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# **Assessment of Application of Participatory Methods for Complex Adaptive Systems in the Public Sector**

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**ASSESSMENT OF APPLICATION OF PARTICIPATORY  
METHODS FOR COMPLEX ADAPTIVE SYSTEMS  
IN THE PUBLIC SECTOR**

by

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## Preface

There is a poem by John Godfrey Saxe that goes like this:

*“It was six men of Indostan  
To learning much inclined,  
Who went to see the Elephant  
(Though all of them were blind),  
That each by observation  
Might satisfy his mind.”*

It continues with them examining different parts of the elephants and making their own conclusions: a man who touched a side of the elephant believed that an elephant is like a wall, another man who felt a tusk thought that an elephant is like a spear, another one reached for a knee and concluded that an elephant is like a tree and so on. After all men finished examining the elephant, the poem goes:

*“And so these men of Indostan  
Disputed loud and long,  
Each in his own opinion  
Exceeding stiff and strong,  
Though each was partly in the right,  
And all were in the wrong!”*

Nowadays, we are surrounded as well by elephants like this and these elephants are different systems around us. These systems have many different aspects and different men and women know only parts of these systems and they all are partly right. But unlike the men from the poem, there is a way to combine this knowledge to know better about systems. And if there were one lesson in this work, I wish it were this understanding that the complexity of the systems around us can be observed and changed by having different men and women working together.



## Abstract

The provision of services by the public sector is the result of a complex adaptive system at work, and involves a large number of stakeholders from different institutions and organisations. In the era of rapid change in requirements and expectations from the public sector, the management of change processes asks for the involvement of many stakeholders from different layers and positions.

Participatory methods provide the ability to involve a wide range of stakeholders, but despite their case-wise documented successes, and well described application in involving citizens in governmental decision-making, very little evidence exists of their role when engaging professionals.

This study assesses the application of participatory methods as an approach to support change processes in the public sector from a complex adaptive system perspective. The purpose of this two-phase exploratory sequential mixed method study with descriptive parts is to first qualitatively explore which needs for change in the public sector could benefit from participatory methods, and then to apply participatory methods for six experiments to assess how effective such methods are to support change processes of complex adaptive systems in the public sector.

Four methods have been included: participatory simulation, gamification, Q methodology and participatory model building. Each of the cases has been scored on a set of frameworks. The cases have been obtained from the fields of road networks, transit and healthcare.

Analysis across the experiment found several trends. Firstly, experiments at the field-level, where expertise and knowledge outside one organisation are required, showed stronger democratisation and focus on mapping out diversity compared to other levels. Similarly, experiments at the sub-system level are more likely to be focused on reaching consensus and using participants for advising. Secondly, a pattern has been found between higher participatory level of a method, a higher degree of power-sharing between the participants, and better results of an assessment. A correlation was observed between overall assessment and other parameters of applications: communication efficiency, knowledge between causes and effects, and direction from leadership.

The recognition that the public sector is a complex adaptive system proved to be more present in the service-oriented fields than in the infrastructure fields. Larger-scale issues at the organisation-level or even field-level proved to be more complex than issues at the subsystem level.

Participatory methods proved to be effective for providing a grip on issues of a complex nature. Particular strengths were the ability to provide for open structures for thinking outside the box, and the use for identification of bottlenecks and constraints in systems. The ability to identify differences in stakeholder perspectives proves valuable, and can be gathered from a wide range of sources in and around a participatory setting.

However, successful participatory methods need high communication efficiency, use retroactive evaluation and need to be done based on high stakeholder collaboration. These costs can outweigh all benefits if the problem is not complex or preparation has not been appropriately performed. Access to the right people, support from the organisation and motivated participants, as well as the right choice for the level of participation proved crucial for its success.

**Keywords:** participatory methods, complex adaptive system, public sector, change process, assessment

# Sammanfattning

Offentliga sektorns tillhandahållande av tjänster är resultatet av ett komplext adaptivt system och involverar ett stort antal intressenter från olika institutioner och organisationer. I en tid av snabba förändringar av kraven och förväntningar från offentliga sektorn förändras behövs förändringsprocesser som involverar intressenter från olika nivåer och positioner.

Participativa metoder ger möjlighet att involvera ett brett spektrum av intressenter. Även om participativa metoder visat sig framgångsrika i enstaka fall, och tillämpningar när det gäller att involvera medborgarna i myndighetsbeslut är väl beskrivna, så finns mycket litet bevis på metodens roll när det gäller yrkesverksamma.

Denna studie undersöker tillämpningen av participativa metoder för stödja förändringsprocesser i den offentliga sektorn ur ett komplext adaptivt systemperspektiv. Syftet med denna tvåstegs explorativa sekventiella blandade metodstudie med deskriptiva delar är att först kvalitativt undersöka vilka förändringsbehov i den offentliga sektorn som kan dra nytta av participativa metoder och sedan att tillämpa participativa metoder i sex experiment för att bedöma hur effektiva sådana metoder är i att stödja förändringsprocesser av komplexa adaptiva system inom den offentliga sektorn.

Fyra metoder har innefattats: participativ simulering, gamification, Q-metodik och participativ modellbyggnad. Vart och ett av fallen har poängsatts utifrån ett ramverk. Fallen har hämtats från områdena vägnät, transit och hälsovård.

Analys av experimenten påvisar flera trender. För det första visade experiment på fältnivå, där expertis och kunskap utanför en organisation krävs, en starkare demokratisering och fokus på att kartlägga mångfalden jämfört med andra nivåer. På samma sätt visar experiment på delsystemnivå mer sannolikt att fokus ligger på att nå konsensus och använda deltagare för rådgivning. För det andra har ett mönster påvisats mellan högre deltagande nivå av en metod, högre grad av fördelning mellan deltagarna och bättre resultat av en bedömning. En korrelation observerades mellan övergripande bedömning och andra applikationsparametrar: kommunikationseffektivitet, kunskap om orsaker och effekter och ledarskapsdirektiv.

Erkännandet av att den offentliga sektorn är ett komplext adaptivt system visade sig vara mer närvarande i de serviceorienterade områdena än inom infrastrukturen. Storskaliga problem på organisationsnivå eller till och med på fältnivå visade sig vara mer komplexa än problem på delsystemnivå.

Participativa metoder visade sig vara effektiva för att handlägga frågor av komplex natur. Särskilda styrkor var förmågan att tillhandahålla öppna strukturer för att tänka utanför lådan och att identifiera flaskhalsar och begränsningar i system. Möjligheten att identifiera skillnader i intressentperspektiv visar sig vara värdefull och kan samlas från ett brett spektrum av källor i och kring en deltagarmiljö.

Framgångsrika participativa metoder kräver hög kommunikationseffektivitet, användandet av retroaktiv utvärdering och måste baseras på samarbete med intressenter på hög nivå. Kostnader kan överskugga alla fördelar om problemet inte är komplext nog eller om förberedelserna inte har utförts på lämpligt sätt. Tillgång till rätt personer, stöd från organisationen och motiverade deltagare, liksom det rätta valet för nivån på deltagande visade sig vara avgörande för framgång.

**Nyckelord:** participativa metoder, komplext adaptivt system, offentlig sektor, förändringsprocess, bedömning

# List of Publications

## Paper I

Kornevs, Maksims, Jannicke Baalsrud Hauge, and Sebastiaan Meijer. 2019. "Gaming Simulation Validation: Matching Participants' Worldviews with Their Decisions." In *Neo-Simulation and Gaming Toward Active Learning*. Springer International Publishing.

Contributions: Kornevs is the corresponding author. Kornevs designed and conducted experiments, analysed the results and wrote the main part of the paper.

## Paper II

Kornevs, Maksims, Jannicke Baalsrud Hauge, and Sebastiaan Meijer. 2019. "Gamifying Project Procurement to Incorporate Better Goals of Organizations in the Public Sector." Submitted Manuscript.

Contributions: Kornevs is the corresponding author. Kornevs designed and conducted experiments, analysed the results and wrote the main part of the paper.

## Paper III

Shreenath, Vinutha Magal, Maksims Kornevs, Jayanth Raghothama, and Sebastiaan Meijer. 2015. "A Feasibility Study for Gamification in Transport Maintenance: Requirements to Implement Gamification in Heterogeneous Organizations." In *2015 7th International Conference on Games and Virtual Worlds for Serious Applications (VS-Games)*, 1–7.

Contributions: Shreenath is the corresponding author. Kornevs contributed to the design of a feasibility study, contributed to data collection, analysed the role of the procurement process and wrote the main part of the text related to the procurement. Kornevs revised the full paper.

## Paper IV

Kornevs, Maksims, Jannicke Baalsrud Hauge, and Sebastiaan Meijer. 2018. "Perceptions of Stakeholders in Project Procurement for Road Construction." *Cogent Business & Management* 5 (1): 1–16.

Contributions: Kornevs is the corresponding author. Kornevs designed and conducted experiments, analysed the results and wrote the main part of the paper.

## **Paper V:**

Moustaid, Elhabib, Maksims Kornevs, Fredrik Lindencrona, and Sebastiaan Meijer. 2019. “A System of Systems of Mental Health in Cities, Digging Deep into the Origins of Complexity.” Submitted Manuscript.

Contributions: Moustaid is the corresponding author. Kornevs contributed to the design of experiments, contributed to data collection and analysis. Kornevs revised the full paper.

## **Other Publications**

*Kornevs also contributed to the following papers that have not been included in this thesis:*

Kornevs, Maksims, Nicole Kringos, and Sebastiaan Meijer. 2014. “A Research Agenda for Green Procurement of Infrastructures.” In 2014 International ICE Conference on Engineering, Technology and Innovation (ICE), 1–7.

Kornevs, Maksims, Nicole Kringos, and Sebastiaan Meijer. 2016. “Developing a System Dynamics Model from Perceptions.” In 32nd Annual Q Conference, 1–9.

Kornevs, Maksims, Nicole Kringos, and Sebastiaan Meijer. 2016. “Perspectives of Stakeholders on Road Procurements: In Search of Procurement Aspects Using Q Methodology.” In CESUN 2016 Conference, 1–8.

Kornevs, Maksims, Nicole Kringos, and Sebastiaan Meijer. 2016. “Using Q Methodology Data for Modelling and Simulation: The Case Study of Developing SD Model for Road Procurement in Sweden.” In The 35th International Conference of the System Dynamics Society, 1–7.

