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Overcoming the Valley of Death: A Design Innovation Perspective

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In large organisations, innovation activities are often located in separate departments, centres or studios. These departments aim to produce prototypes of solutions to the problems of operational business owners. However, too often these concepts remain in the prototype stage: they never cross the valley of death *to become implemented.*

A design approach to innovation is presented as a solution to the problem. However, practice shows that teams that use this approach nevertheless encounter this problem due to the larger infrastructure of the organisation they are part of. This research aims to explore which factors contribute to the valley of death *for design innovation. Additionally, this paper presents first insights into how design practices help to mitigate this phenomenon.*

An embedded multiple case study at a large heritage airline is used to study this phenomenon. A thematic analysis of the data finds that organisational design, departmental silo's and dissimilar innovation strategies contribute to the valley of death*. The issues with resource-assignment that result from these factors are displayed. Last, materialization, user-centeredness and holistic problem-framing are indicated as practices that help to mitigate this problem.*

Keywords*: organisational infrastructure; implementation; innovation department*

Introduction

An increasingly turbulent environment is forcing companies to take a more proactive stance to innovation (Eisenhardt, Furr, & Bingham, 2010). Organisations' that aim to innovate while maintaining current operations (O'Reilly & Tushman, 2004, 2013) often choose for an organisational form in which there is a semi-separate innovation department or team sitting remote to existing departments. Organising innovation separate from operational departments, may result in the *valley of death* phenomenon where there is difficulty implementing, accelerating or commercializing an innovation across an organisation (Sandberg & Aarikka-Stenroos, 2014). The *valley of death* is described as the gap between invention and (implemented) innovation or the challenge of accelerating an innovation after proof of concept has been given.

Innovation by design has the potential of mitigating the *valley of death* by structuring the process of innovation from creative ideas to valuable propositions (Kolarz et al., 2015). This approach is characterized by a number of themes (user focus, problem reframing, visualization, experimentation and diversity) which can be related to principles and practices (Carlgren, Rauth, & Elmquist, 2016). However, empirical research that aims to determine if and how this approach mitigates the *valley of death* is lacking. Moreover, practice shows that a *valley of death* may still arise when a design approach to innovation is taken.

This research therefore aims to explore why and how the *valley of death* phenomenon appears when a design approach to innovation is taken. Additionally, a first insight is produced into how this approach helps to mitigate the *valley of death*. The researcher thus set out to answer the following research questions:

- What challenges associated with the *valley of death* are encountered during a design approach to innovation?
- How can a design approach to innovation be applied to overcome such challenges?

This paper reports on the first study in a research project that is performed in the context of a large airline. This airline (like many) does not have a dedicated technological research and design (R&D) department but uses separate hubs to develop new services and improve the existing service and operation. The results indicate that indeed a *valley of death* appears when a design approach is taken to innovation projects. A number of corporate infrastructural factors (such as a complex organisational design) are identified that contribute to this phenomenon.

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Furthermore, numerous design practices (such as visualizing) are proposed to help mitigate the problem at hand. The paper ends with a description of the action research project that is currently in progress which builds upon the contribution of this paper.

Literature Review

This literature review is divided into three parts. Initially, the author provides a short overview of the available literature on the *valley of death*. Second, a short introduction of a practice-based conceptualization of design innovation will be presented. The final section aims to clarify why and how these practices are expected to help mitigate the *valley of death*.

The valley of death

There are two bodies of knowledge that describe the *valley of death*. Papers regarding this subject can be found in the R&D management literature that considers the effectiveness of R&D processes, such as those written by Markham et al. (2010) and Branscomb & Auerswald (2003). Alternatively, the (radical) innovation management literature mentions the phenomenon when a barriers approach to innovation is taken (Assink, 2006; Carlgren, Elmquist, & Rauth, 2014; Van de Ven, 1986).

In the R&D management literature, the *valley of death* is described as 'a discrete segment of development between research and product development' (Markham et al., 2010, p. 1). It is the space between opportunity discovery (invention) and product development (innovation) (Hudson & Khazragui, 2013; Markham et al., 2010). The former is performed in R&D centres (such as in the drug industry with the development of a prototype drug) and the latter in the commercial organisation.

