276 Developing the master project manager.

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The education of project managers is mainly focussed on training in using prescriptive instruments such as PMBOK, PRINCE etc while evidence is mounting that the increasing complexity of projects requires a different set of competences. In this situation, where scholars and practioners are seeking for ways to manage complexity, we reflect on the possibility that a design based approach might provide project management the basis for advanced project management education that prepares project managers deal with complexity. First we give a limited overview of the literature on Design Thinking research and on Design Thinking in Management. Next we briefly explore the literature on Project Management Education. Finally we introduce the Project Design Cycle as a means to prepare project management students to deal with complexity. In particular we discuss how this cycle can help to facilitate learning from project managers' day to day-experience in a simulated situation.

Key words: Project Management, Education, Design Thinking, Complexity, Project Design Cycle

Introduction

For more than ten years researchers have been rethinking of project management (Cicmil et al. 2006; Svejvig & Andersen, 2015; Winter et al.2006), reconstructing project management (P. Morris, 2013; P. W. Morris, 2013; Morris, 1994), making projects critical (Hodgson & Cicmil, 2006), making projects Scandinavian (Lundin & Söderholm, 1995; Packendorff, 1995; Sahlin-Andersson & Söderholm, 2002), and recasting projects as practices (Blomquist et al, 2010). This work has been motivated by the widely shared belief that project management theory is not adequate to the task of helping projects managers carry out their work (Koskela & Howell, 2002). All of the above authors find that what is variously called classical -, main stream -, systems -, or type 1 - project management is too limited in perspective, and does not capture or address many of the most important issues or problems facing project managers. In general all of the new approaches make a "social turn", acknowledging projects as primarily social phenomena and apply a variety of theories and methodologies drawn from social science to the study of projects. Other turns have taken place as well, such as the practice turn, and a complexity turn (Cooke-Davies et al. 2008). In addition, many scholars have shifted from an engineering perspective to a 'critical' perspective (Cicmil & Hodgson, 2006) seeking not so much to propose improvements to project management tools, but to challenge beliefs, theories, and "bodies of knowledge" about projects and how they are managed. This has led to a large body of research rich with new insights and observations. However, many of the leaders of these movements have also come to the conclusion that as yet little of this research has led to significant advances in project management tools, practice, or education (P. Morris, 2013; Svejvig & Andersen, 2015), project management education seems still to be mainly focused on on training in using prescriptive instruments such as PMBOK, PRINCE etc while evidence is mounting that the increasing complexity of projects requires a different set of competences (Pant & Baroudi, 2007, Berggren & Söderlund, 2008, Thomas & Mengel, 2008, Ojiako et al., 2008, Ramazani et al., 2015, Nijhuis, 2017). We therefore introduce the Project Design Cycle as a means to learn project management students to deal with this complexity. But first we give a short review of the literature on Design Thinking research, Design Thinking in Project Management and Project Management Education.

Design Thinking research

Design Thinking is difficult to define (Dorst, 2010). Its meaning is depending on its context and epistemological roots (Johansson-Sköldberg et al., 2013). Within the design realm a rich variety of approaches has emerged, making it better to speak of 'designerly thinking'(ibid). Within the management realm Design thinking is used e.g. as 'a paradigm shift' in approaching innovation and creativity in business (Muratovsky, 2015). Starting with apparently obvious definitions of Design Thinking as 'thinking as a designer' or "defin[ing] courses of action aimed at changing existing situations into preferred ones." (Simon, 1969: 55) the meaning of Design Thinking can be well pointed out by a short review of the literature on Design Thinking research.

As a reaction to the need of mostly architects to modify the practice of design into a more user-friendly one, in the early 1960s design research started with the Design Methods movement (Goldschmidt, 2014: 10). Opposed to the notion that design thinking is intuitive, designing was seen as a logical process, one controlled by rules that could be explicated and prescribed, hence many of the proposed methods took the form of prescriptive models comprising operational design steps (or stages).(-) One basic model of the design process gained consensual acceptance by the entire Design Methods community, the Analysis (of the problems)-Synthesis (of the solutions)-Evaluation- or ASE-model. (ibid, 11, 12). Based on the paradigm of problem solving as information processing –similar to the paradigm underlying cognitive science (ibid, 21) – the ASE-model, particular in the variant of a spiral model, is meant to convey the movement from a wide (abstract) problem space to a specific (concrete) solution (ibid 13) wherein designing can be usefully interpreted as a variety-reducing process. The most influential attempt to devise a complete system for the analysis of design problems and the synthesis of solutions was proposed in Christopher Alexander's *Notes on the Synthesis of Form*, 1964 (ibid, 15).