Kornevs, Maksims, Jannicke Baalsrud Hauge, and Sebastiaan Meijer. 2018. “Grip on Slippery Road Procurement: A participatory simulation approach on a Swedish use case.” In CESUN 2018 Conference, 1–7.

Kornevs, Maksims, Jannicke Baalsrud Hauge, and Sebastiaan Meijer. 2019. “Gamification of a Procurement Process for Professional Training of Public Servants.” Submitted Manuscript.

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# Chapter 1

## Introduction

Many services that we use daily, like healthcare, infrastructures, public transport, education and others are provided by the public sector. The public sector is a part of the economy that is controlled by the government (Kai 2014). However, the public sector does not offer all services solely alone, but regularly in it in collaboration with other companies both in the public and private sectors (Provan and Milward 2001; Cuganesan, Hart, and Steele 2017).

Such collaboration creates a network of companies or stakeholders that affect how well public organisations can perform their functions (Sullivan and Skelcher 2017). This network is complex because of distributed control, information asymmetry and contradicting goals between the stakeholders (Haynes 2015; Fossetstøl et al. 2015). At the same time, the public sector is adaptive because it mostly copes with the dynamic interactions within the system. These interactions can be caused by changes due to new laws or regulations, new companies entering the market, internal changes in current stakeholders or other reasons (Sullivan and Skelcher 2017). It requires for the public sector to be flexible and adaptable to the changing environment. Often, the need for this adaptivity can be seen in strategic plans and visions of organisations (Bryson, Crosby, and Stone 2015). It can be observed in many public organisations that they aim for excellent performance, innovation, sustainability and other long-term improvements to be able to perform their work well (Bouckaert, Peters, and Verhoest 2010). It also affects the procedures and processes that organisations are using, for example, management or procurement processes.

The complexity and adaptivity are characteristics of a complex adaptive system (CAS), meaning that the public sector service solutions can be considered as complex adaptive systems. In a CAS, the system and the stakeholders cannot be separated, and the system as a whole is more than just a sum of the individual components (Dooley 1997). Complex adaptive systems have many unordered elements where connections between causes and effects are unclear. It makes it hard to analyse CAS, and it is even harder when the organisation is undergoing some changes. Introducing change processes to the public sector

requires a proper analysis and assessment because of complex and adaptive needs, contributions and the inter-connections of all stakeholders.

There are different methods to analyse change processes in complex adaptive systems. These methods include, but are not limited to, dividing CAS into smaller sub-systems, simplification, modelling and simulation and use of some mixed methods (Carayon et al. 2015; Dekker 2016; Morowitz 2018). However, a majority of these methods do not include or only partially include aspects of complexity and adaptivity, which often are the most challenging for public organisations (Rusojä et al. 2018; Bizikova et al. 2018). A particular set of methods that have proved to be effective in analysing CAS is participatory methods (Kornevs, Kringos, and Meijer 2014).

Participatory methods are interactive methods that provide an opportunity for stakeholders to share their knowledge, values and preferences for different goals (Asselt et al. 2001). Participatory methods try to increase interaction and collaboration between stakeholders, employees or members of the community and to give everyone the power to make decisions and affect changes (Driskell 2001). A number of authors agree that there is a need to address issues in the public sector with ‘a stronger citizen-oriented, participatory flavour’ (Pollitt 2007, 20; Eppel and Rhodes 2018). Such ideas include, but are not limited to, the new public management approach, public-private partnerships, etc. (Pollitt and Bouckaert 2017; Roness 2017). A push for a participatory flavour can be seen in many public projects such as Horizon 2020, UN sustainable development goals and others.

Multiple implementations of participatory methods to address issues in public organisations can be found in the literature. This scope of applications includes but is not limited to training, negotiation, cultural change, participatory design and other tasks across all fields of the public sector (Helden and Uddin 2016; Warner 2016; Kankanhalli, Zuiderwijk, and Tayi 2017; Torfing, Sørensen, and Røiseland 2016; Godenhjelm and Johanson 2018; Baek and Kim 2018; Figueira et al. 2018; Rieger et al. 2018). Although most of the cases published on applying participatory methods in the public sector include an assessment of outcomes, there are only a few works on how to assess results of cases or to compare them. Chapter 2 presents theoretical frameworks that are used to assess or compare different cases of application of participatory methods; however, no frameworks were found that are dealing with complex adaptive systems for the public sector. As a result, a lack of mechanisms to

compare cases of application of participatory methods for complex adaptive systems in the public sector makes it currently impossible to transfer the experience from these cases to other fields.

### **1.1 Research Objective**

This study assesses the application of participatory methods as an approach to support change processes in the public sector from a complex adaptive system perspective. The purpose of this two-phase exploratory sequential mixed-methods study with descriptive parts is first to explore qualitatively which needs for change in the public sector could benefit from participatory methods, and then to apply participatory methods for six experiments to assess how effective such methods are in supporting the change processes of complex adaptive systems in the public sector. The first phase of the study of needs for change in the public sector is based on a methodological triangulation of a literature review related to issues in the public sector and open interviews with experts. Based on the findings from the literature review and interviews, six experiments are designed to assess suitability of application of different participatory methods when applied in three selected fields of the public sector.

### **1.2 Limitations**

This work uses experiments from different fields of the public sector, but due to the difficulty in accessing stakeholders and the time constraints of the PhD project, the scope has been limited to six experiments conducted in the following three different fields: road networks, transit and healthcare. These experiments and fields were chosen because stakeholders in these fields recognised some of the issues from the complex adaptive system perspective and were willing to engage in this research.

Also, since this work is based on participatory methods, the findings are highly related to participants and might have an observer effect. Thus, the results can be very different in different fields and experiments, although the author tried to be unbiased in the analysis and interpretation of the experiments through an objectivation method and scoring system.

All participants engaged in this research voluntarily. Participants were selected based on their expertise level in the field without consideration of their age, gender, religion or any other prohibited bases of discrimination.

### **1.3 Structure of the Thesis**

This thesis is structured as follows. Chapter 2 presents a theoretical framework about the classification of participatory methods. The next chapter describes the methodology used in this work for the assessment of the application of participatory methods for complex adaptive systems in the public sector. The results and findings are presented in Chapter 4, and a discussion, future work and final conclusions follow in Chapter 5.

## **Chapter 2**

# **Theoretical Framework**

Participatory methods are a wide group of methods that work with participants to achieve their goals and objectives. The methods vary in their objectives; their topics can have a different level of knowledge, maturity, complexity and controversies. Some methods allow anyone to be participants, while other methods require only experts in the fields to be participants. Sometimes participants are randomly selected and sometimes specific people are assigned. The participatory methods also differ in the amount of time and other resources they request for each application (Janice Elliott et al. 2006).

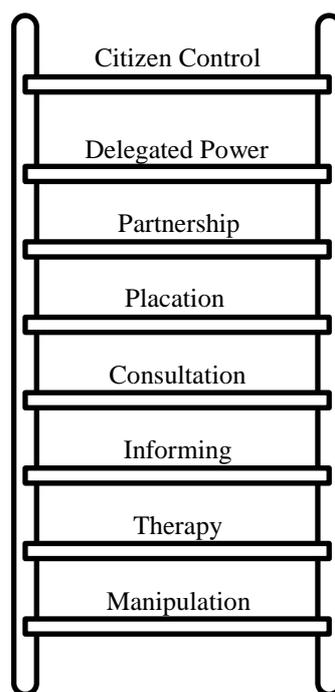
This variety in participatory methods makes it harder for them to fit a specific framework. Nevertheless, there is some work that aims for classification of participatory methods, detailed in the following sections. One of the most popular classifications of participatory methods is known as a ladder of participation and it investigates the degree of power and control that participants have during the application of participatory methods. Another work categorises participatory methods based on their goals and objectives. The third framework presented in this work analyses methods to understand if they are more programmatic or participatory. This chapter ends with two modes of scientific research on participatory methods that help properly assess the outcomes of these methods.

### **2.1 Ladder of Participation**

Participatory methods have a different level of involvement of participants in the process. This can be from ‘formal’ participation, where participants are just informed about decisions, or the decisions and ideas of participants are ignored. On the other hand, participatory methods can give participants full authority and power to make and execute all decisions. Sherry Arnstein (1969), in her work, describes ‘ladder of participation’, which presents eight types of participation as seen in Figure 2.1.

Manipulation and therapy do not intend participants to actually participate, but rather they enable leaders and the top authority to influence participants by, for example, training or behaviour-changing programmes. Informing, consultation and placation aim to present information to participants and also collect their opinions; however, these opinions will not

necessarily be considered by the people in charge. The partnership allows negotiation between participants and leaders. Delegated power and citizen control give most of the power to make decisions to participants.



*Figure 2.1. Ladder of participation, based on Arnstein (1969)*

While this topology is able to show different levels of participation, it has a number of limitations. Some of the limits Arnstein addressed herself, such as an oversimplification of participants and power holders as homogeneous groups, which often is not the reality and it can affect how levels of participation are perceived. Some other limitations include domination during participatory work in groups (Chambers 1994), inequality in local knowledge between minority classes (Mosse 2001), and wrong incentives to participate or to perform participatory methods (Mubita, Libati, and Mulonda 2017).

Other aspects relevant to this work limitation is that participatory methods cannot be used in the same way for the general public and for organisations (Cornwall and Pratt 2011). Structures in organisations are often centralised and bureaucratic, and organisations are dealing with complicated and technical procedures that need to be performed by experts

rather than general participants. Thus, when a participatory method is applied in an organisation, there is a need to evaluate the hierarchy and climate in the organisations to have useful outcomes.

## 2.2 The Categorisation of Goals of Participatory Methods

Participatory methods are used to achieve different objectives and different methods are designed to achieve these objectives. Therefore, van Asselt *et al.* (2001) suggest a categorisation of participatory methods based on their goals. They have selected the four following categories for goals:

*mapping out diversity* – the goal of a participatory method is to uncover different opinions and knowledge;

*reaching consensus* – the goal of a participatory method is to reach and define a single decision;

*democratisation* – the goal of a participatory method is to provide freedom for participants to use their knowledge, wishes and ideas to create something new;

*advising* – the goal of a participatory method is to use the knowledge and expertise of participants to consult on a specific process for supporting pre-made decisions.

