



## **A CORPUS-LED APPROACH ON GUIDELINES EXTRACTION FROM DESIGN THINKING METHODOLOGIES**

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### **Abstract**

Target of criticism and enthusiastic expressions in literature, design thinking (DT) as spread by IDEO has been popularized and practitioners' literature has been growing. However, this DT strand lacks further theoretical characterization. This work is part of a wider research that aims to provide a proper characterization of DT to allow its integration into product-service system (PSS) design process models. This wider research has already provided the 46 most recurrent activities on DT. Besides activities, one of the elements that is also essential on a proper DT application is the mindset assumed by the design team, which is commonly framed by guidelines proposed on methodologies in literature. The goal of this work is to identify the generic and specific guidelines that complement DT recurrent activities, towards a more complete characterization of DT. This goal was achieved by means of a corpus-led approach based on corpus linguistics and frame semantics applied to eight DT methodologies. It resulted into nine generic guidelines and about ten specific guidelines per DT recurrent activity, which can be classified into agent, duration, manner, place and time.

**Keywords:** Design process, Design methodology, User centred design

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## 1 INTRODUCTION

Controversial in academy, design thinking (DT) is a constant target of enthusiastic supporters and sharp critics. The DT approach as popularized by IDEO (Brown, 2008) proposes user-centred innovation in blending “expertise from design, social sciences, engineering, and business” by means of “multidisciplinary collaboration and iterative improvement” (Meinel and Leifer, 2011).

DT is used as a support for innovation in several fields, such as education (Noweski et al., 2012), health care (Kirkland et al., 2009), Information Technology (Lindberg et al., 2012), and others.

Due to its popularity, the practitioners’ literature covering the DT theme has intensively grown on the past years (Liedtka, 2014). Many toolkits and methodologies were published about this subject, proposing how to apply DT in several contexts (IDEO, 2015; Kimbell and Julier, 2012; Liedtka and Ogilvie, 2011; Mootee, 2013; Stickdorn and Schneider, 2011). Those documents are usually composed by many methods and tools divided in iterative stages.

When DT in practice, as proposed by methodologies and toolkits, is deeply analysed, it is possible to identify many elements that are present in other existing theories and approaches. Bjögvinsson et al. (2012) suggest, for example, that DT is nothing but “old good participatory design”. Spee and Basaiawmoit (2016) also pose the doubt of whether design thinking is “new wine in an old bottle” or “old wine in a new bottle”. Liedtka (2014) also agrees that, in DT, “many elements in both process and toolkit are visible elsewhere in management theory and practice”. However, as Liedtka (2014) also states, when all elements of design thinking are observed as a whole problem solving system, i.e., “a bundle of attitudes, tools, and approaches”, it brings novelty with it. Yet, the theory of DT still needs further development.

Dorst (2011) and Johansson-Sköldberg et al. (2013) criticize, for example, that many publications only describe DT as a toolbox. Referring to this aspect and corroborating with Liedtka (2014), Kimbell (2012) reinforces that using the tools and methods that some authors call “design thinking” without assuming the culture of design and the correct mindset may not provide proper results. A case study performed by Rosa et al. (2016) on applying DT with novices in a servitization process also corroborated to this affirmation, showing that most problems and difficulties during the process were due to not assuming the proper mindset.

One approach that DT authors employ to frame practitioners’ mindset is by stating generic guidelines proposed on the beginning of DT toolkits or methodologies, usually called as “mindsets” or “principles”. Each DT methodology, however, proposes different generic guidelines to be followed, not converging most of times. Besides, DT authors usually describe the methods that compose a methodology by means of activities, which are complemented by specific guidelines. The specific guidelines recommend how practitioners should behave during the execution of a method for each specific activity, also representing attitudes during the DT process. However, those activities and guidelines are not necessarily explicit, being embedded in the methods descriptions.