Remarkable is that Alexander dissociated himself from the Design Methods movement by declaring (-) 'I want to state, publicly, that I reject the whole idea of design methods as a subject of study'. Nevertheless, a milestone was reached by the publication of Hebert Simon's "Science of the Artificial'(1969). In this book Simon proposes e.g. that most design problems are ill-structured and ill-defined. Another milestones in the history of Design thinking was reached by the publication of The Reflective Practioner by Donald Schön (1984). Schön proposes e.g that designers frame and reframe the problems at hand until the design task is clear. Although both publications were not based on research they were –and still are- very influential in the Design Thinking debate because of their innovative concepts.

Parallel to these publications, research into design thinking continued. By the mid 1970s researchers considered that the notion of intuitive design thinking might not be so objectionable after all and began to talk about 'descriptive design models', which they contrasted with prescriptive models or methods (Goldschmidt,2014: 19), inducing a change of paradigms in design research from prescriptive to descriptive, from Explaining to Understanding design thinking by describing practice. Hence one of the early descriptive design research texts in Britain –Brian Lawson's Design Thinking (1980/2005), was based on extensive observations (ibid, 22). Another example of influential descriptive empirical research is a workshop among designers at the Faculty of Industrial Design Engineering at the Delft University of Technology (Dorst & Cross, 2001). Concluded is that the 'problem-solving' aspect of design can be described usefully in terms of the co-evolution of problem and solution.

The final example of influential research on Design Thinking is the work of Gabriela Goldschmidt, e.g. described in *Linkography* 2014. Observing designers Goldschmidt traces 'design moves' (Goldschmidt, 2014: 41,47), comparable to chess moves, and studies their design activity by a registration method that visualizes the connection of these design moves into a network of links, the linkograph. Hence patters of these moves emerge. The patterns show for instance that each designers differs sometimes to great extent from other designers, they are mainly personally, but they all show that 'design thinking and reasoning is (-) a typical case of creative thinking, and we can talk now about the synthesis that is to be achieved during the early phase of the design process as a series of cycles of divergent and convergent thinking (-) in which ideation and evaluation follow each other in frequent proximity (-). (ibid, 46).

Summarizing this short review of the literature on Design thinking research, the following is selected for the argument of this article:

- Because design problems are ill-structured or ill-defined (Simon, 1973) in the early phases, Design thinking is focused on defining the problem
- by framing and reframing it (Schön, 1984)
- in a co-evolution of problems and solutions (Dorst & Cross, 2001) as a series of cycles of divergent and convergent thinking (-) in which ideation and evaluation follow each other in frequent proximity
- in order to synthesize the problems and solutions (Goldschmidt, 2014: 46)

Although many models of Design Thinking are hypothesized, these findings from descriptive empirical research didn't lead to a model that describes Design Thinking.

Design Thinking in Management theory

Design as a strategic tool was first mentioned in 1984 in Kotler & Rath, 1984 (Johansson-Sköldberg et al., 2013: 127) After some 20 years Design Thinking became a topic in management discourse. Based on their different backgrounds Johansson-Sköldberg et al. distinguish in three types of design thinking in the management discourse (ibid, 128):

1. Design Thinking as design company IDEO's way of working with design and innovation (e.g Kelly, 2001);
2. Design Thinking as part of management theory (Boland & Collopy, 2004).
3. Design Thinking as a way to approach indeterminate organizational problems, and a necessary skill for practicing managers (e.g. Dunne & Martin, 2006)

In the first type the CEO of IDEO, Tim Brown, labelled their concept as design thinking, detailing steps in the process of their work and providing stories to help everyone use IDEO's methods, particularly business people and social innovators (Johansson-Sköldberg et al., 2013: 128). Inspired by the way of working of architect Frank Gehry the second type of Design Thinking in Management is characterized by merely a design attitude, distinguished from the usual decision attitude of managers. In this line of thought world-renowned scholars as Carl Weick use the design situation as an application of their own frameworks of thinking and theorizing (ibid. 129). In the third type Design Thinking as an ongoing cycle of generating ideas (abduction), predicing consequences (deduction), testing, and generalizing (induction) of the third type has been promoted as a useful process in different disciplines, including library administration, legal practice management, HR and in the management area strategy and organizational change and development. (ibid, 128, 129).