Mapping out diversity and reaching consensus can be seen as opposite poles of the targeted outcome, while democratisation and advising are opposites in terms of aspiration. Hence, all of them create a plot as seen in Figure 2.2.

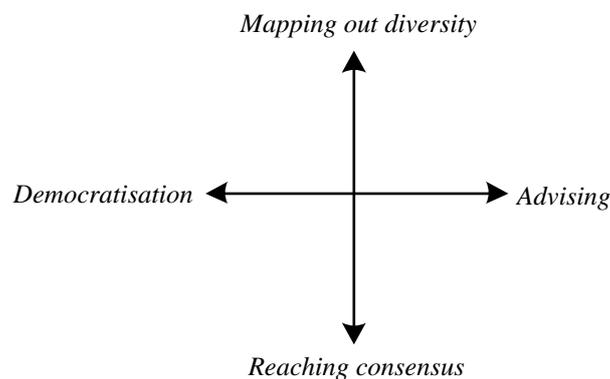


Figure 2.2. The categorisation of goals of participatory methods, based on Marjolein B.A. van Asselt *et al.* (2001)

This categorisation helps to compare cases of application of participatory methods and to see a correlation between these cases and their characteristics such as the chosen method or field of application.

### **2.3 Participatory Method Framework**

Another author (Russ 2010) classifies participatory methods between two frameworks: programmatic and participatory. The programmatic framework uses a top-down approach to stimulate or manipulate people to adopt a positive attitude towards changes, while the participatory framework suggests an open dialogue between stakeholders. Russ suggests six parameters to distinguish between the two frameworks:

*implementation flexibility* – programmatic methods use pre-made instructions for change implementation, while participatory methods allow more freedom for participants to decide how change should be implemented;

*direction from leadership* – programmatic methods provide instructions and descriptions from the organisation's leaders, but participatory methods lack concrete directions from leadership and allow more organic change;

*stakeholder collaboration* – programmatic methods do not require any inputs from stakeholders, and participatory methods use multiple stakeholders for input knowledge and information;

*organisational climate* – programmatic methods are based on a strong top-bottom hierarchy, while participatory methods build consensus and involve all people in a process;

*communication efficiency* – programmatic methods allow making decisions without much time and resource investment, but participatory methods require time and resources for gathering information and opinions and performing an analysis of the results;

*evaluation of 'successful' change* – programmatic methods have specific metrics for success evaluation, and participatory methods can perceive the level of success only in retrospect.

These parameters help to determine the participatory level of an application of a method. Parameters and the final outcome are a scale rather than a binary answer and they can help to identify bottlenecks in the requirements, plans and execution of the participatory methods.

## 2.4 Modes of Scientific Research of Participatory Methods

The results of participatory methods and their assessment depend on the purpose of each individual application. However, there are two fundamental modes to study a method: analytical science and design science research (Klabbers 2009). The first mode is used to evaluate participatory methods from an analytical science perspective. This mode assumes that a participatory method is an experiment with an established relationship between the inputs and outputs. The second mode is based on design science. It looks at participatory methods as a platform where participants together envision and design new solutions for the change process. Schematically, both modes can be seen in Figure 2.3.

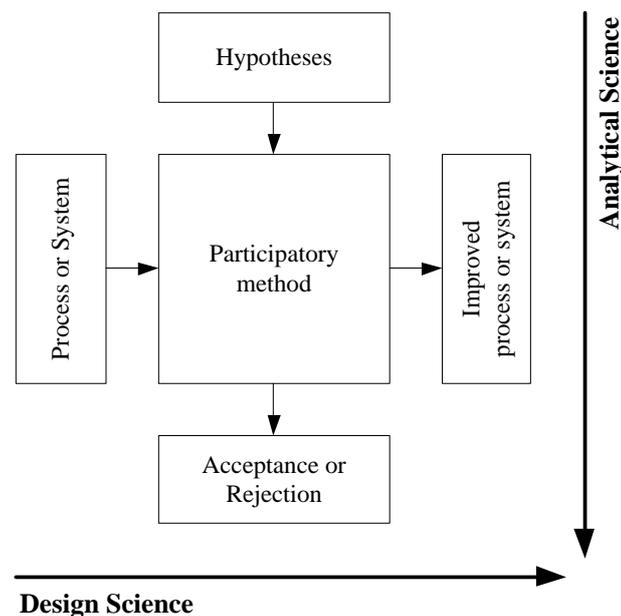


Figure 2.3. Modes of scientific research of participatory methods, based on Hoogen (2018)

Analytical science and design science use different parameters for assessment (Venable, Pries-Heje, and Baskerville 2012; Sonnenberg and Brocke 2012; Bharti Mittu and Chauhan 2015). Analytical science is assessed based on validity and reliability, while design science is assessed based on usability and credibility.

There are similarities between these terms, but there are also differences. Both validity and usability refer to a perception that the processes in the participatory methods are a good representation of the reality (Robinson 2008). However, validity is performed from the modeller perspective and usability from the participant or client perspective. This means that some processes can be an accurate representation of the reality and be valid but at the same time these processes can be too complicated and hard to use participatory methods and therefore having no usability. On the other hand, the process can have low validity but still be very useful for an application of a participatory method and hence have high usability.

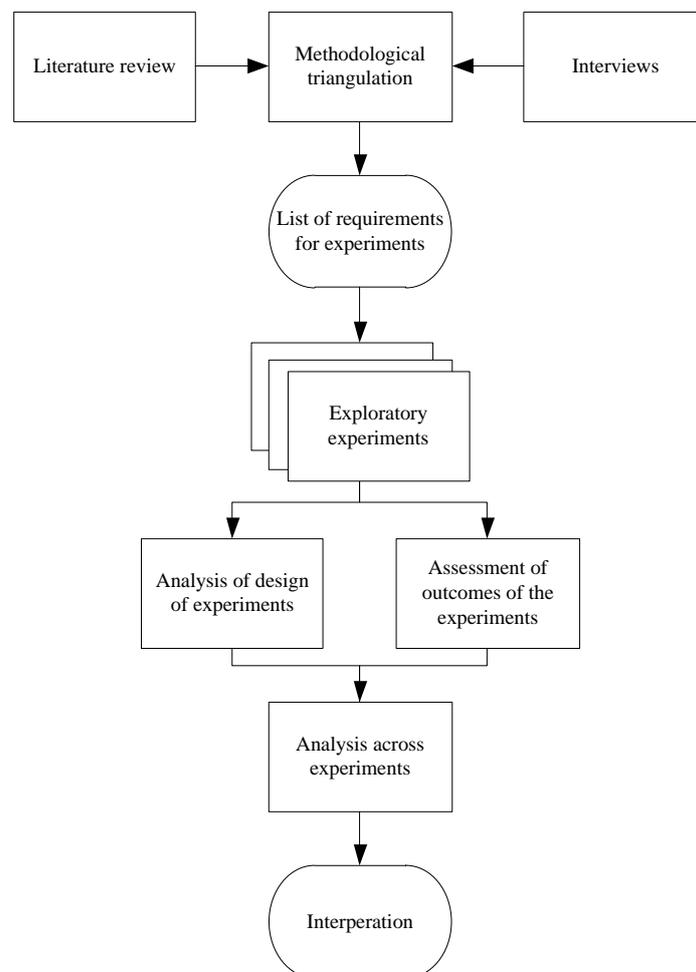
Reliability and credibility look at the quality of the results (Robinson 2008; Lankveld et al. 2017). But similar to validity and usability, reliability is performed from the modeller perspective and credibility from the participant or client perspective. Some participatory methods can produce results that can be repeated and give the same results, but the participants will disagree with them; and sometimes participatory methods will end up with results that are impossible to repeat, but still these results will be credible for the participants.

Analytical science (with validity and reliability) deals more with linear ordered systems, while design science works (with usability and credibility) better with complex adaptive systems (Hoogen 2018).

In conclusion, a combination of these four frameworks gives more insights into the performance of the application of participatory methods for complex adaptive systems in the public sector. These frameworks allow assessment of the application of methods from the level of participation, from the goals of the methods, from a participatory method framework and from the proper mode of scientific research of participatory methods.

## Chapter 3 Methodology

This chapter describes the methodology used in this work. It starts with a triangulation of the results from the literature review and interviews to identify needs for change in the public sector. A result of this step is a list of requirements for exploratory experiments where participatory methods would be used. After the list is specified, the set of experiments are performed and analysed based on the decisions about design, and assessed based on the outcomes of each of the experiments. The findings from this analysis are used to investigate patterns across all experiments.



*Figure 3.1. An overview of the methodology of the thesis*

### **3.1 Identification of Needs for Change in the Public Sector**

A triangulated approach was used to identify needs for change processes in the public sector. The triangulation was based on the results from the literature review and interviews. Details of the results of the literature review are presented in section 4.1.

A literature review helped to identify issues with the change processes in different fields of the public sector. A review was performed in the Scopus and Google Scholar databases with a query containing ‘public sector’ and ‘fields’ or ‘groups’ or ‘sectors’ or ‘domains’ and ‘change process’ or ‘issues’ or ‘problems’ or ‘management’ in the title, abstract or keywords.

The second part of the identification of needs for change in the public sector was interviews with experts from the selected fields of the public sector. Interviews were conversational with no predetermined questions, and the conversations were built around these three topics:

- the public sector from a complex adaptive system perspective;
- issues and challenges with change processes in the public sector; and
- experience of applying participatory methods to address these issues and challenges.

Eleven experts were interviewed. All experts were part of strategic groups in their organisations. The interviewees were from three fields of the public sector: road networks, healthcare and transit. These fields were selected based on the practical feasibility of access to experts, as well as sufficient complexity in the fields. When all interviews were completed, they were analysed based on their themes and common topics.

### **3.2 Experiment Planning and Analysis**

Six experiments were conducted to assess how well the application of participatory methods supports change processes in the public sector. Each experiment was based on a real-world problem that was addressed with a participatory method. The experiments were chosen based on the identified needs for change in the public sector. The participatory method for each experiment was chosen to address a problem in the best way. Although each experiment had a number of results from the application of the methods, this work did not

focus on all individual findings from all the experiments, but rather it looked at assessment of the application of these methods.

