Exploring the Fourth Order: Designing Organisational Infrastructure. In Research Perspectives in the Era of Transformations

Klitsie, J.B.; Price, R.A.; de Lille, C.S.H.

Publication date
2019

Document Version
Final published version

Published in
Proceedings of Acamdamy for Design Innovation Management Conference

Academy for DESIGN INNOVATION MANAGEMENT Conference 2019
LONDON, UNITED KINGDOM
19–21 JUNE 2019
Research Perspectives IN THE ERA OF Transformations

Exploring the Fourth Order: Designing Organisational Infrastructure

KLITSIE Barend[a]*; PRICE Rebecca[a] and DE LILLE Christine[ab]

[a] Delft University of Technology, The Netherlands
[b] The Hague University of Applied Sciences, The Netherlands
* corresponding author e-mail: j.b.klitsie@tudelft.nl
doi: 10.33114/adim.2019.07.227

Companies are organised to fulfil two distinctive functions: efficient and resilient exploitation of current business and parallel exploration of new possibilities. For the latter, companies require strong organisational infrastructure such as team compositions and functional structures to ensure exploration remains effective. This paper explores the potential for designing organisational infrastructure to be part of fourth order subject matter. In particular, it explores how organisational infrastructure could be designed in the context of an exploratory unit, operating in a large heritage airline. This paper leverages insights from a long-term action research project and finds that building trust and shared frames are crucial to designing infrastructure that affords the greater explorative agenda of an organisation.

Keywords: corporate infrastructure, fourth order design, action research, design process, innovation

Introduction

In recent periods, as companies aim to establish *organisationally fit* or *resilient* exploitive organisations (Martin, 2019; McGinn & Hacket, 2019), it has become increasingly attractive for organisations to create specific innovation labs (Blindenbach-Driessen & Van Den Ende, 2014). These labs perform the needed exploration of new strategic possibilities to lower the risk of disruptive innovation (O'Reilly & Tushman, 2013). Some companies' plan their explorative capacity by using the logic that they know from exploitative activities. An example is Unilever's R&D organisation, where R&D is split up in research streams that mirror the commercial organisation but are separated in a stage-gate manner. Alternatively, some organisations' experiment with other organisational designs such as corporate venturing units or cross-disciplinary teams with mixed results (Tushman, Smith, Wood, Westerman, & O'Reilly, 2010). The foreclosure of the Disney, Coca-Cola, Turner and Microsoft innovation centres over the past 3 years (Berengian, 2017), is testament to the challenges of creating organisations that afford the creativity and risk-taking associated with innovation while supporting the need for effective outcomes (Pisano, 2019).

In recent years, driven at least in part by *Design Issues* editor Richard Buchanan and catalysed by the special issue of *Design Issues* 'Design and Organisational Change', a number of (design) scholars have come to a common understanding. To:

> *Emphasize design as a professional practice that is consciously moving into the domain of organisational design and organisational change, drawing from areas of design practice that are more*

> *closely identified with design as it is commonly understood in the design community, including architecture, industrial design, information design, and interaction design. (Buchanan, 2008, p. 4)*

These scholars posit that a design approach, taken to a strategic level, may result in both a different change process and different organisational structures (Gruber, De Leon, George, & Thompson, 2015) which can be better suited to support exploratorive activities.

Despite a number of publications that mention this movement of design (Buchanan, 2015; Dunbar & Starbuck, 2006; Gruber et al., 2015), few papers explicitly display how organisations could be 'designed' or what the expected benefits might be (Buchanan, 2008, p. 8). This research leverages the insights of an 18-month action research engagement to display such a process. Additionally, we introduce the concept of organisational *infrastructure* as design material. In this paper, we thus aim to explore: (1) what are the components of organisational infrastructure, and; (2) how can we design with these components? This paper thus contributes an initial methodology, a sequence of steps and an underlying philosophy (Kettinger, Teng, & Guha, 1997).

Literature Review

Organisations

According to Puranam, Alexy and Reitzig (2014) who have accumulated heavily cited definitions of an organisation, an organisation is "a multiagent system with identifiable boundaries and system-level goals (purpose) toward which the constituent agent's efforts are expected to make a contribution" (p. 163). Underlying this definition is the assumption that organisations are formed to allow a group of individuals to achieve more than they would alone (Junginger, 2008; Puranam, 2014) and that within large organisations, sub-organisations may be identified, with separate actors and goals.

For example, the airline that was studied in this project has a clear group of members (in-house and contracted employees), boundary (activities performed by the company) and purpose (to survive as company by raising capital through the business of transporting customers and goods). Additionally, within this airline, we could identify specific sub-organisations such as the department that is responsible for ground handling (which focusses on a minimum number of delays) and the department that is responsible for the operations inside the plane which focusses on customer- and-employee satisfaction.

In line with Tushman and O'Reilly (1996) an organisation can be described by looking at four aspects: the (1) culture, (2) structure, (3) strategy and (4) the processes used to create value for end-customers (Stoimenova & De Lille, 2017). All of these four aspects can be 'designed' in a way if design is viewed as the act of making plans (Dorst, 2017). For example, many tech-companies currently focus on realizing 'an engineering culture' of which the design is materialized through the definition of a number of values. Of these four, this paper focusses on solely infrastructure, as a variation on structure, as it has received the least attention from design scholars so far.

As Buchanan (2015) states: "most of the research and applications of design have focused on attitudes, skills, methods, and techniques" (p. 5). Whereas design scholars have published on how a design approach can improve an innovation culture or mind-set (also named *design attitude*) (Kochargaonkar & Boult, 2014; Michlewski, 2008; Yee, Jefferies, & Michlewski2017), innovation processes (or *design thinking*) (Lievesley et.al (2017), and strategy for innovation (also coined as *strategic design* (Calabretta, Gemser, & Karpen, 2016). Yet how one practically goes about the design of an organisation's infrastructure remains largely under-researched (Brown, Buchanan, Doordan, & Margolin, 2008)[1,2].

[1] Exceptions are the papers in the *Design Issues* special paper from 2018: Design and Organisational Change (Boland et al., 2008; Buchanan, 2008; Junginger, 2008) and scarce other papers (Brown & Martin, 2015; Junginger, 2005) in which the design process is presented as a complimentary activity to the design of more concrete products and a conference paper (Kronqvist & Salmi, 2011) in which infrastructure is designed in conjunction with a new innovation process.

[2] Organisation Design is a related but different topic as it aims to compare the effect of organisational structures and developmental processes, for organisational designers to then implement (Dunbar & Starbuck, 2006). We specifically focus on the process of creating new designs, explicitly leveraging local context. Nevertheless, we aim to build a bridge by leveraging knowledge from the organisation design field, for example by adopting Puranam's (2014) micro-structural approach to organisations.

