PRINCIPLES GUIDING TEAMS IN NEW PRODUCT DEVELOPMENT PROJECTS

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ABSTRACT

This work describes the concept of establishing principles for teams in new product development projects. Principles provide guidance for teams and support them in decision making. They turn behavioural patterns of teams, that cover important aspects of collaboration, management as well as design-specific aspects, from an implicit to an explicit level and allow the team to develop a common understanding. Principles are formulated to invite for action with proactive phrasing and visualization of each key message. Aiming to let principle evolve into shared models for a team, we propose a sequence of steps from learning about principles for the first time to following a team-individual set of principles and taking consequential measures. To elucidate we introduce and illustrate a dozen principles. This exemplary set was presented to student teams and their coaches at the beginning of a nine month course for undergraduate students. In this preliminary and explorative study, the feedback of students and their coaches shows that the concept of principles was well understood by both groups and that they were stimulated to reflect upon them. The feedbacks also indicated, that the participants struggled to come up with new principles that differ from the provided examples. In the future, more thorough investigations shall be conducted into the usage of principles over the full duration of similar projects.

Keywords: Principles, new product development, design teams, shared mental models.

1   INTRODUCTION

Teams play an important role in product development, especially in the context of new product development (NPD) projects [1]. The daily work of teams in NPD projects is commonly supported and structured by processes (e.g. stage gate process) or methods (e.g. quality function deployment). A range of processes and methods has been widely established in teaching, research and industry practice. They help to deal with several kinds of challenges and offer approaches for situations with certain boundary conditions. However, particularly NPD projects are characterized by high uncertainty [2], nonlinear processes [3] as well as the uniqueness of each project [4], which means for some emerging problems no matching method or process can be found. There is not enough guidance and support on a general level, independent from fixed boundary conditions and applicable throughout the whole project.

For teams in NPD projects, we propose the introduction of principles, which should provide compass-like guidance on a higher degree of abstraction than processes and methods. Principles describe how to work together in the design team and how to approach design problems. The idea of principles for teams is to make an implicit working philosophy explicit, which is central for a common understanding on how to proceed and how to make decisions when facing challenges.

In the following, the general concept of a common mindset and shared mental model (SMM) is explained in relation to principles. Then a model for principles in teams is introduced and 12 principles are exemplified. Finally the preliminary feedback of students and coaches from an initial study are described.

2   FUNDAMENTALS

The idea, that a designer's mindset strongly influences the way he acts, is supported by the work of Andreasen. He stated that "the appropriateness of the user's mindset seems to be a very strong precondition for the proper application of methods." [5]. Furthermore in this context Person et al. pointed out, that "a proper mindset positively influences the designer's ability to use a method, as it

allows him or her to more effectively address the problem or challenge at hand when designing." [6]. Whereas the mentioned authors refer to the connection between a mindset and a method, the principles introduced in this paper are intended to function on a more general level. Principles provide an orientation for decisions to be made in the design process and hence steer the choice of actions.

In contrast to the previous mentioned authors, who discuss on an individual level, the principles aim to support the designers on a team level. The explicit definition of a working philosophy with its textual and visual description allows the team to create a common understanding on how to proceed in the design process. This common understanding can be seen as a SMM within the design team. Cannon-Bowers et al. define SMMs as "knowledge structures held by members of a team that enable them to form accurate explanations and expectations for the task, and in turn, to coordinate their actions and adapt their behaviour to demands of the task and other team members" [7]. Especially in NPD projects, which are characterized by less routine procedures, SMMs are relevant to work effectively. Thereby SMMs can guide the behaviour of teams when dealing with new situations [8]. In their work about cognitive processes in design teams, Bierhals et al. found that the existence on SMMs of small groups (subgroups) are positively related to team performance [9]. Principles can help to create a SMM, which has an impact on the decisions the designers make.

One example of the explicit use of a concept similar to principles is the d.mindsets, developed by the d.school in Stanford. The d.mindsets consists of seven items that communicate relevant mindsets in fuzzy front end projects to the students (e.g. bias towards action) [10]. However, the question how to introduce and implement those mindsets to design teams and what effect their application has on them, has not yet been discussed.

3 SUGGESTED MODEL FOR PRINCIPLES IN TEAMS

This section is subdivided in three parts. First, the characteristics regarding the formulation and composition of the principles are explained. Second, the way principles are intended to be used are described and, third, a basic set of 12 principles is introduced.

3.1 Characteristics of principles

The visual and textual structure of the principles is intended to be catchy and easy to remember. Therefore they are composed of three elements: First, they have a short head-title of maximal four words (e.g.: *redesign your tools*). Second, they have a lead title, which describes the principle in more detail (e.g.: *challenge and adjust your working environment*). Both, head and lead are phrased in a proactive way, so that they invite for action. Third, a drawn image of an easily memorable scene gives a visual representation of the lead.