Traditionally within this field, research has been done into the typical discovery research (or R&D) and New Product Development (NPD) processes. Recent research in this field points out that in the additional pre-NPD, post-R&D *valley of death* process, critical business decisions are taken that refer to both the technical, businesses and commercial development of a product or service (Markham, 2013; Perry-Smith & Mannucci, 2017) Authors in this field indicate that this phenomenon (as illustrated in figure 1) is worthy of more research due to how little we know about it relative to its importance for the success of product development (hence for example also the special issue of *Technovation* in 2018).

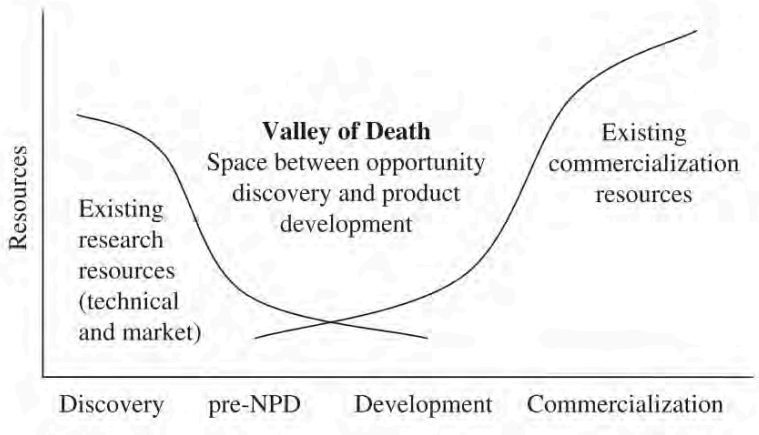

Figure 1: the valley of death in Markham et. al (2010)

Literature that deals with the barriers (as opposed to the drivers) to innovation, such as Moss Kanter (2006), Assink (2006) and Sandberg & Aarikka-Stenroos (2014), also deals with the *valley of death.* In this field, the process of innovations is generally divided in three phases: ideation, R&D and acceleration or commercialization (O'Conner & DeMartino, 2006). The author of this paper considers the challenges of the last phase, to develop from a *physical artefact* (Trott, 2002) to an implemented and scaled solution as the *valley of death*. This is in line with Assink's (2006) definition who describes the valley as the gap between breakthrough invention and commercial application. According to a literature study by Sandberg & Aarikka-Sternroos (2014), customer resistance, a lack of

commercialization competences and an unsupportive organisational structure are key contributors to the *valley of death*.

Currently, most of the research in this field focusses on indicating barriers throughout the entire innovation process, rather than focussing on specific phases. Also, this research often looks at many different initiatives which applied different innovation approaches. Last, research has been limited to general descriptions of barriers rather than describing how these barriers work or how they should be managed.

Coinciding with the academic worlds' interest in the *valley of death* is a rising consciousness of companies of this phenomenon. In its annual report, the Design Council opens with a statement from a business executive that states: 'The Valley of Death – everyone talks about conquering it…The UK has been inventing for years but has not been very good at commercialisation – now we're trying to do that' (Kolarz et al., 2015, p. 2). Similarly, the COO of the large airline that is the subject of this study mentioned in his annual address 'We've invested a lot in our capacity to generate new ideas and create prototypes, now it's time to become good at implementing these ideas'.

As the interest of both the academic literature and business executives in the topic is rising, the time seems right to study what exactly causes the *valley of death* and how it can be mitigated.

Design innovation

As an approach to innovation, the use of design has enjoyed increasing attention both in the academic (Mueller & Thoring, 2012; Rae, 2016; Volkova & Jakobsone, 2016) and business world (Brown & Martin, 2015; Kolko, 2015). As a relatively young field of research, many (design) researchers still struggle to define how design relates to innovation (Cooper, Junginger, & Lockwood, 2009; Kimbell, 2012; Rodgers, 2013). Gradually, design innovation research converges around more specified concepts such as 'Design-driven innovation' (de Goey, Hilletofth, & Eriksson, 2017; Verganti, 2003), 'Design-Led Innovation' (Price & Wrigley, 2016; Wrigley & Bucolo, 2011), business-minded 'Design Thinking' (Rodgers, 2013; Schmiedgen, Rhinow, Köppen, & Meinel, 2015) and theoretical 'design thinking' (Dorst, 2011), but a consensus on differences and similarities between those has yet to emerge

In this paper the design innovation concept of Carlgren, Rauth & Elmquist (2016) will be used. This concept is chosen because of its holistic definition that frames it as a way of performing innovation and because it is grounded in how design is practiced in large companies. This has resulted in a useful division on 'themes', 'principles' and 'practices'. It therefore fits the practical purpose of this paper.