This work identifies what are the generic and specific guidelines of DT, being part of a wider research that aims to provide a characterization of DT in order to allow its integration into product-service system (PSS) design process models (Rosa, 2017). A corpus analysis combined with frame semantics was performed, structuring activities and their guidelines from 8 DT methodologies as combinations of agent, action, object, duration, manner, place and time. In a previous step, 46 DT most recurrent activities were identified (Rosa, 2017). This work focuses on the guidelines associated with those activities. The generic guidelines proposed by the authors were also systematized, identifying the most common ones in literature. A comparison was performed, identifying the most relevant generic guidelines due to their recurrence in literature and in the methodologies description.

## 2 METHODOLOGY

The methodology employed to identify specific guidelines in this research is structured with corpus linguistics, the study of “the use of language characteristics by considering the relevant association patterns” (Biber et al., 1998). Corpus linguistics is characterized by the empirical analysis of a “large and principled collection of natural texts, known as a ‘corpus’”, depending “on both quantitative and qualitative analytical techniques”, and achieving high reliability due to those characteristics (Biber et al., 1998).

Corpus linguistics “allows researchers to identify and analyse complex ‘association patterns’” (Biber et al., 1998), making it compatible with the goal of this research, which demands extracting activities and guidelines embedded in the corpus.

As already stated, corpus linguistics depends on other techniques. The concept of frames, from frame semantics, was used to support it. A frame is “any system of concepts related in such a way that to understand any of them you have to understand the whole structure in which it fits” (Fillmore, 1982).

Thus, it is necessary to establish a structure for representing an activity as a frame. FrameNet (Baker et al., 1998) provides a database of frames, explaining their structure and elements. The frame “Activity”, which is used to structure the description of a given activity, is available in this database. The elements of this frame are illustrated in Figure 1 and the description of this frame is provided below:

*“An abstract frame for durative activities, in which the Agent enters an ongoing state of the Activity, remains in this state for some Duration of Time, and leaves this state either by finishing or by stopping. The Agent’s Activity should be intentional. This frame is intended mostly for the inheritance of common FEs [Frame Elements], and to provide the frame structure for the beginning, ongoing, finish, or stop stage of an Activity, each of which constitutes a subframe of this frame.”* (Baker, 1997).

Frame “Activity”					
AGENT	ACTIVITY	DURATION	MANNER	PLACE	TIME
[Core]	[Core]	[Non-core]	[Non-core]	[Non-core]	[Non-core]

Figure 1. Frame structure for extracting activities and guidelines

Each frame element may be core or non-core. According to Ruppenhofer et al. (2010), “a core frame element is one that instantiates a conceptually necessary component of a frame, while making the frame unique and different from other frames”, i.e., a frame cannot exist without its core elements, which are “agent” and “activity”. Non-core elements complement the core ones with further information. For a better comprehension, each frame element is better explained in Table 1.

Table 1. Frame Elements (FE) Description based on Baker (1997)

Frame Elements (FE)	Description
Agent	The Agent is engaged in the Activity
Activity(*)	This FE identifies the Action in which the Agent is engaged to modify a given Object
Duration	This FE identifies the amount of Time an Activity takes.
Manner	Any description of the activity which is not covered by more specific FEs, including secondary effects (quietly, loudly), and general descriptions comparing events (the same way). It may also indicate salient characteristics of an Agent that also affect the action (presumptuously, coldly, deliberately, eagerly, carefully).
Place	This FE identifies the Place where the Activity occurs.
Time	This FE identifies the Time when the Activity occurs.
(*) In the context of this research, activities are composed by the combination of two sub-elements: “action” and “object”. Action is the verb that composes the activity. Object is a noun or clause that represents an input, a deliverable or even people upon whom the action is being performed.	

First of all, it is necessary to clarify one aspect of this frame. The frame “activity” has one frame element also called “activity”. Thus, it is important to read this method carefully in order to avoid any misunderstanding due to this nomenclature.