Organisational Infrastructure

Similar to how product designers need knowledge of materials and experience designers need to understand the components available to them, so do we search for the materials of fourth-order design. It is to this end, that we aim to introduce organisational infrastructure as design material.

Much like structure, the word 'infrastructure' has been used on many occasions in a wide variety of media and has lost much of its meaning (Prud'homme, 2004, p. 3). Infrastructure, according to the Oxford living dictionary (n.d.) and the *business* and *academic content* Cambridge dictionary (n.d), describes the systems and services that are needed to operate or work effectively. In contrast, a description of structure focusses on the arrangement of- or relations between parts of a system (Oxford living dictionary, n.d.). Infrastructure thus provides more focus and detail on the elements themselves and the interaction between the system and the user is of crucial importance[3]. If we take the budgeting systems as example, we are more interested in how the budgeting system works and what 'the rules of the game' are, than how the budgeting system relates to the HR system.

Infrastructure is the "built networks that facilitate the flow of goods, people, or ideas and allow for their exchange over space" (Larkin, 2013, p. 328). Infrastructure is often approached functionally (Torrisi, 2009): we don't design roads, bridges or tunnels, we design *a highly effective transportation system for an engaged society.* Similarly, when considering the design of organisational infrastructure (infrastructuring in participatory design[4]), we aim to conceive a means for communication, rather than the meetings structure or hierarchical design. A budgeting system, again, provides an example: it is a means for employees to receive capital for their projects – which in turn provides a means for innovation outcomes. In sum, we engage with infrastructure not because of the elements themselves, but because (when coupled with labour) they are a means to support and maintain work to be done (Agid, 2018; Prud'homme, 2004).

Designing in the fourth-order

As Gabay (2018) illustrates after an extensive literature review (as indicated in Table 1), designers have a distinctive approach to problems if compared to a typical business approach. As a result, a design process is human-centred, future-oriented and visual (De Lille, Roscam Abbing and Kleinsmann, 2012), focussed on creating new opportunities over selecting from existing alternatives and it emphasizes co-creation (Aguirre, Agudelo, & Romm, 2017) and prototyping (Carlgren, Rauth, & Elmquist, 2016).

Table 1: Contrasting business and design, adopted from Gabay (2018)

Criteria	*Business approach*	*Design approach*
Value	Exchange-value: quantitative, objective (revenue, costs, profits)	Use-value: qualitative, subjective (experience, emotions, desires)
Focus	Customers, market (age, gender, size)	Humans, culture (personality types, backgrounds, traditions)
Tools	Analytical, numerical input, (ROI, BEP, NPV, CLV), 'Planning Oriented'. Support 'yes or no' decisions	Intuitive, observation, imagination, empathy (ethnographic research, journey mapping, prototyping), 'Action Oriented'. Reveal and connect new information
Attitude towards uncertainty & failure	Uncertainty: Fight (reduce, eliminate or control) Failure: avoid or eliminate	Uncertainty: Embrace (explore, experiment) Failure: accept

[3] Additionally, Prud'homme (2004, p. 4) and Star (1999) provide a number of specific qualities of infrastructure such as embeddedness.

[4] The verb *Infrastructuring* has also received increasing attention within participatory design literature (Hillgren, Seravalli, & Emilson, 2011). Although these authors' do refer to some similar qualities such as a long-term focus and embeddedness, our conceptualization is organisation-based.

Logic	Deductive, inductive	Abductive
Activities	Exploitive	Explorative
Work Processes	Linear, clean, short	Iterative (circular), messy, long
Thinking	Convergent	Divergent, convergent
Bias	Reliability (inability to include new relevant information)	Validity (no consistency in processes and measurements)

As designers' have been tasked with increasingly complex and wicked problems (Muratovski, 2015), scholars have realized the suitability of the approach due to how it reframes problems and solutions (Dorst, 2017) and its human-centeredness (Norman & Stappers, 2015). However, designers will also need to develop new methods to use their skills in this new context (Björgvinsson, Ehn, & Hillgren, 2012; Norman & Stappers, 2015).

In *Wicked Problems in Design Thinking*, Buchanan (1992) distinguishes between four (4) areas in "which design is explored throughout the world by professional designers and by many others who may not regard themselves as designers" (p.9). These areas (as visualized in figure 1), have no hierarchy and may be seen as working domains in practice (Golsby-Smith, 1996). In recent years, a number of authors have suggested that an increasing number of designers act on the *Systems, Organisations and Environments* level (Boland, Collopy, Lyytinen, & Yoo, 2008; Cooper & Junginger, 2009; Gruber, De Leon, George, & Thompson, 2015; Kronqvist & Salmi, 2011; Muratovski, 2015). In this level, organisations are seen as products which can be designed (Buchanan, 2008). Designing at this level focusses on systemic integration and the performed activities, which may be spurred by design on other levels, are geared towards finding a new 'organizing thought' and the resulting organisational changes (Buchanan, 1998, 2001; Junginger, 2005).

According to Golsby-Smith (1996), fourth order designers need to deal with three unique features in their approach: purpose, integration and systems (or community). First, the fourth order designer needs to understand and influence the *field* which revolves around processes and tasks, consisting of system level values and a purpose. Second, design in this order seeks integration with connected systems and activities. Third and last, is a focus on people or communities, in which discussion is not only fostered but the direction and facilitation of the conversation is key.