3.2 Usage of principles

We propose the following sequence for establishing the idea of principles in student teams: (1) Introduce the concept of working with principles and explain the 12 exemplary principles, which were provided as basis (see Figure 1). This helps teams to understand the way principles work since the idea of using principles is not familiar to them. (2) Encourage the teams to create additional principles at this point in time or later in the project. (3) Let the teams choose the principles they want to apply in their team and position them visible in the project room. (4) Let them determine how they use those principles and in which manner they will affect their design process. The individual implementation of resulting measures is an important aspect and a continuous ongoing process, as new situations will lead to new ways of implementing a principle.

3.3 Basic set of principles

To provide a basic set which should help to understand the general idea and to stimulate teams to develop their own principles, 12 exemplary principles have been formulated by the authors (see Figure 1). They address elements of project management, team collaboration as well as design specific elements. In the following the 12 principles are introduced by presenting for each principle the respective head and lead text, as well as a short description of its intended meaning. We aim to give the reader an idea about the formulation and variety of principles, but do not claim to have verified these specific principles in detail.

ITERATE FOR EVOLUTION - fail and learn from it

This principle highlights the relevance of iteration cycles. Iteration is seen as continuous repetition of synthesis and analysis. At the end of the analysis a validated learning step [11] (prototype, test, interview, calculation, etc.) is performed, before moving on with the next synthesis. Failing is explicitly allowed.

BREATHE IN BREATHE OUT - alternate divergent and convergent activities

The distinction and the alternation between divergent and convergent phases are important, because each of these two thinking and working styles require particular actions and attitudes. Especially in teams the awareness of the actual phase is essential in order to adapt ones behaviour e.g.: don't judge in the process of idea generation.

DOCUMENT AS YOU GO - write and sketch knowledge while developing it

Continuous documentation in the dynamic environment of a NPD project is highly relevant. On the one hand the whole team needs to have access to input created by one team member as fast as possible, because every work step is building upon these results. On the other hand documentation forces to think about a coherent red thread and supports validated learning.

FOCUS ON THE USER - understand the users' needs and react to them

Every product has one or more user groups. To find the user groups, to isolate their needs and to test the product ideas by confronting them and recording their reaction is relevant along the whole process. User reactions are also a good basis for validated learning.

CREATE ENERGY - establish rituals and emotionalize your work

Motivation and trust are important in NPD teams, as the team members are working closely together and depending on each other. The challenge of creating something new and the necessity of exchanging information continuously make the atmosphere in the team an essential success factor.

MINIMIZE DISTANCES - create physical closeness of people and resources

Short distances between team members as well as to relevant physical equipment, but also to the users enables to work in short iteration cycles. The strong negative correlation between the frequency of communication and the physical distance between colleagues [12] is often underestimated.

GET PHYSICAL AND TEST - build it to validate your thoughts

Physical representations of the ideas help to communicate, to understand, to analyze thoughts as well as to provide inspiration for further ideas. Especially in interdisciplinary teams prototypes help to create a shared understanding of an idea.

LEARN NEW SKILLS - be curious about what others do and how they do it

NPD teams are dealing by definition with the challenge to create a novel and valuable product. The curiosity regarding new skills, new approaches or new knowledge creates new perspectives on a problem or an idea. This can lead to new thinking styles and new product ideas.

GO RADICAL - be brave and go against common patterns

This principle aims to create an atmosphere, which allows to think about radical ideas and to push disruptive solutions. For reaching the limit on what is feasible, first going to utopia and coming back to the limit can be more helpful than starting at a current solution and improving from this basis.

REDESIGN YOUR TOOLS - adjust your working environment

Tool, methods and also the physical environment like the office space often don't fit to the individual problems that need to be solved in a NPD project. Hence this principle empowers not only to work on the problem but also on the toolset to solve the problem.

VISUALIZE TO CONVINCE - show me don't tell me

A picture is worth more than a thousand words. Visual representations are essential to convince others and even oneself of content. Only if team members really have the same understanding of an idea, they are able to give valuable feedback and make good decisions.

Figure 1. Principles for teams in NPD projects (12 examples)

INVENT YOUR OWN PRINCIPLE - reflect on patterns and isolate the essence
The prior described principles are not a complete set. Each team should set up their own composition and shape their own principles whether they are motivated by a value (e.g. sustainability) or as a reflection/answer to a behaviour or problem in their team.

4   INITIAL REFLECTION OF PRINCIPLES IN STUDENT PROJECTS

In a preliminary and explorative study the idea of using principles, in particular the 12 exemplary principles, were introduced to undergraduate students from mechanical engineering, electrical engineering and industrial design in Zurich, Switzerland. At the beginning of a nine-month project based course the students taking that course as well as their coaches were confronted with the principles. The aim of this investigation was to evaluate on whether the way the principles are composed (head, lead, picture) is understandable and how students would generally react to it.