As explained before, this work gives continuity to a previous step of the wider research of which this work is part, where the most recurrent activities of DT were identified. In that analysis, each sentence of the whole corpus was set in the shape of the frame “activity” (whenever all core elements were present on that sentence, i.e., whenever that sentence could be considered an activity). Each frame was codified due to its frame element “activity”. This codification was performed in two steps. The first one was composed by the codification of the sub-element “action” (see Table 1), unifying under the same code every semantic-related verb (hypernyms, synonyms and troponyms) by means of the lexical database

WordNet (Princeton University, 2010). The second one was composed by the codification of the sub-element “object”, unifying under the same code all synonymic nouns or clauses, also based on WordNet. The final code was composed by the combination of both action and object codes. After codification, the most recurrent activities, i.e., those cited by at least half of the authors included in the analysis, were selected. Any low-level activities were excluded, i.e., activities in a level of detail considered too low to be included in this analysis, such as tasks.

In this work, the scope changes. The recurrent activities are already known, derived from that analysis. Now, those selected activities must be set in the structure of the frame “activity”. Those frames must be combined, extracting the complementary information of the frame, i.e., all frame elements except for activity. One example is provided in Figure 2 for better comprehension. In order to provide an example on how the frames were created, the frames on Figure 2 were extracted from the following excerpts: “create empathy in the context of possible solutions for prototyping” (Plattner, 2010), “to generate empathy [...] from your audience” (Plattner, 2010); “Work on creating empathy” (Liedtka and Ogilvie, 2011); “Building empathy with users” (RCA, 2010); “The intimacy of the insights generated also serves to build empathy with the participants” (Stickdorn and Schneider, 2011); “building empathy with customers throughout the entire organization” (Stickdorn and Schneider, 2011).

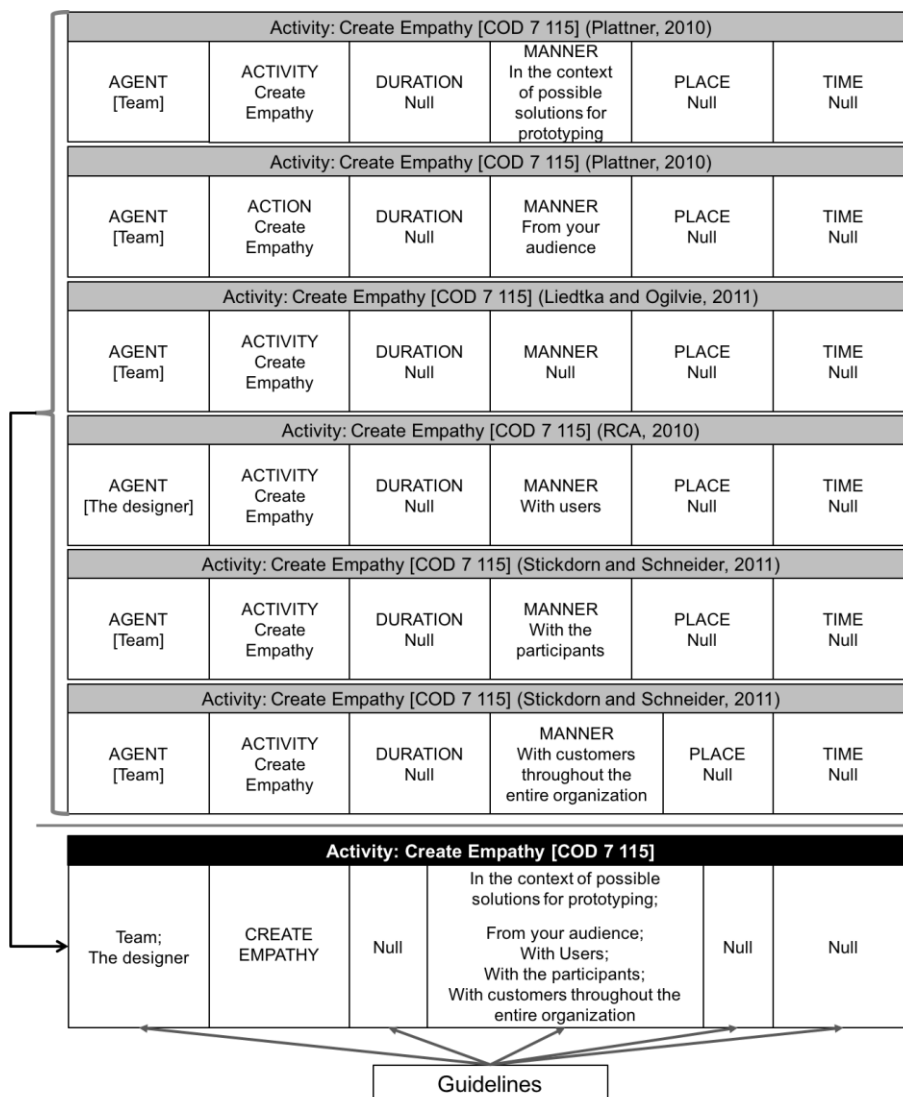


Figure 2. Example of a frame composition for the activity “create empathy”