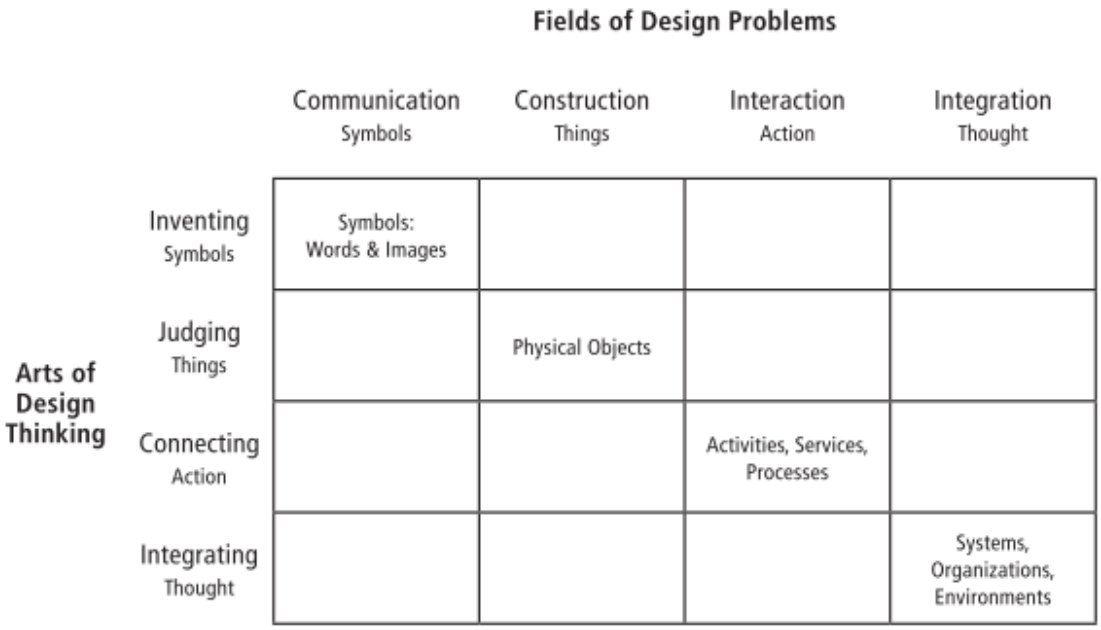

Figure 1: Four orders of design (Buchanan, 2015)

Research Design & Methodology

To explore what organisational infrastructure consists of and how it can be designed, an action research approach was applied (Reason & Bradbury, 2008). This approach fits the explorative nature of the study and the importance of the contextual (social) embedding of the phenomenon to be studied (Coghlan, 2011). The overall research design is similar to that used by a 'Design Innovation Catalysts' as described in detail by Price (2016). Crucially, a long-term engagement was set-up between the first author, a designer by education, and a large airline (from hereon: FlyCo). Over an eighteen (18) month period, the researcher conducted three individual *Action Research Cycles* (Lewin, 1946).

This paper reports on the insights gained in the third and final cycle, where the action researcher was asked to act as manager of an innovation team and use his knowledge and experience of design to come up with a new organisational infrastructure. During this cycle, the first author became 'an insider' (Brannick & Coghlan, 2007; Ottosson & Björk, 2004) and spent four days of every week as line manager of a small team, responsible for creating and prototyping operational innovation. The researcher joined meetings with directors and executive vice presidents, but also spent a significant amount of time with project level and operational employees. He thereby gained access to a vast amount of internal data sources, including strategic documents and was able to record rich insights into the dynamics of the organisation (Brannick & Coghlan, 2007).

Qualitative Data Generation and Collection

During this period, the design researcher author carried a digital diary in which he took field notes of observations from one-on-one meetings and group participatory observations. This primary mode of data collection is used to gather:

> *In-depth descriptive details of people (including oneself), places, things, and events, as well as reflections on data, patterns, and the process of research. These details form the context and quality control that shape multiple qualitative data points into articulated, meaningful, and integrated research findings.* (Brodsky, 2008, p. 324)

The observations were captured in plain text, drawings, schemes, pictures and film. The author thus aimed to record not only observable facts, but also his own experience of the process of designing infrastructure and theory building (Herr & Anderson, 2005). The observations were captured on a password protected digital device and standard company in-house measures could be followed to ensure data security. Additionally, semi-structured interviews with fellow managers were done to canvas the organisational infrastructure and how innovation was realized (Sarpong & Maclean, 2012). Finally, a second researcher interviewed (and performed a focus group with) the team-members regarding their experiences as innovators within the company and as participants in the infrastructure design process.

A number of measures were taken to increase validity and reliability of the research design, which focused in this case on minimizing reactivity, 'going native' and alignment (Langley & Klag, 2017). To improve construct validity, both data and methodological triangulation were performed (Blandford, 2013). Additionally, by member checking our findings with the participants of the study, possible interpretations were evaluated from multiple perspectives to increase rigor (Baxter & Jack, 2008). Finally, to avoid a distorting subjectivity effect, on the fifth day of the week a 'critical friend' (in this case colleague) was used to discuss findings and conclusions (Herr & Anderson, 2005).

Foci: Components of Organisational Infrastructure

To be able to collect data in the field regarding organisational infrastructure and in line with this papers' aim to contribute to a practical understanding, the concept of organisational infrastructure is further broken down into a limited set of observable components. As this research explored the concept of organisational infrastructure as design material, the specific materializations of the components were not completely predetermined by literature. Rather, throughout the first two cycles of this action research project, the four (4) tasks of organisation (Puranam et. al, 2014) and the qualities of infrastructure (Prud'homme, 2004; Star, 1999) were used as guidelines to identify organisational infrastructure components at the studied company. Table 2 provides an overview of the identified components of organisational infrastructure.

Table 2: Identified components of organisational infrastructure – building on Puranam et al. 2014.

Component title	Example questions
The division of tasks	
Team composition	What different functions work together in a team or on daily basis?
Team responsibilities	What is a team held responsible for? What do they need to complete?
Hierarchical structure	Who reports to whom? Who evaluates whom?
Location	Where do people work on a daily basis? How do people communicate?
The allocation of tasks	
Project selection criteria	How are projects selected? Which projects are prioritized and why?
Formal roles	What are official internal titles, what terms are used in job vacancies?
The provision of rewards	
Budget systems	How are budgets allocated? When and through which systems do teams request budget?
Team Key Performance Indicators (KPI's)	How are teams evaluated? On which aspects or by which measurements?
Professional development paths	How and on what basis are employees promoted or (financially) rewarded?
The provision of information	
Hierarchical structure	(see above)
Meeting structure	Who is invited to which meeting? When do these take place?

Qualitative Data Analysis

As this paper focusses specifically on the infrastructure design process, only data from evens that were explicitly related to this process were included in the analysis. An overview of which data was in- and excluded for the analysis for this paper can be found in the appendix. In total 26 pages of field notes from one-on-one meetings, 29 pages of field notes from group activities (such as meetings) and 40 reflective notes were analysed. Together, this adds up to just under 100 *temporal observations* of the design process (Langley, Smallman, Tsoukas, & Van De Ven, 2013). Additionally, seven (7) one-hour interviews were included in the data-set.

A qualitative data analysis process was performed over a two-step process as proposed by Braun and Clarke (2006). First, the authors spend an extensive amount of time to get familiar with the data on a high, process level. This was done by mapping key events of the process and the related insights of these moments as prescribed by Poole, Van de Ven and Holmes (2000) (and exhibited in Figure 2). Secondly, a thematic analysis was performed, which involved searching for themes in the data based on reoccurring patterns and testing these themes on the entire data set.