According to their analysis, design can be characterized by 5 'themes': user focus, problem framing, visualization, experimentation and diversity. Each *theme* (e.g. user focus) can be linked to *principles* (e.g. empathy) and accordingly to *practices* that showcase these principles (such as qualitative user research). These *practices* are observable and can thus be used to distinguish design innovation projects from others.

Design to overcome the valley of death

In the earlier mentioned report of the British Design Council, design is indicated as a tool to cross the *valley of death*:

> *…Our innovation system often presents formidable obstacles in getting scientific ideas and discoveries to market…Design is one of the most powerful tools we have for this and for smoothing the journey from research insight to practical, marketable applications (Kolarz et al., 2015, p. 4).*

Liedtka (2015), although not specifically naming the *valley of death*, discusses how design helps to improve innovation outcomes by reducing cognitive biases in the innovation process. There are thus signs that design may aid to cross the *valley of death*.

Indeed, customer resistance (driven by a lack of market sensing ability (Assink, 2006)) is mentioned as one of the key factors of the valley of death (Sandberg & Aarikka-Stenroos, 2014). One can imagine that a design process, in which a user focus is applied and experimentation with users is key, this barrier might be overcome or at least lowered. The barriers analysis of Assink (2006) provides more basis for this line of thought. Assink for example mentions the challenge of *organisational dualism* or *ambidexterity* (O'Reilly & Tushman, 2013) which design has been mentioned to aid (Stoimenova & De Lille, 2017). Last, Assink mentions that a risk averse climate hinders the development of radical ideas as in innovation uncertainty prevails and a probe-and-learn approach needs to be taken. This coincides with the experimental and iterative nature of design and the ambiguous nature of projects that designers are used to (Jahnke, 2013; Kolko, 2015).

At an activity level, it is not difficult to link design to the *valley of death*. Markham et al. (2010) describe that within the *valley of death*, attention is paid to technical viability, market/user research and business case development. In the literature review, Carlgren et al. (2016) mention that the majority of the descriptions of design include finding a balance between (technical) feasibility, (user) desirability and (business) viability.

Contrastingly, it should also be noted that Carlgren, Elmquist and Rauth (2016) argue that the use of a design approach may have the opposite effect and enlarge the valley as: 'the strong focus on reframing problems and building on deep user insights in DT [Design Thinking] seem to reinforce this challenge even more.' (p.355)

From this literature review, we can conclude that different authors offer ways in which a design approach may aid to mitigate *the valley of death*. However, none of the current research describes how design helps the cause. This research thereby adds to the existing body of literature by contrasting the findings above with the empirical reality of an airline company in which design is used to innovate.

Research Design and Methodology

Context and case selection

This research project is performed in the context of a cooperation between a legacy airline carrier (from hereon: AirCo) and the research institute of the author. The cooperation between the two institutions aims to build design capabilities in the airline and to perform research on (the effect of) design in large, mature companies.

The airline industry is typically seen as an operationally driven, highly regulated and highly networked business (Price, Wrigley, & Dreiling, 2015). Operators are required to invest heavily in aircrafts (which need to be designed and used for dozens of years) and the routes that an airline operates is seen as its major competitive advantage.

AirCo operates at a mid-range price-point and aims to use a customer-intimacy strategy to attract customers. AirCo is one of the oldest airlines in the world and faces fierce competition from both low-cost airline carriers (such as EasyJet and RyanAir) and high-quality, high-priced gulf carriers (such as Qatar Airways and Emirates). AirCo has a traditional, hierarchical organisational structure as visualized in figure 2, which consists of mainly parallel silos of departments, with a separate user innovations department and a digital department that interacts with others.

This context was chosen because of two reasons. First, the researcher had access to multiple cases and employees from various ranks within AirCo who were willing to provide information. Second, due to its operational focus, highly networked and regulated nature (Price, Wrigley, & Dreiling, 2015) the airline industry is known to be a challenging industry to innovate in (Price, 2016). This context not only seems to amplify the *valley of death* challenges, the ability to conceive and implement innovations, is thus also seen as a highly valuable competitive advantage in this industry.