After the hype of Design Thinking in management discourse around 2010 (cf. ibid, 123), Nussbaum warns that Design Thinking has given the design profession and society at large all the benefits it has to offer and is beginning to ossify and actually do harm because companies absorbed the process of Design Thinking all too well, turning it into a linear, gated, by-the book methodology that deliverd, at best, incremental change and innovation (Nussbaum, 2011). Since then the debate on Design Thinking in Management still continues. Parallel to Nussbaum, e.g. Hassi and Laakso discuss in their *Design Thinking in the management discourse: defining elements of the concept.* the use, application, benefits and limitations of Design Thinking and try to set out a framework for design thinking from the current management discussion (Hassi & Laakso 2011). Muratovski even reports on the new role of design in business and society as a paradigm shift (Muratovski, 2015). Contrary to Nussbaum he finds in documents, not based on empirical research, of several companies such as Apple Inc., Nike Inc., Coca-Cola, IBM, Pricewaterhouse-Coppers (PwC), Deloitte, Accenture, Barclays, Facebook Inc. and Google, even the Bill & Melinda Gates Foudation and The World Bank, that they somehow adapt to design thinking as a way of dealing with complex problems with two key features: engagement of stakeholders, sometimes called 'Human-centered design', from the very start and first focus on the definition of the problem, or better 'problem-finding' (ibid, 135). In an apparently more academic publication and under the title *Managing by Design* the editors of the Academy of Management Journal seem to confirm Muratovski's findings by writing that over the past two decades, the importance of design and the value of design thinking as a tool for innovation have been recognized by both business and government (Editorial, 2015). They further provide a model contrasting the approach of business-, engineering and design-led innovation. All three approaches are appropriate depending on the context, with the latter being best applied where breakthrough thinking and disruptive innovation is required, or to address "wicked' problems (ibid. 2). Meanwhile, new publications on Design Thinking in Management are still released e.g. Carlgren et al., 2016 with *Framing Design Thinking: The Concept in Idea and Enactment* and Mahmoud-Jouini et al., 2016 with *Contributions of Design Thinking to Project Management in an Innovation Context*. One could conclude that despite some critique Design Thinking is still an issue in the Management discourse and although not based on empirical research it appears to be a way to deal with ill-defined, indeterminate or wicked problems.

Design Thinking in Project Management Education

Kimbell signals a growing interest in design in management academia including experiments in teaching design to MBAs and executives at e.g. the Fox School of Business (Temple University, 2011), the Rotman School of Management (University of Toronto, 2011), Said Business School (Kimbell, 2011), and the Weatherhead School of Management (Case Western Reserve University, 2011) (Kimbell, 2011: 293, 294).

Similarly to the theoretical discourse with its distinction between the 'Designerly' discourse (Carlgren et al. 2016) of design-based researchers and the Design Thinking discourse of management 'theorists', the education streams have remained separate, with design thinking within design-based education drawing on Schön or Simon for engineering applications, and management-based offerings being concerned with pedagogical foundations (Johansson-Sköldberg et al., 2013: 128).

Dunne and Martin define Design Thinking in the realm of education as approaching management problems as designers approach design problems (Dunne & Martin, 2006: 512) and as solving wicked problems through collaborative integrative thinking using abductive logic (ibid: 513). This, we believe,

is the essence of design thinking: solving wicked problems in a coëvolution of problem and solution (Dorst & Cross, 2001), where wicked (or ill-defined or indeterminate) concurs with complex, because of the uncertain or unpredictable character of complexity (cf. Bosch-Rekveldt et al. 2010, Verhees, 2013: 69).

In the debate on project management education the lack of training student project managers in dealing with this complexity is observed by Thomas & Mengel: their review of the literature and of project management training programs demonstrates the focus on standardization of the field and on preparation for the professional designation of project managers (2008: 304). This is confirmed by Pant, 2007, Ojiako et al. 2008, Ramazani et al., 2015, and particular recently by research into the actual practice in project management education in the Netherlands (Nijhuis, 2017). Hence, project managers must be taught to ‘‘seek first to understand” the increasingly complex environments they are operating in as opposed to our current ‘‘biased. . .focus on problem solving” and applying prescribed techniques. Rather than training project managers to apply tools and techniques, we need to prepare them to diagnose situations, adopt appropriate tools and techniques, adapt the tools and techniques as necessary, and to learn continuously (Thomas & Mengel, 2008: 311). Although not always made explicit as such, within this debate there appears to be a growing attention for (aspects of) design thinking in complex, sometimes innovation, situations in (project) management, e.g. the introduction of a experiential learning model (Berggren & Söderlund, 2008), the approach of *Project Managers as Reflective and Creative Practitioners* (Ojiako et al., 2008) or *Project managers as reflective practioners* (Louw & Rwelamila, 2012), the use of *Guided reflection on project definition* (Cano & Lidon, 2011) or *A problem solving perspective as a continuous learning perspective* (Ahern et al., 2014) and finally *Linking Design Thinking with Innovation Outcomes through Cognitive Bias Reduction* (Liedtka, 2014). For example Berggren & Söderlund, 2008 and Ojiako et al., 2008, discuss rethinking Project management education by respectively emphasizing articulation and reflection (Berggren & Söderlund, 2008: 289) or reflection (Ojiako et al., 2008: 4, 5) in the development of project managers from trained technicians to reflective and creative practioners (cf. Louw et al., 2012) or finally the use of reflection as a learning aid in the definition of a real life project by project management students that had a positive effect on their learning (Cano & Lidon, 2011). With that Design Thinking appears to be of increasing value for teaching project management students to deal with complex situations.