Figure 2: Data familiarization through process mapping

Findings

A key characteristic of action research is an element of change which is introduced by the researcher. As a result, and as exemplified by Lüscher and Lewis (2008), action research is often reported in a narrative form where events and reflection are combined (Reason & Bradbury, 2008). In this manner, the following sections describe how organisational infrastructure was designed.

The Context and Design Challenge

As a traditional, network carrier, FlyCo faces constant competitive pressure from low-cost airlines. Specifically, FlyCo is challenged to continually improve its operational performance, both in quality (i.e. avoiding delays and cancellations) and in quantity (i.e. optimizing the amount of flights per aircraft per day). To this end, an innovation team was established. This team (team Y) uses (co-creative) design and lean start-up methodologies to find and quickly prototype new operational tactics to be implemented in live operation. Table 3, at the end of the end of the findings section displays the organisational infrastructure of the team before the redesign process.

At its initiation, Y focused on realizing results quickly, by utilizing a lean governance structure, close ties with top management and by holding to a credo of 'learning by doing'. The team and especially their managing director noticed over time that an increasing number of innovations that were prototyped weren't further developed and implemented whilst there was no apparent reason or decision to kill development. After initial prototyping, these projects would end in *the Valley of Death* (Markham, Ward, Aiman-Smith, & Kingon, 2010). As the director would later recount: "…the former manager of the team, he would use his network and willpower to get stuff done. He would just keep nagging at every table until it was realized. That doesn't work anymore" (field note, 17/08). The *Valley of Death* was becoming an increasingly important problem, one field-note of another meeting with this director shows "We need to make bottom-line impact. Otherwise, others will do it" (field note, 24/04). Crucially, the lack of implemented innovation started to influence the credibility of the team (field note, 20/05 & 29/5).

Additionally, an increasing number of departments within FlyCo became interested in the way of working that team Y developed and wanted to apply those same methodologies. However, articulating, translating and transmitting a way of working required new capabilities and the team found it challenging to organise this activity within their current infrastructure (field note, 04/06).

After a personnel change, the managing director was left searching for a (temporary) manager. After inquiry by the author into replacement, the director asked him to consider the job (field note, 16/05). The author would be tasked with determining a strategy for Y to go "into a new S-Curve" and together with the team and the director, design a suitable organisational infrastructure.

Process overview

Over period of six months, a number of sessions were organized by the first-author to support the infrastructure design process, as exhibited by figure 3. These sessions were structured and presented as a co-creative design innovation process. By this framing, the author hoped to invoke the same open-minded, creative and critical mind-set that the team was known for and thought themselves to be (internal communication, 09/09). Additionally, by doing this, the author explicitly framed the process of infrastructure design as similar to the process of product innovation design. These sessions were preceded by a number of meetings in which the assignment was presented by the managing director and the challenges were further elaborated by the parting manager of the team. After the strategic sessions, three one-on-one meetings were held between the author and the manager to finalize the design. Finally, the results were presented to the team.

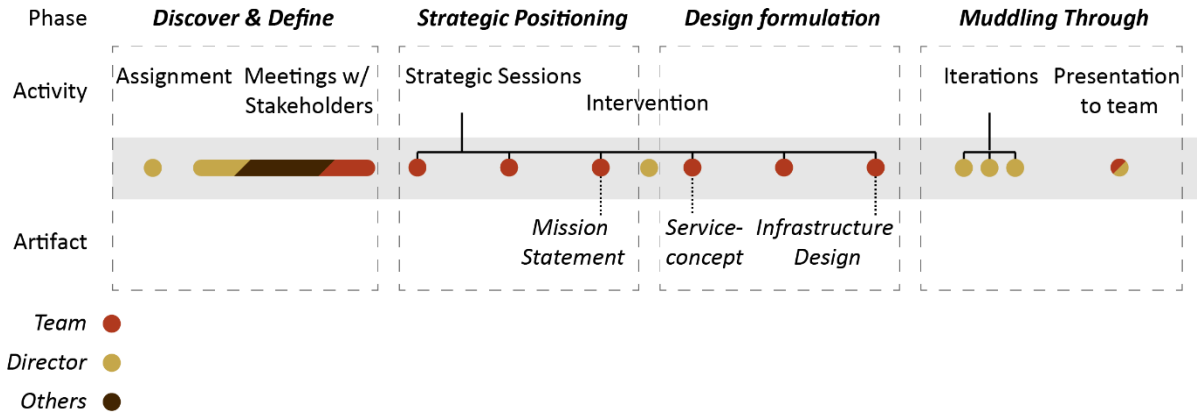

Figure 3: Infrastructure design process

Four phases of the design process

The design process can be divided into four phases which differ in the type of activities that were performed, and the stakeholders involved. The first phase included the analysis of the status quo and the problems to be solved by the new infrastructure. Following this, a higher abstraction level was assumed in which a new strategic direction was created for the team. This direction was embodied in the formulation of a new mission statement. After this phase, this strategy was gradually given body by defining the *service concepts* needed to attain the strategy and constructing the necessary infrastructure. Finally, this plan or infrastructure design, was presented to the managing director. At this point, a final process of iteration and negotiation began as a final design emerged. In the next paragraphs, each of these four phases will be examined in more detail.

1) Discover and Define

Initially, the author met with the departing manager, former and current employees of the team and again with the director. During these unstructured interviews the challenge to be tackled was explored. Through open-ended questions, starting from the current challenges of the team, asking about the historic development of the organisation and collectively looking forward towards possible solutions, the author aimed to uncover both explicit and implicit dynamics (Sanders & Stappers, 2012). Additionally, the author participated in regular team meetings and observed during meetings and informal discussions. This allowed the author to see the described organisational dynamics and uncover additional information that may have seemed irrelevant for the interviewees.

Over this period, the challenge to be solved was explicated from different angles. Some indicated team culture as an important factor: "scaling-up prototypes is just not in the mind-set of the team" (field notes, 07/05).

Others pointed towards “unclear targets” which “weren’t defined” (07/05) or according to some “didn’t focus on implementation… If they would, the process would change” (field note, 15/05). Still others mentioned that work pressure interfered with actions to ensure implementation (15/05). Finally, additional challenges surfaced during this period, such as internal team struggles (field note, 16/05). In sum, the design brief expanded considerably over this period as the context became clear. This process may be best compared to what in design process descriptions are often called the *Discover* and *Define* phases (Liedtka, 2015).

Two observations during this period are particularly recurring and thus worth noting. First, there seemed to be many different ‘frames’ (Dorst, 2017) through which to look at the Y team and their challenge (within and outside of the team). According to some, Y was a team that had unique research capabilities and therefore could educate the business on their needs. It was referred to as the team that came up with the concepts that people didn’t know they wanted, or the team that co-created solutions with employees. As described by Dorst (2017), these different frames influenced the perceptions of the challenges to be solved and the ‘criteria’ with which the new design would be judged.