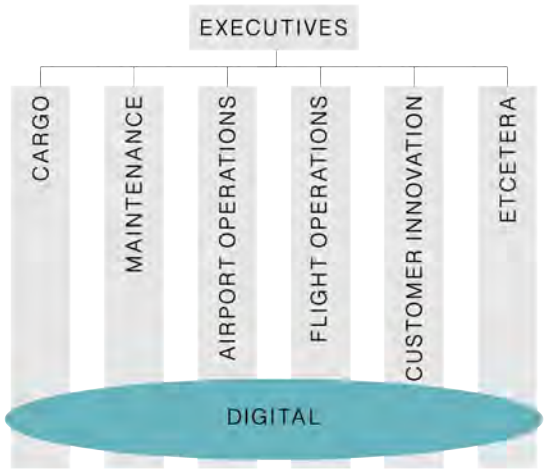

Figure 2: AirCo company structure

For this study, an embedded case research design was chosen due to the complex and contextualized nature of the object of study (Scholz & Tietje, 2002; Yin, 1984). This approach allowed the authors to explore the phenomenon from different angles and integrate multiple data sources (Scholz & Tietje, 2002). By considering and comparing different projects, a holistic understanding of the process leading to a *valley of death* was built (Baxter & Jack, 2008).

The cases that were selected for the interviews were from the Digital department of AirCo. The Digital department is not hierarchically linked to any of the operational divisions that characterizes the AirCo organisational structure (as can be seen in figure 2). The department is tasked with developing digital solutions to enable better service-delivery and to improve the employee and customer experience. For the interviews, four cases were purposefully selected (Palinkas et al., 2015) from this department. The projects were selected based on:

- The active involvement of both a trained designer and a business manager, to be able to contrast the approach of both team-members.
- The use of design practices as described by Carlgren, Rauth, & Elmquist (2016), to discover whether these were perceived to help cross the *valley of death*
- The appearance of a *valley of death*, to explore the underlying causes
- The involvement of multiple operational departments to be able to perceive challenges related to meta-departmental factors

Data collection

In order to both understand the *valley of death* phenomenon and the designers role in mitigating it, eight semi-structured interviews were held. This approach matches the exploratory nature of research conducted by Blandford (2013). The semi-structured interviews allowed the author to probe whilst gathering information regarding a range of topics. Interviews were done with both business managers and designer team members. Interviews were one hour in duration and recorded with consent. A comprehensive overview of the different projects and participants can be found in table 1.

Table 1: Selection of cases

	1. Boarding System (BS)	**2. Bag Tool (BT)**	**3. IT Back-End (BE)**	**4. Unaccompanied Minors (UM)**
Project Goal	Optimize flow of passengers while boarding & improve customer satisfaction	Optimize flow of passengers in the airport by changing their behaviour concerning hand luggage	Facilitate and align processes communication around pilot in 2020	Redesign the Unaccompanied Minors' service, a future vision.
Participant	1 designer 1 manager	1 designer 1 manager	2 designers 1 manager	1 designer
Delivered prototype	Physical prototype, tested at the gate	Physical prototype, tested at the gate	Visualisation of architecture and mock-up interface	Physical prototype, digital mock-up and service design blueprint
Status at time of writing	Ownership transferred to partner airline	Ownership transferred to airport	Almost ready for launch after 2 years	At low prioritization position for backlog

After an initial test interview, it appeared that the (often externally hired) designers were unable to answer certain questions regarding AirCo's standard modus operandi. Similarly, the managers were unable to answer some of the questions regarding the designers' experience. Different questions were thus asked to the designers and to the company managers according to their role in the project. This limited the number of questions per respondent, which provided time to explore deeper explanations of statements with respondents. Main themes discussed were:
Designers:

- The development of the project
- Starting point
    - Parties involved
    - Dependencies
- Challenges encountered
    - Impediments
    - Solutions to those impediments
- Learnings (related to challenges) for both the designer and AirCo
- Role in the project (and potential shift of this role throughout the project)

AirCo management:

- Challenges encountered in project
- Innovation approach
    - Standard
    - Difference with design approach
- Implementation approach
    - Involvement of users
    - Communication with stakeholders
- Perceived effect of design

Data analysis

Data were analysed applying a thematic analysis (Blandford, 2013). The flexibility of this approach is vital as it provides a method to analyse rich and detailed, yet complex data and produce distinguishable themes (Braun & Clarke, 2006). It does so by looking for similarities in quotes regarding processes, language and attitudes (Tesch, 1990). The structure of the themes that were identified is visualized in figure 3. The grey blocks indicate the main challenges that were linked to the *valley of death*. The blue blocks represent the structural factors of AirCo that cause these problems.