After the first three days of intensive teamwork the 12 exemplary principles were presented to the students of the six project teams (39 students) by handing them out a printed version. They were asked how they would implement them in their actual project and if they already have ideas for own principles. Their notes showed that they understood how a principle basically works. For in average 84% of the principles they collected meaningful ideas on how they want to implement them into their projects. For example one team added "implement a timeline with milestones in the project room" and "create a promotion video to impress sponsors" to the principle *visualize to convince*. No team managed to formulate their own principles at this point of time.

The seven coaches who either performed the same course one year before or gained other experiences in similar projects were asked to reflect on the principles based on their former undertaken projects. The coaches' notes were more detailed, showed less focus on the implementation of the principles and included more reflections regarding the evaluation of the principle in general. As shown in Figure 2 their answers were assigned to five categories, classifying their level of agreement to the principles. The principle *visualize to convince*, *breathe in breathe out* and *learn new skills* are strongly supported by the coaches. Surprisingly four answers pointed out that the principle *minimize distance* was very important for their communication, even though communication is not mentioned in the description of the principle itself. The two principles *iterate for evolution* and *go radical* were hardly discussed in the reflections. Iterations were often seen as time consuming and the question was raised how many iterations are possible within the course. *Go radical* was generally supported but five coaches mentioned that it should be limited to some phases or that it can be hard to communicate radical ideas to the stakeholders. Furthermore they had difficulties to reflect on *invent your own principle*.

The feedback by the students and the coaches showed that the structure how principles are set up is understandable and stimulates to reflect upon them. The student teams defined methods, tools or rituals to implement the principles in their projects. The coaches' feedback showed that not each of the 12 principles are suitable for all project teams. This confirmed the assumption that each team needs to define its own set of principles to work with, consisting of given and self-created principles. However, the reflection also showed that the process of defining own principles in a Bachelor course is difficult for the students and must be supported by the academic staff. In further studies the influence and usability of principles have to be investigated over the full duration of similar projects.
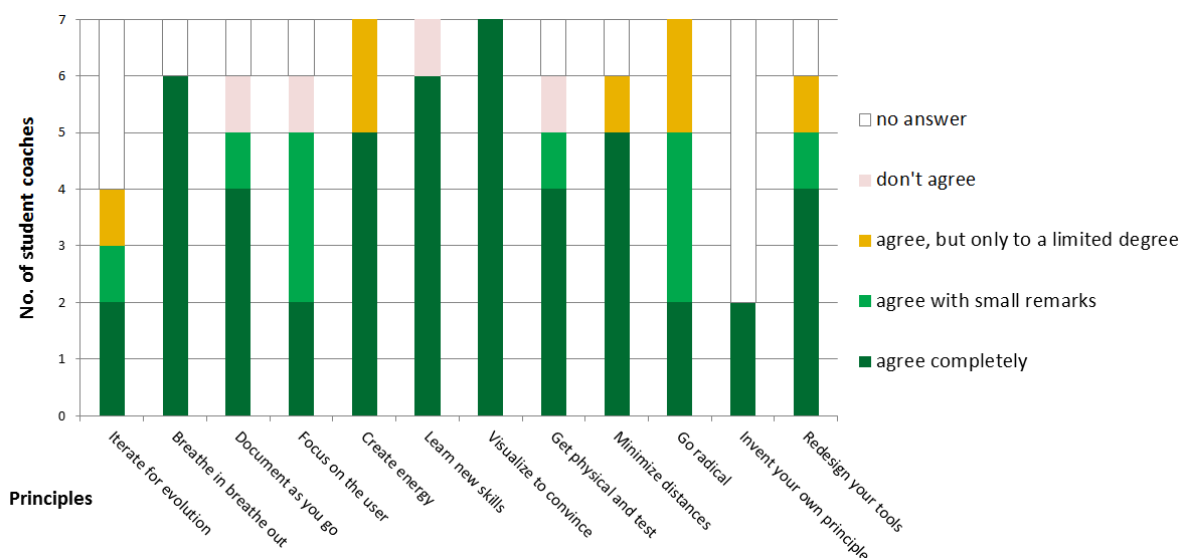

Figure 2. Overview of the coaches' reflection on the 12 basic principles

5   CONCLUSION

This paper describes the idea of establishing principles for teams in NPD projects. Next to processes and methods principles can be an additional element to support and guide development teams. Principles make the working philosophy of a team explicit and thereby allow the team members to create a common understanding on how to proceed during the design process. They are phrased in a proactive way and are composed by the three elements: head, lead and image.

12 exemplary principles, which cover important aspects of project management, team collaboration as well as design specific elements are introduced. In a preliminary and explorative study, this set of principles was tested with undergraduate student teams and their coaches in a project-based course. The feedback of the students and coaches shows, that the structure how principles are set up is understandable and stimulates to reflect upon them. Furthermore they trigger a discussion about the design process and the prioritization of actions. Further experiments over the whole duration of projects has to be conducted in the future, focusing on implementation strategies and effects on team performance.

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