A second observation was a disrupted bond between the members of the Y team and the director, due to a decreased level of (field note, 12/06). This also appeared to be related to a figurative ‘distance’ between the Y team and the rest of the department (field note, 25/05). This situation complicated the entry of the author into the team (as he was hired by the director) but also complicated the process in general, as for example, team members weren’t forthcoming about their concerns and viewpoint on the problem to be tackled (field note, 12/06).

2) Strategic Positioning

After the author spent his first months on the job, the director posed a question to the entire team: “Do you accept my assignment? Will you design a strategy and think of an organisation which shows how to design innovations…takes these innovations from concept to implementation and… brings your way of working to the rest of the organisation?” (field note, 19/06). This was the trigger for the first-author to organize a series of strategic sessions in which the team co-created a new strategy and organisation.

In total, six (6) sessions were organized by the author, of which three (3) focused on crafting a strategy and three (3) on designing the organisational infrastructure. Participants in these sessions were the PO’s, the author and an employee from the larger department who represented an outside view. During these sessions (which lasted on average 3 hours), (silent) brainstorms were held and a constructive and critical discussion was fostered to come to agreed-upon statements.

In the first session the author presented his findings of the first months as context. These were presented in the form of statements. For each statement, the team debated on whether they agreed and/or whether changes were needed. These statements generally focussed on the merits and dangers of designing a strategy in general and what would make a good strategy. Statements included were for example: “without a clear strategy, we will have prioritization issues” or “a strategy will help us to communicate better with Business Owners” (internal correspondence, 26/6). The team also initiated a brainstorm on what would be the downsides of determining a strategy, and thus what the strategy should not result in. These included statements such as: “a strategy might result in tunnel-vision.” (field note, 18/07). Finally, the team felt the need to determine what ‘a strategy’ would include. A decision was made to adopt a strategy design tool which defines four linked elements:

1. Where are we now?
2. What is our vision of this team and department?
3. What projects will get us there?
4. What are our guiding principles in getting there?

The second meeting focused on getting ‘on the same page’ (internal communication, 19/07). Beside exploring the strategies that were made in previous sessions and exploring the current business context, the author touched upon a number of examples from other companies. Also, the team agreed upon a number of major themes to focus the strategic efforts on: (1) mindset, (2) tools, (3) methodology and (4) organisation.

The third and final meeting focused on defining a new vision and mission for the team. Out of a silent brainstorm, a clustering exercise and a thorough discussion, the team came up with a statement which described why the team existed and what it intended to achieve.

With the formulation of this statement, the team effectively decided on which frame to pursue during the next phase. This was important as team members mentioned earlier that they found it challenging to think about and propose decisions regarding their own infrastructure due to the uncertainty of their situation and the complexity of the problems they were facing (field notes 24/07). Without a specific frame to pursue, decisions regarding infrastructure seemed impossible to make (reflective journal, 26/07).

3) Infrastructure Design Formulation

The last three strategic sessions had the aim of translating the new mission to more concrete infrastructure. This phase was initiated with a one-on-one meeting with the director, in which he indicated an expectation to implement a piece of infrastructure. This element had been discussed in earlier sessions and seemed to compliment with the new mission. Following this intervention and a session in which the team defined a *service-concept*[5]*,* two (2) sessions were organized in which the concept was translated into elements of the organisational infrastructure.

This discussion was facilitated with the use of a template adopted from Van Assen (2019). Eventually, three 'products' were defined. In the final two sessions, an organisational infrastructure that would facilitate the 'production' of these products was proposed. Again, this infrastructure was eventually 'coloured-in' by answering a number of questions collectively and coming to a final answer through discussion. Questions that were likened those presented in table 2 (internal correspondence, 06/08).

A noteworthy observation is that in the *service-concept* session, fierce debates erupted in which team members realized that their frames on the team (and implicitly on the problem to be solved) did not match. Even though the team members had agreed on a mission statement, a chasm appeared between two groups of team members. Eventually, the author had to make a decision. When this was done, the rest of the infrastructure elements, such as team roles, responsibilities, resourcing and KPI's fell into place[6]. As one of the team-members mentioned: "It's weird…we are just talking from our toes, really from the inside…we're just writing down stuff that we already know implicitly" (Memo, 24/08). Finally, what is interesting to note about these sessions, is that the team uncovered that to be able to implement their solution, they needed to include the infrastructure design of another team into the scope. This conclusion essentially broadened the scope of the both the problem and solution space. This co-development of problem and solutions is typical for a design process.

4) Muddling Through

In the final phase of the infrastructure design process, the author presented the work that was done and the results to the director. The new mission statement, service-concept and infrastructure was presented with the aid of visualizations which acted as prototypes. Subsequently, the author and director performed another round of iterations to make the design fit with the progressed insight of the managing director and other developments that were taking place in the department (field notes 13/09). Finally, the new design was presented back to the team. At the time of writing, a selection of elements of the design have been implemented. Within the context of fourth order design, this final phase should be considered an integral part of the process. Currently, the managing director and newly appointed manager are muddling through: opportunistically and incrementally implementing elements of the design (Norman & Stappers, 2015).

In this final phase, the previously mentioned trust issue re-occurred. This especially surfaced when the final design was presented to the team. First, they mentioned that they missed the connection between what they had felt owner of through co-creation and what was presented back to them (field notes 05/10). Second, the team indicated that they found it challenging to work with and towards a design that wasn't completely detailed yet, as long as they couldn't trust that their vision was aligned with that of the director (field note, 22/10).

Another resurfacing issue was that the author and director appeared to have different frames. This became especially apparent in a discussion on team composition. Whereas the director preferred a composition which was more fit for the development of solutions (exploitation), the author proposed a team that would be

[5] To define a 'service concept', is to decide if the team were a miniature company, what would it offer, what would it need and how would it organize itself?

[6] According to Dorst (2017), this is common on design processes. Once a working frame has been identified, solution elements are easily identified.

equipped for research and ideation (exploration) (20/09). This was eventually resolved by adopting a new frame, in which teams develop over time to perform both functions subsequently (internal communication).

The Infrastructure Design

Table 3 illustrates the previous organisational infrastructure of team Y as well as the new infrastructure that resulted from the design process (infrastructure that was altered is bolded for emphasis). This table indicates the nature of the changes that were applied as well as the scale of the changes. As can be seen, the new design differs on many aspects from the original design.