The whole corpus was structured in the shape of activity frames, combining together the frame elements proposed for activities that are unified under the DT recurrent activities, as illustrated on Figure 2.

The corpus of this analysis was composed by DT toolkits and methodologies in literature. The goal was to extract activities that characterize DT to allow its integration with PSS design process models. Thus, prescriptive documents were necessary. The toolkits and methodologies were selected by analysing

citations, authors and scope. First of all, the most known and used methodologies were selected. Then, methodologies proposed by known DT researchers were also included. They were selected focusing on the scope, avoiding to employ methodologies focused on the same context. Eight methodologies were selected (Fabricant et al., 2012; IDEO, 2015; Kimbell and Julier, 2012; Kumar, 2013; Liedtka and Ogilvie, 2011; Plattner, 2010; RCA, 2010; Stickdorn and Schneider, 2011), covering contexts such as business, social, service, and overall design.

The final results were submitted to analysis, identifying highlights on those guidelines. Furthermore, DT methodologies usually present a collection of generic guidelines, usually called “mindsets” or “principles”, that should be followed through the entire DT process in order to lead the design team on assuming a proper mindset. Those guidelines are commonly explicit on the text, not needing any technique to extract them from text excerpts. Those generic guidelines were extracted from the corpus and listed, identifying which ones are proposed by multiple authors and which ones are cited only once.

### 3 GENERIC GUIDELINES

This section presents the generic guidelines proposed by the authors that compose the corpus used in this work. Notice that only six methodologies were employed, even though the corpus was composed by eight authors. Two methodologies of the corpus do not present generic guidelines in their methodologies. Thus, they were not included in this analysis.

Twenty-three generic guidelines were identified when considering all DT methodologies that compose the corpus of this analysis. However, only nine of them were corroborated by more than one author. Those nine generic guidelines are presented in Table 2.

Table 2. Basic mindsets proposed by the authors selected for the corpus

Mindset	[1]	[2]	[3]	[4]	[5]	[6]
Focus on human values (Empathy)	X	X	X	X	X	X
Embrace experimentation	X		X	X	X	
Explore multiple options		X	X	X		
Show, don't tell	X			X		
Be mindful of process	X					X
Bias toward action	X	X				
Start in the unknown		X		X		
Look at both the detail and the big picture				X	X	
Design based on how people do things				X		X
Legend						
[1] Plattner (2010)						
[2] Liedtka and Ogilvie (2011)						
[3] IDEO (2015)						
[4] Kimbell and Julier (2012)						
[5] Stickdorn and Schneider (2011)						
[6] Kumar (2013)						

Only one generic guideline is recurrent in all methodologies: “Focus on human values”. This guideline explicitly shows the greatest nature of DT: creating a new experience based on empathy, i.e., from really understanding the users’ feelings, experiences and values. Experimentation comes right after, being present in four methodologies and illustrating the practical prototype-orientated guidance of DT. In fact, one of the common stages of DT is prototyping and testing. Exploring multiple options is also one of the three most recurrent generic guidelines. This guideline is not only associated to DT, but also seen as a product development good practice (Markham and Lee, 2013). Starting concepts evaluation with multiple concepts increases the chances of developing a successful product. Exploring multiple options also helps design teams on avoiding design fixation and enhancing creativity based on the ambiguity of not knowing the answer.

This work takes into consideration the generic guidelines appearing at least in two different DT methodologies. It is a filter for not using generic guidelines that are suggested by one single author, since other authors may not be in agreement that such a guideline is able to support DT.

