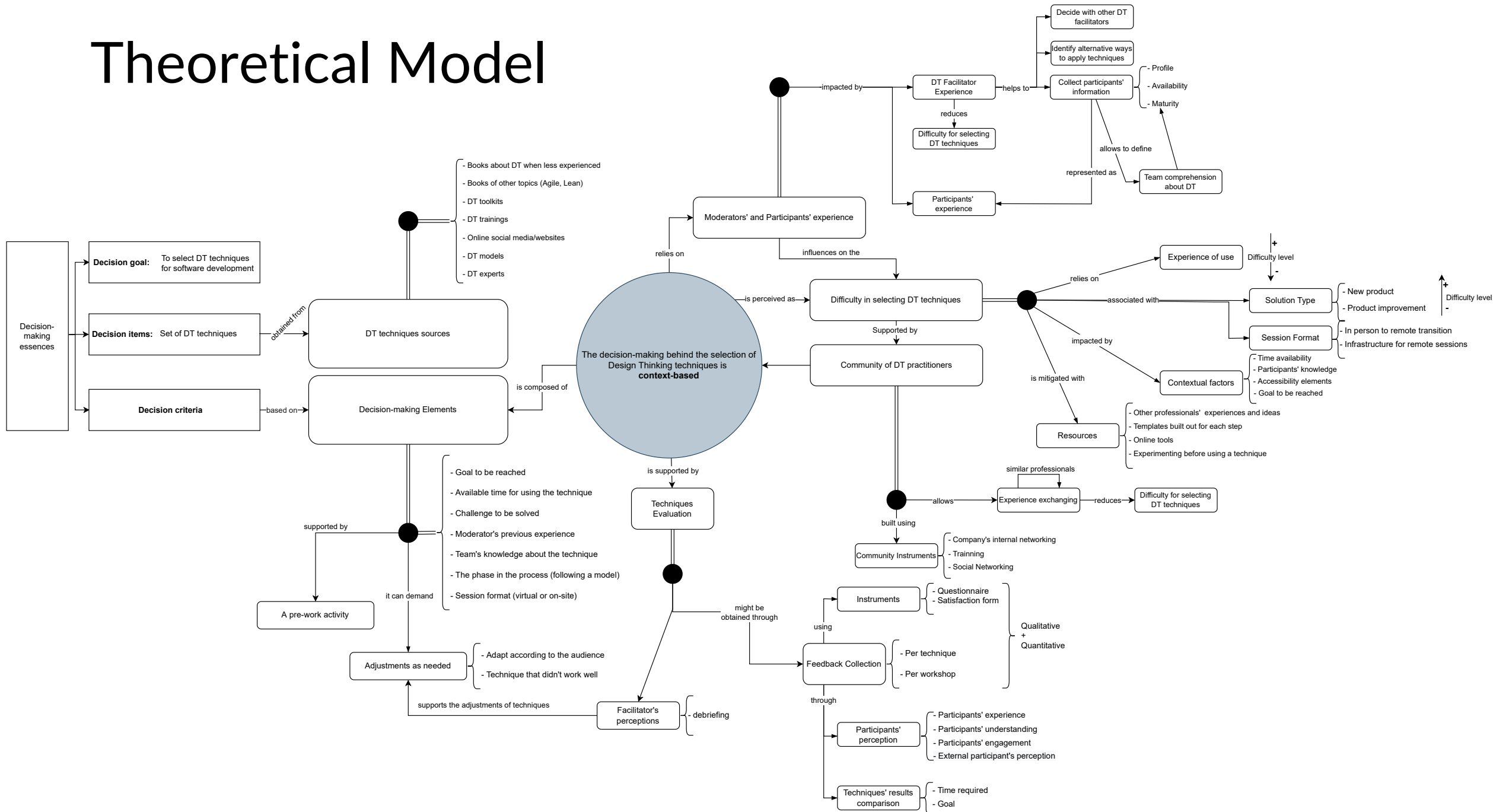
Discussions

The decision-making of DT techniques is based on different sources of techniques and powered by a community of DT practitioners

- DT facilitators search for data about DT techniques in their social networks or consult DT experts. Establishing a community of DT facilitators is a way of sharing experiences and collaborating to build collective knowledge.
- Community of practice (CoPs) is also applied in other SE subjects. For instance, Kniberg and Ivarsson (2012) [135] proposed the Spotify model as a CoP for scaling management and collaboration in self-organized teams using Agile. In the context of DT, a CoP support experience exchange among similar professionals reduces the difficulty of selecting DT techniques.



Theoretical Model



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