Table 3: New Organisational Infrastructure of Y Teams – changes in **bold.**

Component title	*Infrastructure of Y teams*	
	The division of tasks	
Team composition	• Full-time former operational staff • Part-time operational staff (gate-agents, baggage staff, etc) • Access to an internal team of software developers	• Full-time former operational staff • **Full-time analytical staff** • Part-time operational staff **when needed** • Staffed with **in-team software developers when needed** Full-time former operational
Team responsibilities	• Analyse operations to define bottlenecks • Design & Prototype concepts to prove feasibility, viability and desirability • Spreading way of working to other departments	• Analyse operations to define bottlenecks • Design & Prototype concepts to prove feasibility, viability and desirability • **Support a new team which spreads way of working** • **Develop and implement solutions** • **Evaluate operational impact**
Hierarchical structure	• Reporting to a director, who reports to the COO in the operational organisation (as opposed to the support or sales organisation) • In a department with high-tech product teams that develop software tools for the optimization of the operation • Not formally connected to other innovation teams	• **Reporting to a product manager,** who reports to the director • In a department with high-tech product teams that develop software tools for the optimization of the operation • Not formally connected to other innovation teams • **Supported by a *capability lead***
Location	• At the airport, close to *the action*, far from other teams in the department	• **Co-located with other development teams** • **With a lab at the airport, close to '*the action*'**
	The allocation of tasks	
Formal roles	• Product Owners[7] (PO's), expected to set, manage and perform activities needed to develop concepts and	• **Challenge** Owners, expected to set, manage and perform activities needed to **tackle 1 challenge** and related stakeholder

[7] Adopted from the 'agile' methodology but adapted to a context of prototyping.

	stakeholder management. Also responsible for daily management of the builders • Builders, operational staff that design features and prototypes and perform tests.	management. Also responsible for daily management of the builders **in their team** • Builders, operational staff that design features and prototypes and perform tests
Project selection criteria	• Yearly objectives are set for the team in agreement with business owners[8] • Manager of team gathers challenges related to objectives from business owners • Team selects projects based on a number of factors[9] • Product Owners take-up challenges whenever they have time left with no distinction for the business in which the challenge lies	• Yearly objectives are set for the team in agreement with business owners • **Challenge owners** gather challenges related to objectives from business owners • **Challenge owner** selects projects **related to their challenge** based on a number of factors[10]
	The provision of rewards	
Budget systems	• Yearly budget set for staff and costs of prototyping • Separate budget 'envelope' to finance software support, based on high-level plans for half a year	• Yearly budget set for staff and costs of prototyping
Professional development paths	• Unclear	• Unclear
Team KPI's	• Number of prototypes tested at scale & implemented in the organisation • Number of departments that are engaged	• **Amount of progress made on objectives set by business**
	The provision of information	
Hierarchical structure	• (see division of tasks)	• (see division of tasks)
Formal meeting structure	• Bi-weekly update with small portion of operational innovation staff • Weekly team meetings with PO's and team manager • Bi-weekly update with other PO's from the department • Team manager meets weekly with management team of department	• Bi-weekly update with small portion of operational innovation staff • Weekly team meetings with **C**O's and team manager • **Product manager** meets weekly with management team of department

[8] This was as it was presented and designed, the data shows however that objectives were only set once at the start of the team and the team added objectives along the way.

[9] The expected operational impact, technology, priority as indicated by business owners and *wow*-factor.

[10] A new set of criteria was developed, including expected operational impact and cross-departmental engagement.

• (Bi)-monthly update meetings with business owners	• **Challenge owners meet regularly with business owners**

Conclusion & Practical Implications

This paper introduced the concept of organisational infrastructure and explored its potential as part of a widened view of fourth order subject matter. Four interlinked elements of organisational infrastructure are presented based on literature and observations. Also, we describe a methodology which uses these elements and includes four stages, consisting of interviews, co-creative sessions and a final 'muddling through' phase.

Even though this project has assumed a design process which likens to that of lower order design projects, some fourth-order elements are clearly distinguishable. First, throughout the process, the facilitated search for team and department *purpose* is recognizable as proposals for mission statements and infrastructure designs brought to light differences in what the purpose of the team should be. Second, there is a recognizable attempt to reach integration, which culminated in the 'muddling through' sessions, but which is also recognizable in the fact that the scope of the project was enlarged with another department. In this case, the search for integration also allowed for an organisational design to emerge which explicitly recognizes and facilitates an ambidextrous operation.

Two notes of caution for the application of the presented approach to organisational infrastructure design should be mentioned. First, it is important to have established a bond of trust between those that are part of the organisation that is being redesigned and the designer. Overcoming ambiguity and uncertainty, which are typical elements of design processes, is challenging when the object to be designed is the infrastructure of an organisation. In this context, we do not design a tool to work with, *but what to work on, how to work and who to work with*. This personal level of involvement seems to magnify moments of uncertainty and a lack of trust in either the process or the designer thus introduces considerable challenges. Involvement of all stakeholders on a more regular basis, the authors' feel, may mitigate this challenge.

A second implication from the discussion of the results is the perceived effect of not explicitly agreeing on a reframed problem statement. During the described process, the author, director and team did not openly agree on *what problem* the infrastructure design should solve and thus which frame to operate from. As a result, conflicting frames re-appeared a number of times, confusing and frustrating stakeholders when viable solutions to problems were ignored or undervalued because of diverging frames.

This research also indicated towards two (2) possible benefits of designing organisational infrastructure. First, similar to Junginger's findings (2005), the co-creative approach to organisational infrastructure design resulted in engaged employees who felt ownership of change. With this sense of ownership came an openness from employees to quickly adopt the designed change. Second, the explorative and iterative approach allowed for the problem and solution to co-evolve. By allowing this, a more holistic and coherent design could be developed. However, despite the noteworthiness of these observations, future research is needed to establish these more firmly.

Finally, this paper presented the results of an ongoing analysis and as such includes only a sample of the available data. Future research will involve further qualitative data analysis of all three action research cycles and write-up regarding the journey of FlyCo as a company undergoing transformation via design. Further research will be performed to explore, amongst others, the interplay between the Y team and the rest of the organisation as a result of these organisational changes.

References

Agid, S. (2018). 'Dismantle, change, build': Designing abolition at the intersections of local, large-scale, and imagined infrastructures. *Design Studies*, *59*, 95–116.

Aguirre, M., Agudelo, N., & Romm, J. (2017). Design Facilitation as Emerging Practice: Analyzing How Designers Support Multi-stakeholder Co-creation. *She Ji: The Journal of Design, Economics, and Innovation*, *3*(3), 198–209.