Each experiment was individually analysed based on the theoretical framework, and for each experiment the level of participation, goal categorisation, participatory framework degree and assessment based on usability and credibility were determined.

### *Participatory methods*

There are many different participatory methods. However, only four different methods are used in this work.

*Participatory simulation* is described in Papers I and II. A participatory simulation is an approach that combines modelling and simulation with real participants. Such a combination provides an environment for learning about the system, generating new solutions, and testing policies.

*Gamification* incorporates game mechanics into real life situation to improve the behaviour of participants and usefulness of systems. It is achieved through playful designs, rewards, points and badges. Gamification method for public organisations is described in Paper III.

*Q methodology* is described in Paper IV and it is a methodology for investigating subjectivity that participants have regarding a specific topic. This methodology allows an in-depth study of cases, which is typically lacking in conventional survey methods. It uses a person-orientated approach instead of variable-based, meaning that attributes are analysed in a context of different perspectives rather than as standalone variables. This secures that all viewpoints (even the most extremes ones) are included, and Q methodology maps out diversity of opinions on the topic.

*Participatory model building* is an approach that includes relevant stakeholders in a model building process. Participants decide what variables should be in the model, and how these variables are connected. Such method provides a better understanding of the system from different perspectives. Steps of the participatory model building are described in Paper V.

### *Level of participation*

The level of participation was determined using Arnstein's ladder of participation, as seen in Figure 2.1. It was determined using feedback and comments from participants and representatives from the host organisation and calculated based on a checklist, as seen in Appendix A.

### *Categorisation of goals*

Goals were defined during the problem identification and experiment design steps by representatives from the host organisation. While the framework of the categorisation of goals, as seen in Figure 2.2, provides four goals, it is true that a method can have goals that would be somewhere between the ends of each of the axes. Due to this reason, the targeted outcome of the method (the vertical axis 'mapping out diversity – reaching consensus') and aspiration (the horizontal axis 'democratisation – advising') were evaluated based on the checklist in Appendix A.

### *Participatory method framework*

Programmatic and participatory frameworks are evaluated based on the set of criteria by Russ (2010), as mentioned in the previous chapter. However, the original list of six criteria has been modified for this work by dividing the criterion '*stakeholder collaboration*' into internal and external stakeholders, and adding three extra criteria:

*priority of action and thoughts* – in a programmatic framework, action gets priority over thoughts, while in a participatory framework thoughts, beliefs and ideas are important;

*the focus of the experiment* – in a programmatic framework the main focus of the experiment is its results, while participatory methods are more interested in the experiment's processes;

*cause and effect connection* – in a programmatic framework the connection between the causes and effects in the system is known, but in participatory framework systems this connection is usually missing, does not exist, or can be perceived only in retrospect.

The evaluation was done during the problem identification and method design based on the checklist found in Appendix A.

### *Assessment of application of participatory methods*

Since the general purpose of all applications of participatory methods in this work is system or process improvement, rather than hypotheses testing, the mode of scientific research is more suitable for this work, as seen in Figure 2.3. Design science is assessed based on usability and credibility (Klabbers 2009). Usability describes aspects related to the process of applying participatory methods. However, in this work, the usability was focusing on the flexibility of participatory methods and their capacity to support the change process. Credibility showed the degree to which the results of participatory methods could be trusted and used for the further change process.

Usability and credibility were assessed by investigating the elements of a participatory simulation (Meijer 2009, p. 33; Grogan and Meijer 2017, p. 543). Although these elements are for research games, the majority of participatory methods have the same foundations: participants and selection process, rules and constraints, objectives, context or situation, output research data and gained experience of participants.

Usability of the selection of participants depends on identifying and selecting people for methods ensuring good representation and transparency. The usability of rules and constraints is influenced by the degree by which the method can mirror the organisational reality. Usability of the objective depends on the flexibility to adapt the aim and scoring mechanism to facilitate better discussion and gain better results from the method. Usability of the context relates to each individual case of applying any method and it deals with the flexibility of the examples or cases that are used, forms, files or documents that participants are provided, the quality of the briefing and debriefing sessions.

The credibility of the output research data depends on the match of the targeted outcome of the method with the real one. It depends also on the quality and usability of the outcomes. A generalisation of the findings is important for the credibility of the research data too. The credibility of the gained experience of participants is related to the lessons learned by participants and its transferability to real-world processes. Credibility depends also on the purpose of using participatory methods – was the participatory method just a manipulation tool or was it real power delegation to participants. Moreover, the credibility of the gained experience of participants is related to the change in the organisation related to the culture of using participatory methods.

In this work, the assessment of an application of methods is presented using the following five levels:

- level 5 (excellent) – the outcomes of the application exceeded the expectations of participants or representatives of the host organisations and showed excellent understanding of the system;
- level 4 (good) – the application provided good outcomes and demonstrated solid understanding of the system;
- level 3 (sufficient) – the application provided sufficient outcomes and met the expectations of participants or representatives of the host organisations;
- level 2 (minimal) – the application provided minimal outcomes, the application needs to be redone;
- level 1 (not sufficient) – the application did not reach the designed objectives and did not provide any meaningful outcomes.

An assessment of the usability and credibility of the application of participatory methods in this thesis was performed in a qualitative way based on comments and feedback from participants during and after the participatory method, interviews with participants and observations.

### **3.3 Analysis across Experiments**

Six experiments were analysed together based on the targeted outcome, motivation, participatory utilisation and success of the participatory methods to identify patterns in the application of participatory methods as an approach to support change processes in selected fields in the public sector from a complex adaptive system perspective.

Although the values for each parameter are numerical, the values of different parameters cannot be compared with each other because of different distributions of values for each parameter. Hence, a comparison between the different experiments was done not by the values of the parameter, but rather based on the rank of the parameter. Spearman's rank-order correlation (Spearman 1904; Corder and Foreman 2014) was used for this analysis. It helps to measure the strength and direction of the correlation between two variables based on their

ranks. Spearman's rank-order correlation coefficient  $\rho$  is calculated based on this formula:

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

where  $d_i$  is the difference in paired ranks, and  $n$  is the number of experiments.

Spearman's correlation coefficient can be in the range of -1 to +1. A positive coefficient corresponds to an increasing trend between two variables, while a negative coefficient corresponds to a decreasing trend. When the coefficient is close to zero, it indicates statistical independence between the two compared variables.

In this work, all experiments were ranked based on their assessment and the correlation between the assessments was compared with the experiments' different parameters. The results are used to indicate what parameters of applications of participatory methods affect the assessment of these applications and to gain conclusions on what aspects of participatory methods affect strong or weak overall assessment of the application of participatory methods in the studied cases within the public sector.



## **Chapter 4**

### **Results**

This chapter presents the results of this work. It starts with the results from the identification of issues in the public sector and lists the requirements for experiments based on these results. After that, the six experiments are presented and analysed. The chapter ends with an analysis across all experiments.

#### **4.1 Needs for Change in the Public Sector**

A literature review to identify needs for change in the public sector was performed based on the top 200 results from Scopus and top 500 results from Google Scholar published in the last five years after the results were sorted by the proportion of times a search query occurred in each publication. Titles and abstracts were read and inspected to ascertain whether the publications identify issues within different fields of the public sector. As a result, 176 studies were used in the literature review. These studies identify nine fields within the public sector (in alphabetical order):

- education;
- emergency services (fire brigades, paramedics, police, prisons);
- healthcare;
- housing and urban planning;
- military;
- road networks;
- social care;
- transit; and
- utilities (electricity, internet, natural gas, sewage, telephone, water).

Some of the fields such as healthcare or education were mentioned often, while some others like some of the utilities and the military were mentioned only by a few authors. Some authors used semi-equivalent names while referring to the same type of services, for example, 'healthcare' and 'medicine'. The fields emergency services and utilities are often reported separately; however, the issues in these fields are similar and they are often mentioned

together (Princen et al. 2016; Castro-Alvarez et al. 2018). In addition to the fields, 52 issues and needs for change were identified during the literature review. The results are presented in Table 4.1.

Table 4.1. List of issues in different fields of the public sector

Field	Needs for change	Sources
<b>Education</b>	Communication	Beauchamp 2015; Bozkurt et al. 2015; Littlefield, Rick, and Currie-Mueller 2016; Englund, Olofsson, and Price 2017□
	Management commitment	Fryer, Antony, and Douglas 2007; Antony 2015; Pucciarelli and Kaplan 2016; Anthun and Innstrand 2016; Srirangam Ramaprasad et al. 2017; Psomas and Antony 2017; Dyer and Dyer 2017□
	Process management	Stiglitz and Rosengard 2015; Ceulemans, Lozano, and Alonso-Almeida 2015; Quan, He, and Sloan 2016; Seyfried and Ansmann 2018□
	Training and learning	Abdullah and Ishak 2015; Kennedy et al. 2015; Farid et al. 2015; Reece and Walker 2016; Mirzakhanyan, Gevorgyan, and Karapetyan 2016; Simmons 2016; Pulido, Villamil, and Tarazona 2017□
<b>Emergency services</b>	Aspects of innovation	Braga and Weisburd 2015; Adams et al. 2017; Bond and Gabriele 2018□
	Composition and capability of the workforce	McDonough, Phillips, and Twilbeck 2015; Taylor et al. 2015; den Heyer and Mendel 2018□
	Connectivity with a community	Deuchar, Miller, and Barrow 2015; Green and Holloway 2016; Paul et al. 2017; Strudwick, Jameson, and Rowe 2017□
	Employee engagement	Jin and McDonald 2017; Anthony-McMann et al. 2017□
	Inclusion	Radnor et al. 2015; Young et al. 2018□
	Organisational structures	Nakrošis, Vilpišauskas, and Kuokštis 2015; Srivastava and Rajadhyaksha 2016; Brough, Chataway, and Biggs 2016□
<b>Healthcare</b>	Representation of diversity	Schuck and Rabe-Hemp 2016; Krieger 2017; Hollerbach et al. 2017□
	Accountability	Saluja et al. 2016; Almost et al. 2016; Liang et al. 2017; Sahi et al. 2018□
	Business management	Scott 2016; Morden 2016; Henrique et al. 2016; van Rossum et al. 2016; Bloom et al. 2017; Holopainen, Niskanen, and Rissanen 2019□
	External stakeholder influence	Palvia, Jacks, and Brown 2015; Hytti et al. 2015; van Offenbeek and Vos 2016; Rycroft-Malone et al. 2016; Ahsan and Rahman 2017□
	Policies and legal aspects	Birkland 2015; Drachsler and Greller 2016; Peters 2018□
	Technology acceptance	Al Abri et al. 2014; Y. Gao, Li, and Luo 2015; Hsieh 2015; Hsiao and Tang 2015; Money et al. 2015; Ladan, Wharrad, and Windle 2018; Der Zijpp, Wouters, and Sturm 2018□
<b>Urban planning</b>	Service level	Niakan and Rahimi 2015; Islam et al. 2015; Nelson and Staggers 2016; O'Hara et al. 2018□
	Development strategies	Geneletti et al. 2017; Sallis et al. 2016□
	Lack of a feedback loop	Duffhues and Bertolini 2016; Langemeyer et al. 2016; Rich, Rich, and Dizyee 2018□
	Materials choice	Akbari et al. 2016; Bae 2017□
	Spatial and temporal dynamics	Peng et al. 2017; Hillier 2017; Geneletti et al. 2017; Clark, Gertler, and Whiteman 2017□
Stakeholder engagement	Mok, Shen, and Yang 2015; Geneletti et al. 2017; Cheng et al. 2017□	