Project Design Cycle

To learn project management students to deal with this complexity, we propose the use of a ‘Project Design Cycle’. The Project Design Cycle is developed based on literature (Heintz et al., 2015). It is as a cycle of generate and test problems towards solutions in an iterative way, but the design cycle also bears similarity to Deming’s Plan-Do-Check-Act cycle (Deming, 1986) and the Kolb Learning Cycle: Concrete Experience – Reflective Observation – Abstract Conceptualization – Active Experimentation (Kolb, 1984). These similarities are not coincidental, design and management both rely on learning and feedback from the situation to arrive at better outcomes than might otherwise be realized. For the purposes of illuminating the role of design thinking in building project management the following formulation of the cycle may be most helpful:

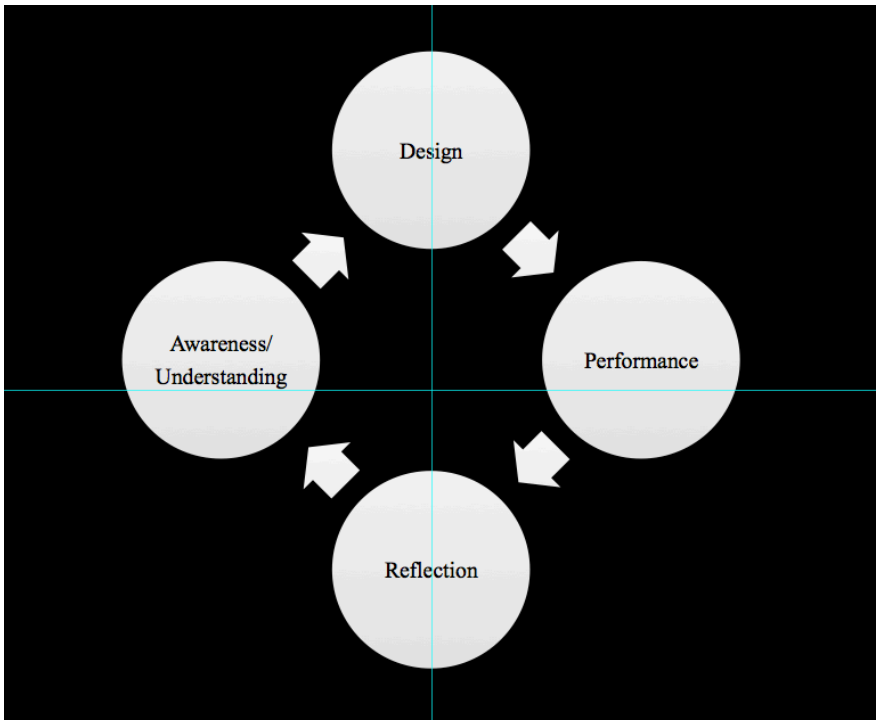

Figure 1. The project design cycle

- **Awareness**

The cycle begins with establishing awareness of the current situation. This awareness encompasses not only the formal project as captured in so called "project information", but also, and importantly, the social situation (situational awareness), including the status and state of the various actors and stakeholders in the project. Awareness has a very significant component of sense-making. It is at this stage that the project manager considers which metaphor – which project management perspective – best illuminates the situation. Using this metaphor and its terminology, the project manager can then describe the situation.

- **Design**

Out of this awareness comes an understanding of both the current state and a desired outcome. Also, out of the choice of metaphor, comes a tool set which can be used to design a course of action to effect the change from the current to the desired state. Having determined that action is required, design refers to the shaping of a course of action. This course of action will consist a set of actions the project manager him- or her-self must to in order to initiate and guide the other actors in the actions they must carry out.