In a similar way, the data produced initial insights regarding how design contributed to the mitigation of the *valley of death.* The majority of the data however did not touch upon this subject. The insight are therefore less elaborate.

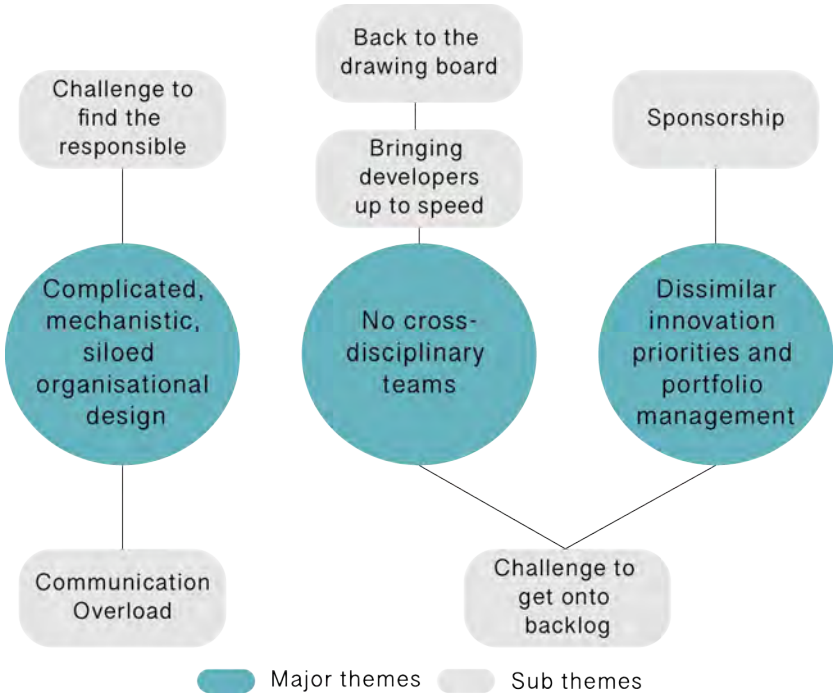

Figure 3: Themes produced during analysis, challenges in grey and factors in blue.

Finally, to inform the discussion, the insights that were produced during the analysis, were discussed with managers from AirCo. This discussion served to confirm and validate the findings and also resulted in deeper insight into the factors that cause the problems. Their response, together with data that was already gathered from the second (action research) study was used for triangulation and is included in the following discussion.

Design Innovation at AirCo

In this section the findings from the analysis will be presented and discussed in relation to existing literature. The insights will be structured according to the themes portrayed in Figure 3. First, a short description will be given of how the *valley of death* was experienced at these design projects at AirCo. After this, the three factors will be unpacked. Data from the interviews will be used to support and explain the challenges associated with these factors. Also, in this section the challenges will be mirrored with literature that is already available. Thus this section also includes the discussion and aims to indicate how this research adds to current literature.

At the end of this section, three insights are presented that unpack how designers contribute to mitigating the *valley of death*. These insights will also be coupled with the available literature regarding how design helps to improve innovation (outcomes), specifically the practices as introduced in the literature review.

As the cases were selected purposefully, it is not surprising that a *valley of death* as described in the literature review (Assink, 2006; Hudson & Khazragui, 2013) was encountered in all cases. Especially the managers recognized this and saw this phenomenon as reoccurring. As the BT-case manager mentioned: 'Everyone can make a plan, but to get the plan implemented: that is the real issue!'. Similarly, the BS-manager recounted: 'Innovation is when you get something implemented in your real operational processes, and if you look critical at the innovations at AirCo almost none make it to that stage.'

Organisational design

AirCo is a more than 100 years old company with more than 30.000 employees that operates in a highly operationally focussed and heavily regulated business. This has led to a company that has a complicated, siloed and mechanistic (as opposed to organic) design.

The airlines legacy has led to an organisational design which is hierarchical and specialized, and which has grown increasingly complicated over the years. For example, when digital technology was identified as a possible driver for competitive advantage, a Digital department was created which interacts with almost all other AirCo departments. However, due to historic choices and a strategic alliance with another airline, the Digital department is not responsible for digital social media interaction or the website.