<b>Military</b>	Emergent behaviour	Wilkinson, Jordan, and Currie 2016; Farnell, Saddington, and Lacey 2019□
	Evolutionary development	P. Chen and Unewisse 2016□
	Geographical distribution	Sutyagin and Bronk 2017; Shengrui et al. 2018□
	Organisational structures	Alvinus, Ohlsson, and Larsson 2018□
	Training and learning	Hedlund, Börjesson, and Österberg 2015; Brynielsson, Lindquist, and Luotsinen 2016□
<b>Road network</b>	Materials choice	Pettang 2016; Petrovic, Vale, and Zari 2017; Moretti and Loprencipe 2018; Ervin 2018□
	Mobility behaviour	Freudendal-Pedersen 2016; Holden 2016; Rode et al. 2017; Papagiannakis, Baraklianos, and Spyridonidou 2018□
	Public procurement process	Pazell et al. 2016; Shen et al. 2017; Guerin 2017; Tunji-Olayeni, Emeteri, and Afolabi 2017; Grimsey and Lewis 2017; Zavadskas et al. 2018□
	Reliance on the private sector	Huchzermeyer and Misselwitz 2016; Clark, Gertler, and Whiteman 2017; Tafti 2019□
	Technology acceptance	Seuwou et al. 2017; Hussain et al. 2017; Ismail 2018□
	Technology development	L. Gao et al. 2015; Baporikar 2016; Yuan and Feng 2016; Awad, Hyder, and Irfan 2017□
<b>Social care</b>	Ageing population	Skinner and Hanlon 2015; Hafford-Letchfield 2016; Rimpiläinen, Morrison, and Rooney 2016; Davies and James 2016□
	Representation of diversity	Dutta 2016; Schiller 2017; Polo et al. 2018; Gopaldas and Siebert 2018□
	Service level	Vrangbaek 2015; Beadle-Brown, Bigby, and Bould 2015; Dillon and Chang 2016; Goossen and Austin 2017□
	Stakeholder engagement	Jarvis, O'Brien, and Soutar 2015; Leyden et al. 2017; McDermott, Kurucz, and Colbert 2018□
	Training and learning	Hansson, Höög, and Nyström 2017; Boelen 2018; Darley 2018□
<b>Transit</b>	Electric/self-driving vehicles	J.-Q. Li 2016; Grazia Speranza 2018; Duarte and Ratti 2018; Marletto 2019□
	Environmental aspect	Brown et al. 2016; Lee, Chung, and Lam 2016; Miller et al. 2016; Garcia Zambrana and Khan 2018□
	Geographical distribution	Mauss et al. 2015; Nuzzolo and Comi 2016; Abenoza, Cats, and Susilo 2017; Y. Chen et al. 2018□
	ICT	Cohen-Blankshtain and Rotem-Mindali 2016; Kuo and Szeto 2018; Sumalee and Ho 2018□
	Organisational structures	Hrelja 2015; Rye et al. 2018; Canitez 2018□
	Spatial and temporal dynamics	Du, Yang, and Liu 2017; Geneletti et al. 2017; Diao, Leonard, and Sing 2017; He, Cheung, and Tao 2018□
	Technology acceptance	Astrini et al. 2016; S.-Y. Chen and Lu 2016; Oña et al. 2016; Leistner and Steiner 2017; Kamrath et al. 2018□
<b>Utilities</b>	Aspects of innovation	Alic and Sarewitz 2016; Sagieva and Kotsemir 2018□
	Community choice	Pincetl, Chester, and Eisenman 2016; Maco et al. 2018□
	Demand dynamics	Arora et al. 2015; Hussien, Memon, and Savic 2017; G. Li et al. 2019□
	Economic growth	Bergstrom and Randall 2016; Helden and Uddin 2016; Haddad et al. 2018□
	Quality and quality control	Kuwayama, Olmstead, and Krupnick 2015; Mutlu 2016□
	Smart homes	Rathore et al. 2016; Talari et al. 2017; Ejaz and Anpalagan 2019□
	Technology development	Hashem et al. 2016; Lora Grando et al. 2017□

A number of authors clustered fields of the public sector into two bigger groups based on the primary functions of the field. These groups are infrastructure-orientated fields (housing and urban planning, road networks and utilities) and service-orientated fields (education, emergency services, healthcare, military, social care and transit). Bartunek and Moch (1987) and Kuipers *et al.* (2014) suggest grouping the issues into three structural levels of need for change based on their effect on the organisation or field:

*sub-system* – issues that are related to the adaptation of systems or structures, and affect only part of the organisation or sub-system;

*organisation* – issues that affect or causes to change an entire organisation or a system;

*field* – issues that cannot be solved only by one organisation, and require cross-organisational change or even cross-fields change.

Based on the orientations of the fields and levels of needs for change, the issues identified in the literature can be categorised as a matrix in Table 4.2. While each issue is classified as either infrastructure-orientated or service-orientated, it can belong to more than one organisational level. For example, issues with a public procurement process related to some documents or parts of processes are addressed at the sub-system level of need for change, but more strategic views on the public procurement process, such as lifecycle processes, are classified at an organisational level.

Table 4.2. Issues in the public sector based on different fields and levels

	<b>Infrastructure-orientated fields</b> (housing and urban planning, road networks and utilities)	<b>Service-orientated fields</b> (education, emergency services, healthcare, military, social care and transit)
<b>Sub-system level of need for change</b>	<ul style="list-style-type: none"> <li>Aspects of innovation</li> <li>Demand dynamics</li> <li>Lack of a feedback loop</li> <li>Materials choice</li> <li>Mobility behaviour</li> <li>Public procurement process</li> <li>Quality and quality control</li> <li>Reliance on the private sector</li> <li>Smart homes</li> <li>Spatial and temporal dynamics</li> <li>Technology acceptance</li> <li>Technology development</li> </ul>	<ul style="list-style-type: none"> <li>Accountability</li> <li>Aspects of innovation</li> <li>Communication</li> <li>Composition and capability of the workforce</li> <li>Electric/self-driving vehicles</li> <li>Employee engagement</li> <li>Environmental aspect</li> <li>Geographical distribution</li> <li>ICT</li> <li>Inclusion</li> <li>Management commitment</li> <li>Organisational structures</li> <li>Policies and legal aspects</li> </ul>

		Process management Representation of diversity Service level Spatial and temporal dynamics Stakeholder engagement Technology acceptance Training and learning
<b>Organisational level of need for change</b>	Aspects of innovation Community choice Development strategies Economic growth Lack of a feedback loop Mobility behaviour Public procurement process Spatial and temporal dynamics Stakeholder engagement Technology development	Ageing population Aspects of innovation Business management Communication Emergent behaviours Employee engagement Environmental aspect Evolutionary development External stakeholder influence Inclusion Management commitment Organisational structures Policies and legal aspects Process management Representation of diversity Spatial and temporal dynamics Stakeholder engagement
<b>Field level of need for change</b>	Aspects of innovation Community choice Economic growth Spatial and temporal dynamics Stakeholder engagement Technology development	Ageing population Aspects of innovation Communication Emergent behaviours Evolutionary development External stakeholder influence Spatial and temporal dynamics Stakeholder engagement

Beside a literature review, ten interviews were conducted to investigate the public sector from a complex adaptive system perspective, to learn about issues and challenges in the public sector, and to research how the experience of applying participatory methods addressed these issues and challenges.

Five interviewees were selected from the road network field (three persons from a government agency and two from private companies), two persons from a state joint-stock company from the transit, and four persons from the two government agencies and one non-governmental organisation. The interviewees participated voluntarily.

Each interview was analysed separately to identify needs for change in the public sector. While all interviewees mentioned some of the issues from the literature review, their biggest concern was not the identification of different issues but rather addressing the need for looking at the public sector as a complex adaptive system. They saw the majority of the

issues across many fields of the public sector as a lack of long-term vision and deeper understanding of the complexity within the sector. According to the interviewees, the two biggest factors that could have an effect on change processes were related *(i)* to the execution of the processes (for example, public procurement) at the sub-system and organisational levels and *(ii)* to networking and stakeholder engagement at the field level. They also were concerned that many solutions aim to fix just a small part of the system without thinking about the consequences for the system as a whole. The interviewees suggested involving more people in decision making by using participatory methods to improve the quality of the decision-making process.

Based on the results from the literature review and interviews, the requirements for experiments were formulated:

- experiments should be in infrastructure-orientated and service-orientated fields of the public sector;
- experiments should address issues of the sub-systems level, organisational level and field level; and
- experiments should address issues related to processes and related to networking or stakeholder engagement.

## 4.2 Experiments

Based on the triangulated results from the first phase of this work, six experiments were conducted in order to assess the application of participatory methods as an approach to support a change in the public sector from a complex adaptive system perspective. The experiments satisfied the requirements from the previous phase as shown in Table 4.3. The following experiments were selected because they had the necessary variety and they were feasible to perform with the limited access to experts in public organisations available for this thesis work. Full evaluation of experiments can be seen in Appendix B.