Baxter, P., & Jack, S. (2008). The Qualitative Report Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers. *The Qualitative Report*, *13*(4), 544–559.

Berengian, A. (2017). It's time to ditch your innovation lab. Retrieved January 2, 2019, from https://venturebeat.com/2017/03/22/its-time-to-ditch-your-innovation-lab/

Björgvinsson, E., Ehn, P., & Hillgren, P.-A. (2012). Design Things and Design Thinking: Contemporary Participatory Design Challenges. *Design Issues*, *28*(3), 101–116.

Blandford, A. (2013). Semi-Structured Qualitative Studies. In M. Soegaard & R. F. Dam (Eds.), *The Encyclopedia of Human-Computer Interaction* (2nd ed.). Aarhus, Denmark: The Interaction Design Foundation. Retrieved from http://www.interaction-design.org/encyclopedia/semi-structured_qualitative_studies.html

Blindenbach-Driessen, F., & Van Den Ende, J. (2014). The Locus of Innovation: The Effect of a Separate Innovation Unit on Exploration, Exploitation, and Ambidexterity in Manufacturing and Service Firms*. *Journal of Product Innovation Management*, *31*(5), 1089–1105.

Boland, R. J., Collopy, F., Lyytinen, K., & Yoo, Y. (2008). Managing as Designing: Lessons for Organisation Leaders from the Design Practice of Frank O. Gehry. *Design Issues*, *24*(1), 10–25.

Brannick, T., & Coghlan, D. (2007). In Defense of Being Native: The Case for Insider Academic Research. *Organisational Research Methods*, *10*(59), 59–74.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.

Brodsky, A. (2008). Field notes. In L. Given (Ed.), *The SAGE Encyclopaedia of Qualitative Research Methods*. Thousand Oaks, CA: SAGE Publications Inc.

Brown, B., Buchanan, R., Doordan, D., & Margolin, V. (2008). How do designers shape the world around us? *Design Issues*, *24*(1), 1.

Brown, T., & Martin, R. L. (2015). Design for Action. *Harvard Business Review*, *93*(3), 57–64.

Buchanan, R. (1992). Wicked Problems in Design Thinking. *Design Issues*, *8*(2), 5–21.

Buchanan, R. (1998). Branzi's Dilemma: Design in Contemporary Culture. *Design Issues*, *14*(1), 3–20.

Buchanan, R. (2001). Design Research and the New Learning. *Design Issues*, *17*(4), 3–23.

Buchanan, R. (2008). Introduction: Design and Organisational Change. *Design Issues*, *24*(1), 2–9.

Buchanan, R. (2015). Worlds in the Making: Design, Management, and the Reform of Organisational Culture. *She Ji: The Journal of Design, Economics, and Innovation*, *1*(1), 5–21.

Calabretta, G., Gemser, G., & Karpen, I. (2016). *Strategic design. Eight essential practices every designer must master*. Amsterdam, Netherlands: Bis Publishers.

Carlgren, L., Rauth, I., & Elmquist, M. (2016). Framing Design Thinking: The Concept in Idea and Enactment. *Creativity and Innovation Management*, *25*(1), 38–57.

Coghlan, D. (2011). Action Research: Exploring Perspectives on a Philosophy of Practical Knowing. *The Academy of Management Annals*, *5*(1), 53–87.

Cooper, R., & Junginger, S. (2009). The Evolution of Design Management. *Design Management Journal*, *4*(1), 4–6.

De Lille, C. S. H., Roscam Abbing, E., & Kleinsmann, M. S. (2012). A Designerly approach to enable organisations to deliver Product-Service Systems. In *Leading Innovation through Design : Proceedings of the DMI 2012 International Research Conference*. Boston, MA: Design Management Institute.

Dorst, K. (2015). Frame Creation and Design in the Expanded Field. *She Ji: The Journal of Design, Economics, and Innovation*, *1*, 22–33.

Dorst, K. (2017). *Notes on Design, How Creative Practice Works*. Amsterdam, Netherlands: Bis Publishers.

Dunbar, R. L. M., & Starbuck, W. H. (2006). Learning to Design Organisations and Learning from Designing Them. *Organisation Science*, *17*(2), 171–178.

Gabay, R. (2018). Breaking the Wall Between Business and Design—Becoming a Hedgefox. *Design Management Journal*, *13*(1), 30–39.

Golsby-Smith, T. (1996). Fourth Order Design: A Practical Perspective. *Design Issues*, *12*(1), 5–25.

Gruber, M., De Leon, N., George, G., & Thompson, P. (2015). Managing by Design: From the Editors. *Academy of Management Journal*, *58*(1), 1–7.

Herr, K., & Anderson, G. L. (2005). *The Action Research Dissertation A Guide for Students and Faculty*. Thousand Oaks: Sage Publications, Inc.

Hillgren, P. A., Seravalli, A., & Emilson, A. (2011). Prototyping and infrastructuring in design for social innovation. *CoDesign*, *7*(3–4), 169–183.

Infrastructure. (n.d.) In Oxford Living Dictionary. Retrieved from https://en.oxforddictionaries.com/definition/infrastructure

Infrastructure. (n.d.). In Cambridge Business English Dictionary. Retrieved from https://dictionary.cambridge.org/dictionary/english/infrastructure#dataset-cbed

Infrastructure. (n.d.). In Cambridge Academic Content Dictionary. Retrieved from https://dictionary.cambridge.org/dictionary/english/infrastructure#dataset-cbed

Jochimsen, R. (Ed.). (1966). *Theorie der Infrastruktur: Grundlagen der marktwirtschaflichen Entwicklung*. Tübingen: J.C.B. Mohr.

Joore, P., & Brezet, H. (2015). A Multilevel Design Model: the mutual relationship between product-service system development and societal change processes. *Journal of Cleaner Production*, *97*, 92–105.

Junginger, S. (2005). *A Different Role for Human-Centered Design in the Organisation*. In *Proceedings of 6th European Academy of Design Conference: Design System Evolution.* Bremen, Germany.

Junginger, S. (2008). Product Development as a Vehicle for Organisational Change. *Design Issues*, *24*(1), 26–35.

Kettinger, W. J., Teng, J. T. C., & Guha, S. (1997). Business Process Change: A Study of Methodologies, Techniques, and Tools. *MIS Quarterly*, *21*(1), 55–80

Kochargaonkar, A., & Boult, J. (2014). Designing an Innovation Culture Within an Enterpreneurial Environment. *Design Management Review*, *25*(3), 10–16.

Kronqvist, J., & Salmi, A. (2011). Co-Designing (with) Organisations - Human-Centeredness, Participation and Embodiment in Organisational Development. In *Proceedings of the 2011 Conference on Designing Pleasurable Products and Interfaces*. Milano, Italy: ACM.