#### 4 SPECIFIC GUIDELINES FOR DT RECURRENT ACTIVITIES

The guidelines were extracted based on the DT recurrent activities that were identified on the previous step of the wider research that contains this work (Rosa, 2017). In order to ease the reader's understanding, those activities are listed in Table 3 and are associated with the generic DT stage where they are prescribed the most: Empathy generation and problem definition (E&P), ideation (ID), prototype and test (P&T), and Implementation (IMP).

Table 3. DT recurrent activities

DT Stage	Activity	DT Stage	Activity
E&P	search patterns	E&P	create design criteria
E&P	identify themes	E&P	create understanding
E&P	inform needs	E&P	identify opportunities
E&P	inform [previous user's] experience	ID	decide ideas
E&P	decide people [who are relevant for the process]	ID	create ideas
E&P	analyze people [who are relevant for the process]	ID	combine ideas
E&P	identify people [who are relevant for the process]	ID	analyze ideas
E&P	interview people [who are relevant for the process]	ID	evaluate ideas
E&P	engage people [who are relevant for the process]	ID	record ideas
E&P	request people [who are relevant for the process]	ID	build on ideas
E&P	talk with people [who are relevant for the process]	ID	communicate ideas
E&P	analyze (design) challenge	ID	draw ideas
E&P	inform stories	ID	create concepts
E&P	analyze notes	ID	inform concepts
E&P	create insights	P&T	understand people [who are relevant for the process]
E&P	understand insights	P&T	create stories
E&P	understand [external people] thoughts	P&T	test ideas
E&P	record observations	P&T	create scenarios
E&P	analyze information	P&T	create low-resolution prototypes
E&P	gather information	P&T	test low-resolution prototypes
E&P	create map	P&T	request feedback
E&P	create empathy	P&T	understand happenings
E&P	create character	IMP	identify [design] solutions
Legend (Generic Stages of DT)			
E&P	Empathy Generation and Problem Definition		
ID	Ideation		
P&T	Prototype and Test		
IMP	Implementation		

In order to enhance understanding about the results, a short explanation about the DT generic stages is provided below:

- Empathy generation and problem definition: In this stage, the team members should create empathy with users by observing “users and their behaviour in the context of their lives”; engaging with users by interacting and interviewing them “through both scheduled and short ‘intercept’ encounters; and immersing the user reality by experiencing what they feel and what they do” (Plattner, 2010). In this stage, the team establishes a meaningful specific problem to be solved.
- Ideation: After data exploration and its synthesis, the second stage focuses on creativity. In this phase, creative ideas arise. Ideation does not allow constraints, but focuses on identifying a whole range of new possibilities. In the end of this stage, the team proposes concepts that should be tested.

- Prototype and test: This stage covers prototyping selected ideas and testing them with users and stakeholders. The prototypes are simple and may represent the solution or specific hypotheses to be tested. They can also be built to gain empathy, to explore options, and to provide inspiration.
- Implementation: This stage is composed by the activities that prepare the company to start the development project, i.e., preparing plans, business model, business case, and performing final tests and strategic planning.

All specific guidelines that complement the activities listed in Table 3 were extracted from the corpus by means of the “activity” frame, as explained in the second section of this paper. It is important to highlight that those guidelines are recommendations and possibilities for performing the recurrent activities that depend on the activity context. They are not mandatory. Besides, each guideline depends on the context where they are presented. Outside their context, guidelines may only provide clues on how to behave regarding the activities.

Listing all guidelines in this paper would not be feasible due to space limitation. However, the complete set of guidelines is available at the following website:

<<https://marvelapp.com/1ih7da8/screen/25383471>>. In order to access the guidelines of each activity, please access the website, click on the action of the desired activity, click on the object of the desired activity and the guidelines for that specific activity will be displayed.

This paper provides an overview of the guidelines, highlighting their interesting aspects. For better understanding the results, a sample with two activities is provided as an example on how the results are structured. This sample is provided in Figure 3.