### 4.2.1 Management game for procuring road maintenance

Road maintenance in Sweden is very challenging due to the cold climate with a big focus on winter maintenance and a low number of bidders (Riksrevisionen 2012). A solution is

Table 4.3. Experiment mapping

<b>Experiment</b>	<b>Issues</b>	<b>Field</b>	<b>Level of need for change</b>	<b>Method</b>	<b>Paper</b>
Experiment A: management game for procuring road maintenance	Aspects of innovation Process management Public procurement process	Service-orientated (transit)	Sub-systems	Participatory simulation	Paper I, Paper II
Experiment B: management game for procuring airport services	Communication Public procurement process Stakeholder engagement	Service-orientated (transit)	Sub-systems	Participatory simulation	Paper I
Experiment C: strategy game about the lifecycle perspective of road infrastructure	Development strategies Public procurement process Stakeholder engagement	Infrastructure-orientated (road networks)	Organisation	Participatory simulation	Paper II
Experiment D: gamification of energy-efficient services in road maintenance	Aspects of innovation Business management Employee engagement Environmental aspect Organisational structures	Service-orientated (road networks)	Organisation	Gamification	Paper III
Experiment E: collection of perceptions about the road network field	Aspects of innovation Stakeholder engagement	Infrastructure-orientated (road networks)	Field	Q methodology	Paper IV
Experiment F: the model building of mental health in cities	Communication External stakeholder influence Evolutionary development	Service-orientated (healthcare)	Field	Participatory model building	Paper V

seen in making contracts more attractive by changing its procurement process and documentation. However, the lack of feedback loops and the absence of good competition make it harder to discuss how these changes can be made.

The Swedish Transport Administration, a public organisation that is responsible for road infrastructure in Sweden, wanted to reach a consensus on the format of procurement for road maintenance, as seen in Paper I. They sought participants to contribute mainly to an improvement of the current procurement process. These requirements fell in the categorisation of reaching a consensus and focused mainly on advising.

The proposed method to achieve the goal was a participatory simulation. It is used to create an environment where project leaders and procurement specialists can redesign the current procurement process and documentation to reach a consensus by exposing participants to mechanisms that exist in the real system. These results were used for further discussion improvement.

This experiment had mostly a fixed implementation with a big push from the leaders to use solutions that had been tested in different types of contracts. There was little direction from leadership on the choice of method and its execution. Internal stakeholder collaboration was very high, with much input from the organisation's employees from different units of the organisation. However, external collaboration was absent and the change was done only within the organisation. The organisational climate was moderately autocratic with a strong hierarchy and strict function distribution. However, suggestions for improvement were welcome, although they were often rejected. Communication efficiency for the application of the method was low and it required development of many elements from scratch to support facilitation of the participatory simulation. Since potential solutions in the participatory simulation can be very different, evaluation of a successful change happened mainly in a retrospective way. During the experiment, actions and decisions were prioritised because the goal was to reach a consensus, and the main focus was on results. However, the discussion and thoughts of participants were important to understand the reasons behind decisions and actions. Developing the application of the method was complicated because little was known about the connection between the causes and effects in maintenance procurement.

Based on the comments of the participants presented in papers I and II, the participatory simulation provided sufficient usability to address the issue. The selection of participants and rules were limited to functions of the procurement specialist, which was enough for the presented issue; however, the developed solution is limited to only maintenance-type contracts and using it for other cases would require more design changes. The application was flexible and could be easily adapted to other needs that the organisation might have. The participatory simulation provided highly credible research data with recommended good strategies for the further change process, as seen in Paper I. The application also gave good experience for participants about mechanisms of the maintenance procurement process in an interactive form. Participants had discussions after the session and exchanged ideas on how to implement the gained experience. Overall, the experiment can be assessed as level 3.

The values for each of parameters are seen in Table 4.4, and the full evaluation is seen in Appendix B.

*Table 4.4. The results of the analysis of the management game for procuring road maintenance*

<b>Parameter</b>	<b>Value</b>
<b>Level of participation</b>	1 (placation)
<b>Targeted outcome</b>	5 (reaching consensus)
<b>Aspiration</b>	3 (mostly advising)
<b>Flexibility of implementation</b>	-2 (mostly fixed implementation)
<b>Direction from leadership</b>	-2 (little)
<b>Internal stakeholder collaboration</b>	4 (very high)
<b>External stakeholder collaboration</b>	-5 (very low)
<b>Organisational climate</b>	-2 (moderately autocratic)
<b>Communication efficiency</b>	-2 (low)
<b>Evaluation of successful change</b>	2 (mostly retroactive)
<b>Priority of action and thoughts</b>	-2 (action gets priority, but thoughts do count)
<b>Focus of experiment</b>	-4 (results)
<b>Knowledge between causes and effects</b>	-3 (little is known)
<b>Participatory framework</b>	has both programmatic and participatory characteristics
<b>Usability</b>	level 3 (sufficient)
<b>Credibility</b>	level 4 (good)
<b>Overall assessment</b>	level 3 (sufficient)

#### **4.2.2 Management game for procuring airport services**

Schiphol airport is the main international airport in the Netherlands. It performs its daily asset management tasks with the help of contractors based on procured contracts. With the need to renew many of the contracts, airport management wanted to change the rules on how to engage with contractors. This would mean that contractors and the airport are partners in a more horizontal relationship with a high degree of functional. However, it was still an open question on how the procurement procedure should be done to support this change in the relationship between organisations, and what type of relationship would be most beneficial for the airport.

The Royal Schiphol Group, the state joint-stock company that manages the airport, required a solution that would help to see how the procurement process can be changed to fit better the company's vision about the partnership. As a part of this solution, the group looked at participatory simulation as a method to experience some ideas about how the procurement could be performed by asking participants to use their expertise to advise on the design of the contracts to encourage a more partner-like relationship and support the change process.

A participatory simulation was proposed in order to achieve this goal to test and experiment with different procurement strategies. A game was played during one full day with 12 participants who were managers and procurement specialists for the Royal Schiphol Group, as described in Paper I.

Since the Royal Schiphol Group had decided that the form of procurement is changing towards partnership, the way that contracts had to be implemented was fixed. At the same time, the content of the contract was up to the participants with very little direction from the leadership. This experiment was the first in the series of steps of the change process, and the focus was the internal perspective. Hence the experiment had a medium level of internal stakeholder collaboration, with less external collaboration. The application of the method provided freedom for participants to make their decisions in the contract, and at the same time, it was limited to the form of the contracts and procurement strategies. Hence, the climate was not autocratic or democratic but a mix of both. Communication efficiency was low because all elements had to be developed specially for this case, and despite the goal to mostly reach a consensus, it was hard to know how to evaluate the successful outcome of the experiment because both the actions and thoughts were important. The main focus for the

outcomes for this experiment was the results. Despite experience of working with different service providers in the airport, there was still little knowledge available about the effects of this type of change in the procurement process.

Participants commented that the usability of the application of the method was sufficient, as seen in Paper I. During the experiment, participants made decisions as they would in real life. The objectives and the purpose of the game were clear and worked well to address the issue. However, since the addressed problem itself was very specific, participants agreed that the participatory simulation as a method was useful for the organisation, but not this specific game.

Paper I shows that participants felt that the outcomes from the experiment were credible. The recorded data was sufficiently useful, although one team did not record all changes properly in the provided forms but instead wrote changes as comments. The credibility of the experience that participants had was high. As a result, this participatory experiment was assessed as level 3.

*Table 4.5. The results of the analysis of the management game for procuring airport services*

<b>Parameter</b>	<b>Value</b>
<b>Level of participation</b>	1 (placation)
<b>Targeted outcome</b>	2 (mostly reaching consensus )
<b>Aspiration</b>	5 (advising )
<b>Flexibility of implementation</b>	-2 (fixed)
<b>Direction from leadership</b>	-4 (very little)
<b>Internal stakeholder collaboration</b>	0 (medium)
<b>External stakeholder collaboration</b>	-5 ( very low)
<b>Organisational climate</b>	0 (mixed)
<b>Communication efficiency</b>	-4 (low)
<b>Evaluation of successful change</b>	3 (mostly retroactive)
<b>Priority of action and thoughts</b>	0 (action and thoughts)
<b>Focus of experiment</b>	-3 (mainly results)
<b>Knowledge between causes and effects</b>	-3 (little is known)
<b>Participatory framework</b>	has both programmatic and participatory characteristics
<b>Usability</b>	level 3 (sufficient)
<b>Credibility</b>	level 4 (good)
<b>Overall assessment</b>	level 3 (sufficient)

#### **4.2.3 Strategy game about the lifecycle perspective of road infrastructure**

The Swedish Transport Administration wanted to improve road quality and reduce costs by incorporating the lifecycle perspective in their strategies. However, it required some big changes in the existing procurement process.

Hence, the Administration set a goal to use a participatory approach to evaluate how the lifecycle perspective can be included in procurement strategies for road infrastructures, as seen in Paper II. It had to include the following phases of road life: planning and design, construction and maintenance. The organisation wanted participants to reach consensus on how this can be done while giving freedom to participants to generate new solutions and ideas.

Participatory simulation was used to achieve the goal. It allowed the needed freedom to be provided for participants while keeping all key elements of the complexity of road infrastructure and the lifecycle perspective. Nine people participated in this participatory simulation. They were top-level managers and experts from the Swedish Transport Administration. One full day was dedicated to this experiment, as described in Paper II.

No pre-made instructions or guidelines were given to participants about how they should try to include a lifecycle perspective in the procurement process, making implementation of this application of the method flexible. In addition, there were no directions from leadership, which gave more space for the organic change process. Internal stakeholder collaboration was very high as such change required teamwork across an entire organisation. However, external stakeholder collaboration was low with little-simulated reaction from the market. Although the organisational climate of the Swedish Transport Administration is moderately autocratic, in this experiment the climate was more democratic, because many participants were in leadership positions and had more opportunities to make changes. Communication efficiency was very low as most of the elements needed to be done from scratch for this game and no models existed to support the participatory simulation. In addition to this, the evaluation of successful change was retroactive because it was impossible to predict what solutions the participants would create. The experiment was interested in both the results of the participatory simulation and the thoughts that the participants had about the application of the lifecycle perspective because of unclear effects of the lifecycle perspective on road infrastructure.