- **Performance**

This set of actions must then be performed by the project manager. It is not just a matter of carrying out the design. A Performance is required in that management, requires that one changes people's minds and actions.

- **Reflection**

Finally, there is a reflection upon the outcome, attempting to draw any lessons about the designed course of action or its performance that may be useful in the future. At this stage the project manager may, for example, choose to reconsider the choice of metaphor, and the description of the situation.

Applying the Project Design Cycle

Project managers with their busy agenda's and often seemingly necessary daily fixation on end goals that must be met, seem to have little time for a reflective practice (cf. Ojiako et al., 2008, Louw et al., 2012), while in fact their behaviour is accordingly to it (cf. Kolb, 1984, Moon, 1999), only they

seem to be not aware of it. The first step that we propose to train prospective project managers in reflective practice is that of Awareness/recognition (cf. Lousberg et al., 2015). This awareness encompasses not only the formal project as captured in so called “project information”, but also, and importantly, the social situation (situational awareness), including the status and state of the various actors and stakeholders in the project. Awareness of what is going on, who is doing what, etc. Also of intentions, goals, and plans. Awareness also encompasses the determination that ‘something needs to be done’ i.e. deviation from the intended course of the project in some why. Awareness has a very significant component of sense-making.
Out of this awareness flows an understanding of both the current state and a desired outcome. Having determined that action is required, design refers to the shaping of a course of action. Design thinking here is important in its open and free approach to generating alternatives and possibilities. But Design should include both generate and test. A designed course of action is also one that has been in some sense tested.
This course of action will naturally consist of a list of things for the actors in the project to do, but equally important it will include things which the project manager him or herself must to in order to initiate and guide the other actors in the actions they must carry out.
This second set of actions must then be performed by the project manager. And this performance constitutes the second main set of activities of the building project manager. The choice of the word performance refers to the performative aspect of management. It is not just a matter of carrying out the design. A Performance is required in that management, especially Design & Construction Management, requires that one changes people’s minds and actions. This requires that one reach them in the same way an actor does. Finally, there is a reflection upon the outcome, attempting to draw any lessons about the designed course of action or its performance that may be useful in the future.

Coping with complex managerial problems in a way as described above can be trained in a simulation of 'real life' situations as in management games. There are practical challenges, of which the least seems: "How do we know whether the simulation is 'real as life '?" In the literature enough material can be found to construct a reasonably similar simulation (cf. Duke & Geurts, 2004). However, the most important practical challenge seems to be: "How do we know whether the trainees have gone through the cycle of Awareness/ Recognition, Design, Performance and Reflection in their daily management 'while doing it '?". We think that this can be solved by subsequently on the one hand discuss with the trainee whether he/ she recognizes the different steps, looking back on his/ her daily functioning as a project manager, but above all by assessing whether he/ she during the exercise of his/her function works ' designerly', i.e. focussed is on analysing the problem by developing various solutions. Because that determines the searching and experimenting nature of managing as designing contrary to the common view on managing as choosing between ready-made options presented. By observing and subsequently evaluating the behaviour of the trainee at his/her daily management, we expect it is possible to train project managers and students in project management in learning from themselves.

Conclusion

In this article we summarized the literature on Design Thinking. Because design problems are ill-structured or ill-defined in the early phases, Design thinking is focused on defining the problem by framing and reframing it in a co-evolution and synthesis of problems and solutions as a series of cycles of

divergent and convergent thinking (-) in which ideation and evaluation follow each other in frequent proximity.
However, we concluded that these findings from descriptive empirical research didn't lead to an overall model that describes Design thinking.
From the literature on Design thinking in Management it is concluded that despite some critique Design Thinking is still an issue in the Management discourse and although not based on empirical research appears to be a way to deal with ill-defined, indeterminate or wicked problems.
Next, from the literature on Project Management Education we concluded that Design Thinking appears to be of increasing value for teaching project management students how to deal with complex situations. Most of the fore mentioned research publications write about the competencies that project managers need to deal with complexity. However, it remained unclear how to teach student project managers to deal with complexity.
Hence, we introduced the model of the Project Design Cycle with its phases Awareness, Design, Performance and Reflection as a means to prepare project management students to deal with that complexity. Finally we discussed the application of this cycle in a simulated situation.
The cycle incorporates reflection and learning into the normal course of project management. This provides the graduate project manager with the opportunity to both improve their knowledge and skills over time, and in gain increased insight into the current project; it helps developing the master project manager.

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