Activity: Analyse People [who are relevant for the process] [COD 11 19]				
<b>AGENT</b> Team; Observers; The designer	<b>DURATION</b> For a few hours; As much as you can;	<b>MANNER</b> In a conversation; In each quadrant [of a 2x2 matrix]; Experiencing the prototype; Creating something; Interacting with your products or services; As they cook, socialize, visit the doctor – whatever is relevant to your challenge; In a context; Without the influence of value judgments upon their actions, circumstances, decisions or issues; As you would other folks; Represented in each user groups.	<b>PLACE</b> In their natural context; In their natural settings.	<b>TIME</b> Through a typical day; Once you're there [in the field].
Activity: Create Low-Resolution Prototypes [COD 7 177]				
<b>AGENT</b> Team; The user; Designers; Various people	<b>DURATION</b> Null	<b>MANNER</b> Without testing the solution at all (or even having a solution in mind); For empathy; To test with users; To reflect input gathered through the review process; Of the many concepts that make up solutions; Which may not look like or wholly represent your solutions at all; As the next step in the assumption testing you started with thought experiments, but now you're going live; With simple materials; Each varying in the one property; Quickly; That much more realistic; Good enough to get the idea across; Iteratively; With the user in mind; Staying as low-resolution as possible.	<b>PLACE</b> Null	<b>TIME</b> Early; Often; Once you've determined what to prototype; Once you've determined how your prototype should change to reflect the feedback you got

Figure 3. Frame composition for activities “Analyse people [who are relevant for the process]” and “Create Low-Resolution Prototypes”

The first activity used as an example is “analyse people [who are relevant for your process]”. This activity is about observing and analysing stakeholders, commonly with higher focus on users. As illustrated in Figure 3, it is possible for the team, for specified observers or for the designer to perform this activity. Its duration may vary. It can range from a few hours until as much as possible. There are

also many ways of doing this, such as in a conversation, with a 2x2 table containing every information about people, observing the user experiencing a prototype or creating something, observing them in their daily life, and so on. It is suggested that this analysis should occur in the context of the person, with the observer being present in a typical day of the person.

The second activity, “create low-resolution prototypes”, is complemented by guidelines that provide recommendations on why to prototype (for empathy, to test with users, to reflect) and how to prototype (with simple materials, staying as low-resolution as possible, and keeping the user in mind). It also states clearly the quick and iterative nature of DT prototypes. There are recommendations on when prototyping could be useful, such as after defining what to prototype and after feedback. It recommends that prototyping must be done early and often. Finally, the prototyping may be done by “various people”, ranging from the team to the user.

As explained before, the guidelines were systematized for the 46 DT most recurrent activities. Figure 4 illustrates how many specific guidelines associated to each frame element (agent, duration, manner, place, and time) are proposed in all recurrent activities.

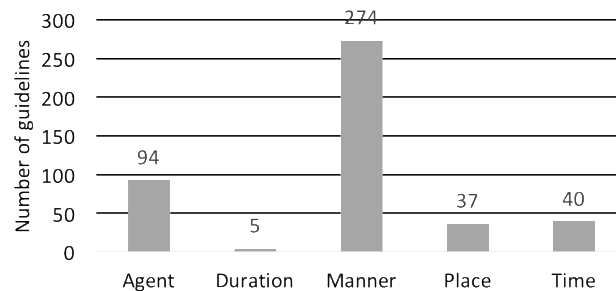


Figure 4. Guidelines on each frame element for all recurrent activities

If the frame structure is retrieved from Figure 1, it is possible to notice that “agent” is the only frame element considered as guideline that is core to the frame structure. Thus, it is expected that guidelines associated with the frame element “agent” would be presented at least once per activity. It would lead to an amount of at least 46 agents (one per activity). According to Figure 3, in average, each recurrent activity would provide two different possible guidelines that represent agents. Still according to Figure 3, “manner” is the frame element with most guidelines associated, presenting 274 different manners when all recurrent activities are considered. “Place” and “Time” have few guidelines, representing, in average, less than one guideline associated to them per activity frame. Thus, there is little differentiation on where and when to perform activities. It does not mean, however, that they are less important. In the example of the activity “Analyse people [who are relevant for the process]”, it is important to know that people should be analysed in their natural context, since it provides more insights and builds greater empathy. The FE “Time” also provides important information, as illustrated in the example of the activity “create low-resolution prototypes”: prototyping “early” and “often” is important for assuming a mindset towards action.