As seen in Paper II, participants thought that the experiment had good outcomes, based on both the usability and credibility. The selection of participants, rules, objectives and context were clear and easy to follow. Participants commented that the application of the method had a sufficiently high level of adaptability because it was not some specific case but rather promoted a strategic vision on the complexity in the field. Some other comments were related to the positive experience that participants gained from the game that can be seen in Paper II. The application of the method also produced valid quantitative and qualitative data.

*Table 4.6. The results of the analysis of the strategy game about the lifecycle of road infrastructure*

<b>Parameter</b>	<b>Value</b>
<b>Level of participation</b>	3 (delegated power)
<b>Targeted outcome</b>	2 (mostly reaching consensus )
<b>Aspiration</b>	-4 (democratisation )
<b>Flexibility of implementation</b>	5 (flexible)
<b>Direction from leadership</b>	-5 (very little)
<b>Internal stakeholder collaboration</b>	5 (very high)
<b>External stakeholder collaboration</b>	-2 (low)
<b>Organisational climate</b>	2 (moderately democratic)
<b>Communication efficiency</b>	-5 (very low)
<b>Evaluation of successful change</b>	5 (retroactive)
<b>Priority of action and thoughts</b>	0 (action and thoughts)
<b>Focus of experiment</b>	-1 (both results and experiment)
<b>Knowledge between causes and effects</b>	-5 (unknown)
<b>Participatory framework</b>	mostly participatory
<b>Usability</b>	level 4 (good)
<b>Credibility</b>	level 4 (good)
<b>Overall assessment</b>	level 4 (good)

#### **4.2.4 Gamification of energy-efficient services in road maintenance**

The Swedish Transport Administration is implementing a new energy management system to reduce the amount of energy used in the road construction and maintenance field. A part of this implementation is related to the behavioural change of employees to promote energy saving in all levels of work in the organisation. It includes, for example, more efficient driving of operators, better repair options for maintenance mechanics, or planning operations

in such a way that they consume less energy. However, these changes affect the organisation at all levels, the external stakeholders and the legal processes for data collection and energy management system implementation, which in turn make the design of such changes a complex process.

The organisation wanted to investigate the capacity of the participatory approach, especially gamification, to support such new energy management systems by changing the behaviour of employees. The Swedish Transport Administration was interested in mapping out diversity by observing different behaviour patterns and ideas about practices that help improve energy management, as described in Paper III. Participants were mainly expected to share their knowledge to advise on best ways to reach the goal of the organisation.

Gamification was selected in this case as a mechanism to promote changes and stimulate more desirable behaviour. However, the analysis and feasibility study of the requirements showed that the Swedish Transport Administration and its partners are not yet ready to implement gamification of its energy-efficient services in road maintenance, as seen in Paper III. Nevertheless, it was still possible to this experiment based on the requirements provided by the Administration and to predict the assessment of an application of the method.

This approach would be mostly fixed because there were employees that still had to follow procedure descriptions and their freedom in what they could do as a part of the gamification was limited. Hence, there also would be a medium level of direction from leadership, who would have to decide in which areas changes can be allowed. This work involves many stakeholders within the Swedish Transport Administration as well as outside partners to ensure proper approach application and data collection; hence it requires medium collaboration from all stakeholders. The organisational climate is moderately autocratic because of the strict hierarchy in the organisation. A successful application of the gamification requires time and resources to be properly implemented, so communication efficiency is low. The evaluation of the success depends on the work's complexity and it can be known a priori for some cases, while for some other cases it can be seen only after the gamification is finished. As a method for behavioural change, actions are important for this method; however, since this experiment is also a part of the change process for the new energy management system, the Swedish Transport Administration is interested in the

thoughts of participants too. There is some knowledge about causes and effects for individual work processes, but very little is known at the system level about the potential effects.

Gamification can be sufficiently easy to adapt to similar work processes, keeping the focus on the energy management system. For example, gamification for snow ploughing can easily be applied to grass cutting. However, Paper III concluded that gamification is less adoptable when the work processes are not comparable, for example, fieldwork and administration work. Hence, this method would have only low usability. At the same time, the received data also would be of low quality because different stakeholders record data in different ways. It is harder to assess the credibility of the experience that participants would gain from it. In general, gamification of energy-efficient services can be assessed as level 2.

It is worth it to notice that gamification is a participatory method; nevertheless, it does not give much freedom for participants to be really in control, but rather it is used for manipulation (behaviour changes) or tokenism (an activity with a minimal opportunity for feedback about the work of the system), as seen in Section 2.1.

*Table 4.7. The results of the analysis of the gamification of energy-efficient services*

<b>Parameter</b>	<b>Value</b>
<b>Level of participation</b>	-5 (manipulation)
<b>Targeted outcome</b>	-3 (mostly mapping out diversity )
<b>Aspiration</b>	3 (mostly advising )
<b>Flexibility of implementation</b>	-3 (mostly fixed)
<b>Direction from leadership</b>	0 (medium)
<b>Internal stakeholder collaboration</b>	0 (medium)
<b>External stakeholder collaboration</b>	1 (medium)
<b>Organisational climate</b>	-3 (moderately autocratic)
<b>Communication efficiency</b>	-1 (medium)
<b>Evaluation of successful change</b>	-1 (some elements are known)
<b>Priority of action and thoughts</b>	0 (actions and thoughts are important)
<b>Focus of experiment</b>	-1 (both results and experiment)
<b>Knowledge between causes and effects</b>	-1 (some knowledge exists)
<b>Participatory framework</b>	mostly programmatic
<b>Usability</b>	level 2 (minimal)
<b>Credibility</b>	level 2 (minimal)
<b>Overall assessment</b>	level 2 (minimal)

#### **4.2.5 Collection of perceptions about the road network field**

In the preparation of a change process in road maintenance procurement, the Swedish Transport Administration is interested in perceptions about the road network field of both their own employees and external stakeholders. Due to the complexity of the procurement process, the Administration is interested in the method that can ensure it can map out diversity and provide democratisation to participants, as described in Paper IV.

To address the road maintenance procurement process as a complex adaptive system, the organisation decided to choose a participatory method for the subjective opinion analysis known as Q methodology. Since Q methodology uses a variety of different statements from different sources about the research topic, there was no fixed agenda and the implementation was mostly flexible. There were few requirements from leadership about the process of the application of the method and the organisation had the final decision on the set of statements used for the method. The collaboration was low because the method collected perceptions individually.

This experiment was to map out the diversity that exists in the road network field not only in one organisation but all stakeholders involved in the process. It was also done in a mainly democratic way, allowing all participants to share their knowledge with minor control that existed within the applied method. Participants in this experiment were from the Swedish Transport Administration and from its partners, and the majority of these organisations have a moderately autocratic climate due to the hierarchy in the organisations. This participatory method is well-established and does not require much preparation; therefore, this experiment had very high communication efficiency and the evaluation of a successful change could be done a priori. The method was interested merely in the thoughts and perceptions of the participants, and not in the process of the experiment itself.

Because this application required deep knowledge about the procurement process, participants did not feel that this application was usable by participants with less experience in procurement, as seen in Paper IV. Also, participants complained that the rules were too hard to follow. Nevertheless, most of the participants liked the diversity in the statements. The results from the collected data were strong, and most of the participants acknowledged the credibility of this application of the method.

Table 4.8. The results of the analysis of the collected perceptions about the road network field

Parameter	Value
Level of participation	-3 (consultation)
Targeted outcome	-4 (mapping out diversity )
Aspiration	-3 (mostly democratisation )
Flexibility of implementation	-2 (mostly flexible)
Direction from leadership	1 (medium)
Internal stakeholder collaboration	-2 (low)
External stakeholder collaboration	-2 (low)
Organisational climate	-2 (moderately autocratic)
Communication efficiency	5 (very high)
Evaluation of successful change	-5 (a priori)
Priority of action and thoughts	-5 (thoughts get priority)
Focus of experiment	-5 (results)
Knowledge between causes and effects	-3 (little is known)
Participatory framework	mostly programmatic
Usability	level 1 (not sufficient)
Credibility	level 4 (good)
Overall assessment	level 2 (minimal)

#### 4.2.6 Model building of mental health in cities

Traditionally mental health is associated with the field of healthcare. However, there is strong evidence that mental health, especially in urban areas, is related to the education, labour market, family support, urban planning and other fields (Klebanov, Brooks-Gunn, and Duncan 1994; Leventhal and Brooks-Gunn 2003). In order to gain more understating on how different organisations can work together to improve the situation with mental health, the International Initiative for Mental Health Leadership (IIMHL) is interested in mapping out diversity about mental health across different fields of the public sector by giving full freedom to participants to share their ideas and thoughts.

To achieve this, participatory model building was used. This method builds a causal loop model of a system by combining variables and links that participants suggest. This experiment was done by five groups as described in Paper V, where each group had from eight to twelve participants from different fields of the public sector.

An absence of any pre-made plan kept the implementation of this experiment flexible. There were no directions from leaders on the topics to focus on or what elements to include or not to include. This method requires high collaboration between stakeholders because all team members have to agree on the final model's elements. This experiment was performed in a democratic climate. Application of this method required much preparation; thus communication efficiency was very low. Also, the evaluation of the models and other outcomes could be done only after the models were completed. While participants were instructed on how to build a model, their actions were less important than the thoughts and connections that they made.

Since the only requirement for participants was experience with mental health, the rules and objectives were well-defined while providing much freedom, this experiment was assessed by participants as having high usability. The data collected during the experiment is presented in Paper V, and it was of high quality and participants did report of them gaining new knowledge and experience from the application of the method. This indicates that the application of this method had an assessment of level 5.

*Table 4.9. The results of the analysis of model building of mental health in cities*

<b>Parameter</b>	<b>Value</b>
<b>Level of participation</b>	5 (citizen control)
<b>Targeted outcome</b>	-5 (mapping out diversity )
<b>Aspiration</b>	-5 (democratisation )
<b>Flexibility of implementation</b>	5 (flexible)
<b>Direction from leadership</b>	-5 (very low)
<b>Internal stakeholder collaboration</b>	5 (very high)
<b>External stakeholder collaboration</b>	5 (very high)
<b>Organisational climate</b>	5 (democratic)
<b>Communication efficiency</b>	-5 (very low)
<b>Evaluation of successful change</b>	5 (retroactive)
<b>Priority of action and thoughts</b>	5 (thoughts get priority)
<b>Focus of experiment</b>	0 (both results and experiment)
<b>Knowledge between causes and effects</b>	-5 (unknown)
<b>Participatory framework</b>	participatory
<b>Usability</b>	level 5 (excellent)
<b>Credibility</b>	level 4 (good)
<b>Overall assessment</b>	level 5 (excellent)

### 4.3 Analysis across Experiments

After individual analyses of the experiments, an analysis across experiments is performed to investigate holistically the application of participatory methods in the public sector. This analysis is performed in four steps: (i) analysis of the categorisation of the participatory methods based on their goals, (ii) analysis of the participatory method framework, (iii) analysis of the assessment of the participatory methods, and (iv) pattern analysis across all variables of the participatory methods.