The airline context that AirCo operates in, adds to this challenge. For example, at the airport a touchpoint could be managed by a 'hub'-manager (airport), a manager responsible for the operation (airline-operational) and a customer experience representative (airline-commercial). All these stakeholders have different goals and priorities, which are often again linked to other parties concerned with topics such as safety and regulations. Moreover, almost all infrastructure is designed to foster vertical communication, as is typical in a mechanistic design (O'Reilly & Tushman, 2013).

Organisational navigation

This complicated and siloed structure results in development teams that get lost in navigating through the company, as the designer of the UM-project mentioned: 'AirCo is a huge company with a very complex department-roles structure. It is even difficult to understand for employees that have worked there for more than 10 years.' The BE-designers mentioned: 'We found the front-end designer actually too late because nobody knew him, he didn't know about my project, it was by accident that we came across him.' Due to inherent complexity, development teams also do not always align all the needed stakeholders. As a result, when the implementation phase is started, new stakeholders enter the process who may disrupt the project by imposing new boundaries.

Communication overload

Additionally, this organisational design seems to lead to a *communication overload*. The moment an innovation is presented and appears *above the surface*, a myriad of internal parties regard it as their responsibility to challenge the project. As the manager of the BS-project mentioned:

> *We tried to stay under the radar as long as we could and tried to communicate as late as possible in order to not get too many questions. By the time more people are aware, communication is key to keep everyone on the same level and enthusiastic…The need to be involved is so huge that you spend all your time and energy just keeping everyone updated and till people feel left out. That leaves you almost no time to solve the actual issue.*

Due to AirCo's complicated organisational design, many internal parties feel responsible for the same part of the operation. The time spent communicating and aligning led multiple teams to lose momentum, which resulted in a loss of enthusiasm and support. From this insight, it becomes clear that transparent responsibility for specific parts of the organisation is paramount.

An unsupportive organisational structure has been mentioned by many other authors to be a barrier to innovation implementation (Sandberg & Aarikka-Stenroos, 2014; Story, Daniels, Zolkiewski, & Dainty, 2014). This research confirms this finding and adds to this by explaining how this structure inhibits innovation. Also, organisational complexity has been studied in relation to innovation (Damanpour, 1996). Interestingly, studies do not concur on the nature of the relationship between the two variables. However, the majority of the studies relate organisational complexity positively with innovativeness (Damanpour, 1996). This research seems to indicate a negative relationship. This adds to current literature by indicating that organisational complexity may work positively for ideation and prototype development (discovery in Figure 1), but not for implementation. This finding is in line Perry-Smith and Mannuci (2017) who propose that different phases of the idea journey require different social networks.

Last, this research agrees with the finding of many previous scholars that a siloed organisation seems to inhibit innovation (Moss Kanter, 2006; Van de Ven, 1986), and specifies how this relates to implementation specifically.

A lack of interdisciplinary teams

The second often-mentioned factor that led to a *valley of death* is the lack of an interdisciplinary team in the phases before the implementation phase. This may lead to a *valley of death* by causing a loss of momentum when implementation team-members become involved. In the most extreme cases the teams even needed to go 'back to the drawing board' because unsurmountable new requirements were imposed.

The designer in the UM-project explained this problem in detail:

After the prototyping phase, there was a big need for alignment and involvement of the technical departments. These were involved late and came with lots of questions…. Making a team earlier would have helped on conducting efficient implementation from different sides. We would have balanced not only on design but also on the management and technical side.

The manager of the BS-project even mentioned the lack of technical knowledge in the development team as key challenge in the implementation phase. Both the BT and the BE designer mentioned that they needed to redesign (part of) their solution as new stakeholders got involved.

Literature on innovation often mentions the need for cross-disciplinary teams (Veryzer, 2005) and this is especially emphasized for design innovation (Beckman & Barry, 2007; Lindberg, Meinel, & Wagner, 2011). This research substantiates this and shows that a lack of such teams at the early phases of development, may lead to concepts that are difficult to implement as technical or managerial disciplines struggle to internalize what the designers developed. As a result, the project reaches a deadlock when engineers or operational personnel becomes involved who may spot new challenges. Also, the absence of interdisciplinary teams can be linked to the challenge of getting onto the 'backlog' (or prioritization list) of other departments as explained in the next section.