A few highlights may be observed when all guidelines are analysed. First of all, it is common to hear that DT should involve users actively throughout the process, mainly in the creation process. However, only about 19,6% of the recurrent activities (9 from 46) were cited at least once with users or stakeholders as the agent. Proportionally, users and stakeholders (people who are relevant for the process) are more frequently seen as the object of the action. Thus, when referring to users’ involvement, the DT methodologies description commonly matches a user-centred process more than a process that is based on customer co-creation.

Secondly, “Duration” is the least used guideline type. From all recurrent activities, only 3 have a duration associated, summing up 5 different duration guidelines. It is expected that DT methodologies would not provide how much time each activity should last, such as a specific amount of minutes, since DT is not a structured linear process. However, the guideline type “Duration” provides a notion on whether activities should be considered for a long or short time. It is important to know, for example, that people should be analysed “as much as you can”. On the other hand, the activity “decide ideas” provides guidelines stating that it should take just a few minutes, not spending too much time on decision criteria, since ideas will be tested and improved later.



## 5 CONCLUSIONS

Assuming the proper mindset during a DT process is essential to achieve adequate results. As explained previously, guidelines prescribe behaviours for the design team to assume an adequate mindset. This work identified what are the most recurrent DT generic guidelines and what DT specific guidelines complement the 46 most recurrent activities of DT. This work was performed by means of corpus linguistics associated with frame semantics and it is part of a wider research that aims to provide a proper characterization of DT to allow its integration into PSS design process models (Rosa, 2017).

The generic guidelines were presented as summary titles and their relevance was established as proportional to their recurrence in literature. Specific guidelines were structured according to which frame elements they fit: Agent, Duration, Manner, Place and Time.

Based on a corpus composed by eight DT methodologies, twenty-three generic guidelines were identified, from which only nine were recurrent in more than one methodology. Specific guidelines were unevenly distributed in the DT recurrent activities, with most guidelines associated to the frame element “Manner” and least guidelines associated to “Duration”.

Generic guidelines are important for the DT process, since they support the design team on assuming an appropriate mindset. However, specific guidelines should have their relevance also acknowledged. As explained in this work, an attempt to characterize DT by means of recurrent activities was performed in a previous step of this research to allow its integration into PSS design process models. However, activities do not provide enough information when not complemented by their guidelines. This fact may be noticed when taking into consideration the activity “analyse people [who are relevant for the process]”. This activity could be seen in a traditional product design process as a market research, for example. However, as provided in Figure 3, DT leads designers to go to the field and effectively observe users in their context and for as long as necessary.

Another similar situation is observed in the recurrent activity “create low-resolution prototypes”. Prototyping is commonly seen in traditional product design approaches as a way to validate the detailed design. Here, however, prototyping is referring to creating low-resolution artefacts that allow the design team to test ideas, concepts, solutions and hypotheses.

Another conclusion that may be brought by analysing the guidelines extracted for DT recurrent activities is that even though many authors describe DT as a customer co-creative approach, the description of DT methodologies is not fully aligned with this statement. More DT recurrent activities consider the user and other relevant people as objects of the action than as agents of the action. Thus, DT is better described as a user-centred process with some customer co-creative activities than a customer co-creative process.

This work provides the following contributions:

- Support people that desire to employ DT. The guidelines presented in this work can be used as a checklist of the guidelines that may be appropriate to each activity in order to assume a proper mindset. As explained before, not assuming a proper mindset may hinder the DT process.
- Support on building the DT theory by characterizing DT guidelines, which are classified by Liedtka (2014) under the label of attitudes as one of the elements of the problem-solving system that is DT;
- Complementing the information of DT recurrent activities with their guidelines, provided integrally at the following website: <<https://marvelapp.com/1ih7da8/screen/25383471>>.

Further steps of this work aim to propose a method for supporting the application of DT in alignment with PSS design process models, which shall employ as a basis the DT activities and guidelines as presented in this work and their comparison with PSS activities (Rosa et al., 2017).

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