Langley, A., & Klag, M. (2017). Being Where? Navigating the Involvement Paradox in Qualitative Research Accounts. *Organisational Research Methods*, *4*, 1–24.

Langley, A., Smallman, C., Tsoukas, H., & Van De Ven, A. H. (2013). Process Studies of Change in Organisation and Management: Unveiling Temporality, Activity, and Flow. *Academy of Management Journal*, *56*(1), 1–13.

Larkin, B. (2013). The Politics and Poetics of Infrastructure. *Annual Review of Anthropology*, *42*, 327–343.

Lewin, K. (1946). Action Research and Minority Problems. *Journal of Social Issues*, *2*(4), 34–46.

Liedtka, J. (2015). Perspective: Linking Design Thinking with Innovation Outcomes through Cognitive Bias Reduction. *Journal of Product Innovation*, *32*(6), 925–938.

Lievesley, M., O'Leary, D., Whitehead, C., Hewitt, I., McPherson, N., & Annal, C. (2017). How Industrial Design Supports a Customer-Centric Innovation Approach in a Technology-Centric Business Environment. *Design Management Journal*, *12*(1), 15–27.

Lüscher, L. S., & Lewis, M. W. (2008). Organisational Change and Managerial Sensemaking: Working through Paradox. *Academy of Management Journal*, *51*(2), 221–240.

Markham, S. K., Ward, S. J., Aiman-Smith, L., & Kingon, A. I. (2010). The Valley of Death as Context for Role Theory in Product Innovation. *Journal of Product Innovation Management*, *27*, 402–417.

Martin, R. L. (2019). The High Price of Efficiency. *Harvard Business Review*, *96*(1), 42–55.

McGinn, D., & Hacket, J. (2019). The costs of complexity are hard to see. *Harvard Business Review*, *96*(1), 56–59.

Michlewski, K. (2008). Uncovering Design Attitude: Inside the Culture of Designers. *Organisation Studies*, *29*(3), 373–392.

Muratovski, G. (2015). Paradigm Shift: Report on the New Role of Design in Business and Society. *She Ji: The Journal of Design, Economics, and Innovation*, *1*(2), 118–139.

Norman, D. A., & Stappers, P. J. (2015). DesignX: Complex Sociotechnical Systems. *She Ji: The Journal of Design, Economics, and Innovation*, *1*(2), 83–106.

Ottosson, S., & Björk, E. (2004). Research on dynamic systems—some considerations. *Technovation*, *24*, 863–869.

O'Reilly, C. A., & Tushman, M. L. (2013). Organisational Ambidexterity: Past, Present and Future. *The Academy of Management Perspectives*, *27*(4), 324–338.

Pisano, G. P. (2019). The Hard Truth About Innovative Cultures. *Harvard Business Review*, *96*(1), 62–71.

Poole, M. S., Van de Ven, A. H., & Holmes, M. E. (2000). *Organisational change and innovation processes: Theory and methods for research*. New York, NY: Oxford University Press.

Price, R. A. (2016). *Implementing Design-Led Innovation in an Australian Airport Corporation. (Doctorate Thesis)*. Brisbane, Australia: Queensland University of Technology.

Price, R. A., Wrigley, C., & Matthews, J. (2018). Action researcher to design innovation catalyst: Building design capability from within. *Journal of Action Research, 66* (1).

Prud'homme, R. (2004). Infrastructure and development. In *Annual Bank Conference on Development Economics*. Washington, DC: World Bank.

Puranam, P. (2014). An introduction to the micro-structural approach. In *The Microstructure of organisations*. Oxford, UK: Oxford University Press.

Puranam, P., Alexy, O., & Reitzig, M. (2014). Whats new about new forms of organizing. *Academy of Management Review*, *39*(2), 162–180.

Reason, P., & Bradbury, H. (Eds.). (2008). *SAGE Handbook of Action Research* (2nd ed.). London, UK: Sage Publications Ltd.

Sanders, E. B. N., & Stappers, P. J. (2012). *Convivial toolbox: Generative research for the front end of design*. Amsterdam, Netherlands: Bis Publishers.

Sarpong, D., & Maclean, M. (2012). Mobilising differential visions for new product innovation. *Technovation*, *32*, 694–702.

Star, S. L. (1999). The Ethnography of Infrastructure. *American Behavioral Scientist*, *43*(3), 377–391.

Stoimenova, N., & De Lille, C. (2017). Building Design-led Ambidexterity in Big Companies. In E. Bohemia, C. de Bont, & L. S. Holm (Eds.), *Conference proceedings of the Design Management Academy: Research Perspectives on Creative Intersections* (pp. 1043–1060). Hong Kong: Design Research Society.

Torrisi, G. (2009). Public infrastructure: definition, classification and measurement issues. *Economics, Management, and Financial Markets*, *4*(3), 100–124.

Tushman, M. L., & O'Reilly, C. A. (1996). Ambidextrous Organisations: Managing Evolutionary and Revolutionary Change. *California Management Review*, *38*(4), 8–30.

Tushman, M. L., Smith, W. K., Wood, R. C., Westerman, G., & O'Reilly, C. A. (2010). Organisational Designs and Innovation Streams. *Industrial and Corporate Change*, *19*(5), 1331–1366.

Van Assen, M. (2019). Optimalisatie via de D-P-PBOI. Retrieved January 26, 2019, from https://www.vanassen.info/opx/d-ppboi/

Yee, J., Jefferies, E., & Michlewski, K. (2017). *Transformations: 7 Roles to Drive Change by Design*. Amsterdam, Netherlands: BIS Publishers.

Appendix:

Table 4: Overview of selection of data for data analysis

Included	**Excluded**
Field notes	
- Only third research cycle - Meetings and strategic sessions with director - Y team meetings surrounding major strategic events - Introduction meetings with former team manager and related business owners - Strategic sessions with Y - Trainings sessions with larger department (on implementing innovations)	- First and second research cycles - Introduction with management of other departments/units - One-on-one meetings on daily business - Leadership coaching meetings - Y team meetings in general
Interviews	
- Y team members and managing directors on organisational infrastructure	- Y team members and other FlyCo employees on general processes and innovation management
Reflective Memo's	
- All audio and visual reflective memos from the third research cycle	- All audio and visual reflective memos from earlier research cycles
Archival data	
- Working document strategic sessions - Presentation to director on organisational infrastructure - Mails, presentations and memo's related to major events in ARC 3	- Archival data, such as documents and presentations from earlier research cycles - Mails & memo's unrelated to organisational infrastructure or the assignment