Dissimilar innovation priorities and portfolio management

As mentioned, most innovations require the collaboration of different departments. An interesting related finding is that a difference in innovation prioritization (due to the absence of portfolio management) between departments also makes implementation more difficult.

At AirCo, all departments are responsible for their own strategy and have the freedom to select which projects they prefer to progress. There is no widely-accepted strategy on which products or improvements AirCo will be working on in the future. Obviously, AirCo has a strategy, however this strategy focusses more on quantitative reports and financial metrics.

The result is that innovation teams often build their support on specific sponsors and that teams experience a *valley of death* if their project isn't highly prioritized by other departments that they need support or resources from.

Challenge to get onto backlog

As mentioned earlier, the lack of interdisciplinary teams and dissimilar innovation priorities result in the *valley of death* if innovation teams need resources or support from other departments. This issue is especially apparent when an innovation initiative relies on the resources of a department that acts as a *production factory*.

In AirCo, the Digital department functions as one large, coordinated *scaled-agile* factory. This means that the department maintains its own backlog, prioritization, working rhythm (or sprints) and planning events. Non-Digital native projects may thus encounter a *valley of death* as they end up at the end of the backlog when they do not match the priorities of the factory or ask for help in the middle of a 'sprint'.

The BE designer explained how their team experienced this:

In the beginning of the project, we worked fast because there were not many dependencies and the prototype could be built stand-alone… Implementation however takes so long because of the AirCo Digital release planning. The project had to fit into their plans and priorities too. This was compounded by data limitations, slow APIs and Back-ends that are not are not accessible.

To sum this up, it appears that a lack of an innovation strategy leads to teams that work at scattered projects which not only leads to few synergies, it also leads to a *valley of death* if projects of one department are dependent on other departments.

Sponsorship

Many of the interviewees also mentioned executive sponsorship as a vital element for development progress. The designer in the BE project mentioned:

[NAME] as a sponsor was definitely necessary because he gave me access to data and people. That's definitely important for implementation in big companies, you need someone to sponsor you. If you don't say their name when emailing, people don't feel oblige to help you.

Interestingly, sponsorship could also trigger a *valley of death* at the moment that executive priorities shift. The design team member of the BS-case explained this: 'Sponsorship is essential. After the last CEO left, the project lost momentum.' His business manager added: 'The project was stopped because the new CEO doesn't sponsor the project anymore and the project lost momentum after so long time.'

This insight clearly shows a paradox in sponsorship. On the one hand, sponsorship is perceived to be needed by some in order to come to the prototype stage. On the other hand, the moment a project loses its sponsor, the team may lose its access to resources and directly encounters a *valley of deat*h. What should be noted here, is that this factor seems not to be limited to the *valley of death,* a loss of sponsorship may also end the project in an earlier stage. However, it does seem that the moment a project transfers from the prototype to the implementation stage, it needs to become self-supporting and more is needed than the sponsorship of one sponsor. If this doesn't happen, the project ends.

The managers at AirCo mentioned that the extreme reliance on sponsorship is the result of a lack of shared priorities. As teams do not have a shared future vision of strategy to 'hook' their project onto, they need to rely on sponsorship. This leads to a myriad of 'pet projects' of managers that experience a *valley of death* as they need support from people and teams that report to other managers.

As with the previous factors, this finding is in agreement with what scholars have found before. The need for a specific and shared 'innovation strategy' has been recognized (Adner, 2006; Moss Kanter, 2006; Pisano, 2015). This research shows how the absence of such a strategy may lead to a *valley of death*.

Overcoming valley of death challenges through design

Adding to the insights above, the results of the interviews indicated three ways in which the practices of designers help to mitigate the *Valley of Death*. These are unpacked in the following section and compared to what has already been written regarding the benefit of using a design approach to improve innovation outcomes.

Materializing to align

According to literature, the visual approach of designers helps teams to align (Hargadon & Sutton, 1997), share insights by making them tangible (Carlgren, 2013) and to discuss ideas (Carlgren, Rauth, et al., 2016). Both the designers and the managers perceived visualization also as a tool to help cross-departmental boundaries and align between departments. The manager of the BT-project described it as follows:

For me the visualization, prototyping, making it tangible... this process is very important in bringing the train up to speed, because people feel what this can bring. Also, this makes them understand: 'this is helping me'...it brings enthusiasm.

The designer of the BE-project and the UM-project both created a video. Both of them mentioned the alignment effect of this video as voiced by the BE-project designer: 'What worked very well is that we had the movie as a boundary object...a lot of people specially at the operations departments saw the movie and it helps to create an image for them.' The UM designer provided a more concrete example:

It is not the same to explain what the project is about to a programmer, to a business analyst or to a ground service agent. You always need to tailor the story to a level of detail and interest. What always worked as an ice breaker was the movie, even if it creates a lot of questions it perfectly works to put everyone in the same page.

This study thus expands that visualization not only helps to align the team during the conception of a concept, but also helps to align team-members that join the team later and other stakeholders that are needed to implement the idea. This practice thereby also helps to mitigate the *valley of death* by smoothing the transition from a proof-of-concept to a feasible and viable solution.

User-centred

An aspect that all company managers mentioned was that designers frame projects around user needs instead of processes and numbers. As the BT-manager explained: 'Designers work more holistically. It's not number-driven but people driven…They think on an emotional and experience level, that's a different perspective.' The manager of the BS-project contrasted this with the average AirCo managers:

> *Most of the colleagues at the 6th floor [at the customer innovation department], 90% of the colleagues only go to the airport when they go to [foreign offices] or they go on holidays, they have no interaction with the real operation whatsoever.*

The manager of the BE-project explained how this user focus helped to align departments: 'This helps to focus more on the customer and the user and shift from traditional AirCo processes'.

The value of being user-centric described as 'empathy building, deep user understanding and user involvement' (Carlgren, Rauth, et al., 2016, p. 46) is usually seen in how it helps to generate new ideas by having a wider range of perspectives and by how it helps in validating concepts. This research shows that there is an additional more internal advantage to being user focussed: it aligns departments on user needs which leads to concepts that cross the *valley of* death and unite departments. This research shows that this is also a vital contribution of design, as it allows the team to communicate with other departments.

Embracing ambiguity and complexity

Two designers mentioned how design helps to tackle complex projects: 'Designers know how to cope with complex and fuzzy projects, embrace the unknown and that is a talent.' The result is that the innovation teams that are driven by design do not produce solutions to part-problems, but rather aim at providing a holistic solution. These solutions aim to take into account all desirability, viability and feasibilities issues at hand. Although this effect was not specifically coupled by the respondents, the manager and authors of this paper believe that a design approach to innovation thus leads to solutions that are easier to implement by departments as the concepts are more 'well thought through'.

Most literature that touches upon this subject is limited to mentioning that a designer culture is one in which ambiguity and complexity are embraced (Jahnke, 2013; Kolko, 2015). Liedtka (2015) however takes a more explicit approach. She argues that amongst others, a focusing illusion is reduced by design due to the introduction of a broader perspective. This research adds to this insight by suggesting that the broader perspective leads to concepts that cross the *valley of death* easier because of their multi-faceted development.

Conclusion and further perspective

This research aimed to answer two questions:

- What challenges associated with the *valley of death* are encountered during a design approach to innovation?
- How can a design approach to innovation be applied to overcome such challenges?

This research provided empirical examples of design innovation projects that encountered a *valley of death*. The *valley of death* in these projects can be linked to three main contributing factors:

1. A complicated, mechanistic and siloed organisation leads to misalignment of stakeholders and a *communication overload*.
2. A lack of interdisciplinary teams results in a situation where innovation teams lose considerable momentum at the implementation stage.
3. Dissimilar innovation priorities and a lack of portfolio management may also lead to a *valley of death* as teams struggle to get resources from other departments and lean heavily on sponsorship.

A design approach may mitigate a *valley of death* due to its practice of materialization, user-centeredness and compatibility with complex and ambiguous problems (Carlgren, Rauth, et al., 2016). These practices help to align teams and stakeholders, to reduce customer bias by being user-centred and to take the multi-faceted nature of innovation problems into account.

Further research

This paper reported on the results of the first study of an extensive action research project to be performed at different innovation departments in AirCo. Now that some of the factors that contribute to the *valley of death* have been identified, the second part of this research focusses on determining how this corporate infrastructure should be changed to facilitate implementation of design innovations within AirCo (Coghlan, 2011; Kock, 2017). To do so, the action researcher (first author) will act as Design Innovation Catalyst (Price, 2016; Wrigley, 2013, 2016) at the Customer Innovation and Operations Innovation department of AirCo.

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