#### 4.3.1 Analysis of the categorisation of the goals of the experiments

The categorisation of the participatory methods is based on the goals of the participatory method. It uses two axes to analyse the results: targeted outcome (mapping out diversity and reaching consensus) and aspiration (democratisation or advising). The categorisation can be illustrated as a plot with the experiments as seen in Figure 4.1.

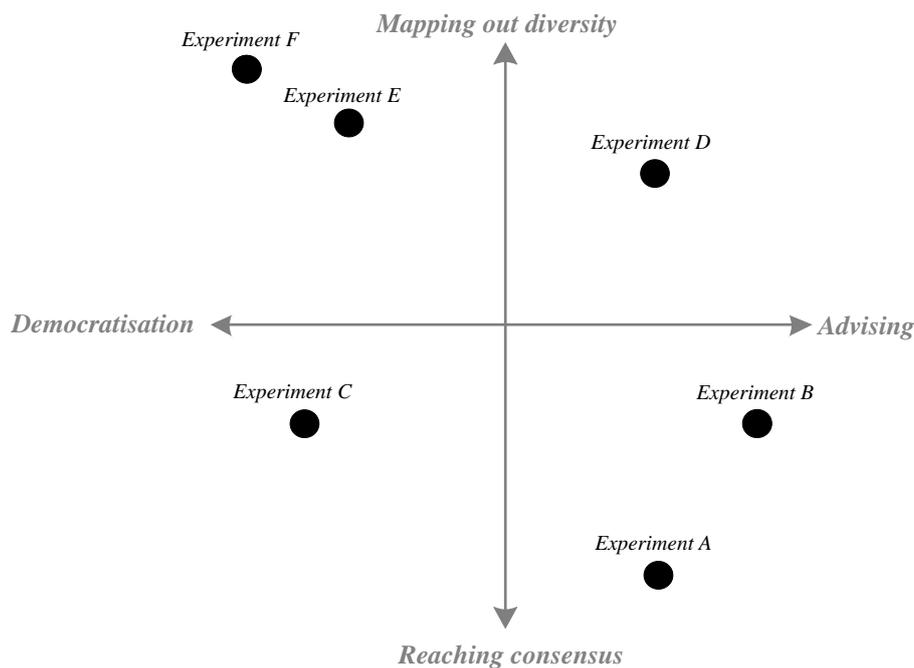


Figure 4.1. The categorisation of experiments based on their goals

A quadrant ‘mapping out diversity–democratisation’ has two experiments about collecting perceptions about the road network field and model building of mental health in cities. They both mapped out diversity in the field and had strong democratisation in their execution. Although the experiments were from different fields, they both were at the field level and

required expertise and knowledge that comes from outside one organisation or one field of the public sector.

The quadrant ‘reaching consensus–advising’ has also two experiments: the management game for procuring road maintenance and the management game for procuring airport services. With a slight difference in the focus on reaching consensus and advising, both methods have similar categorisation. The experiments again do not belong in the same field. However, they use the same participatory method, namely participatory simulation, and focus on similar needs for a change in procurement practices, which means they are at the sub-systems level.

Experiment C, about a strategy game about the lifecycle of road infrastructure, and experiment D, about gamification of energy-efficient services in road maintenance, do not belong to the same quadrant. However, other experiments showed to have a correlation between the categorisation of the experiments and the levels of effects on the organisation or the field; therefore, it is possible that these two experiments at the organisational level are on the diagonal between the quadrant ‘democratisation–reaching consensus’ and the quadrant ‘mapping out diversity–advising’. Both quadrants deal with limits and freedoms at the same time. A goal of the participatory method, the quadrant ‘democratisation–reaching consensus’, is to give freedom to participants to help with limited-space solutions, while a goal of the participatory method, the quadrant ‘mapping out diversity–advising’, is to have freedom with the solution while limiting participants. Both cases describe well the dilemmas with issues at the organisational level (Kuipers et al. 2014).

#### **4.3.2 Analysis of the participatory method framework**

In addition, to examining participatory methods based on their categorisation of the goals, participatory methods can be classified between two frameworks: programmatic and participatory. While this framework is based on a number of criteria and not all of them could be equally important in every situation, in this work it will be assumed that all criteria are equally important; hence, an average of all criteria can be used to describe utilisation of the participatory method.

*Table 4.10. Participatory framework for experiments*

<b>Experiment</b>	<b>Participatory framework</b>
Experiment A	has both programmatic and participatory characteristics
Experiment B	has both programmatic and participatory characteristics
Experiment C	mostly participatory
Experiment D	mostly programmatic
Experiment E	mostly programmatic
Experiment F	participatory

As seen from Table 4.10, experiments D and E were mostly programmatic, meaning that they had some participatory elements but on the whole, they were closer to the programmatic framework. Experiments A and B had a more participatory-orientated design; however, they are also only a combination of programmatic and participatory characteristics. Experiment C was mostly participatory despite some elements not really being in the control of participants. Finally, experiment F was able to fulfil all the criteria of the participatory framework.

In order to explain this distribution, it is important to look at the methods that each experiment used. Experiment D used gamification and experiment E used Q methodology. Both gamification and Q methodology are participatory methods; however, they do not give freedom to participants. Gamification uses game elements to influence a person's behaviour, thus it is a manipulation method, which is the lowest step of the ladder of participation. Q methodology does not manipulate participants, but it is mainly interested in consulting and data gathering rather than making any decisions or changes.

Experiment A and experiment B were designed using a participatory simulation. While a participatory simulation can be at the top of the ladder of participation, the amount of freedom and level of participation highly depended on the goal and purpose of each individual participatory simulation. In the case of these experiments, participants were not given much freedom and the methods were mainly for participants to advise, while the power to judge outcomes belonged to the leaders. Such behaviour is characterised by the middle of the ladder of participation.

Experiment C and experiment F were designed to give as much freedom as possible to participants; and despite having different goals and using different methods, these two experiments had the most participatory results based on the participatory framework. A higher result from experiment F might be related to the openness of the outcome of the method, while experiment C tried to reach consensus; however, there is not sufficient data to claim that it will be true in all cases.

Based on the analysis of the experiments, it is seen that there is a pattern between the participatory framework and the ladder of citizen participation. A method has to be more participatory to have a higher degree of power-sharing between the participants. At the same time, if the task requires nominal or passive participation, then programmatic approaches are more suitable.

#### 4.3.3 Analysis of the assessment of the experiments

An assessment of each method was performed based on an assessment of the usability of the method and assessment of the credibility. As a result, the experiments have been assessed from being weak to very strong.

*Table 4.11. Assessment of the experiments*

<b>Experiment</b>	<b>Usability</b>	<b>Credibility</b>	<b>Overall assessment</b>
Experiment A	level 3 (sufficient)	level 4 (good)	level 3 (sufficient)
Experiment B	level 3 (sufficient)	level 4 (good)	level 3 (sufficient)
Experiment C	level 4 (good)	level 4 (good)	level 4 (good)
Experiment D	level 2 (minimal)	level 2 (minimal)	level 2 (minimal)
Experiment E	level 1 (not sufficient)	level 4 (good)	level 2 (minimal)
Experiment F	level 5 (excellent)	level 4 (good)	level 5 (excellent)

Experiment D and experiment E had the lowest levels of assessment. Experiments A and B were assessed as medium level 3; and experiment E and experiment F had the best outcomes.

It is the same grouping as seen in a previous sub-section, where the groups correlated to the level of participation. Hence, the level of participation affects not only the participatory framework but also the overall assessment of the result. It is related to the complex nature of

the issues and the ability to capture this complexity by participatory methods, while a more programmatic method would fail to include the necessary level of complexity and adaptivity.

Experiment E presented an unusual assessment situation: the experiment had very poor usability while the credibility was strong. This indicates that the outcomes of participatory simulation can be useful and true, even if the method was not right for the situation.

#### 4.3.4 Analysis of the patterns across the experiments

Another way to look at the experiments is to find and analyse patterns across the experiments' parameters. Such patterns provide more information about the experiments and the general assessment of the application of participatory methods for complex adaptive systems in the public sector.

These patterns were observed using Spearman's rank correlation by comparing each of the parameters with the experiment's overall assessment, assessment based only on usability and assessment based only on credibility, as seen in Table 4.12. The results are presented for the parameters where the absolute value of Spearman's rank correlation coefficient  $\rho$  is above 0.70.

*Table 4.12. Spearman's correlation between the assessment of the experiments and their parameters*

<b>Parameter</b>	<b>Combined assessment</b>	<b>Assessment of usability</b>	<b>Assessment of credibility</b>
<b>Target outcome</b>	0.00	0.01	0.39
<b>Aspiration</b>	-0.50	-0.47	0.13
<b>Flexibility of implementation</b>	0.90	0.83	0.79
<b>Direction from leadership</b>	-0.87	-0.91	0.04
<b>Internal stakeholder collaboration</b>	0.91	0.94	0.49
<b>External stakeholder collaboration</b>	0.24	0.27	0.06
<b>Organisational climate</b>	0.93	0.87	0.73
<b>Communication efficiency</b>	-0.87	-0.91	0.04
<b>Evaluation of successful change</b>	0.96	0.97	0.56
<b>Priority of action and thoughts</b>	0.71	0.79	0.26
<b>Focus of experiment</b>	0.66	0.74	0.13
<b>Knowledge between causes and effects</b>	-0.70	-0.66	-0.07

One of the observed patterns, as seen in Figure 4.2, was a correlation between the assessment of the experiments and organisational climate with coefficient  $\rho$  being equal to -0.93. This pattern shows that participatory methods give better results in democratic environments.

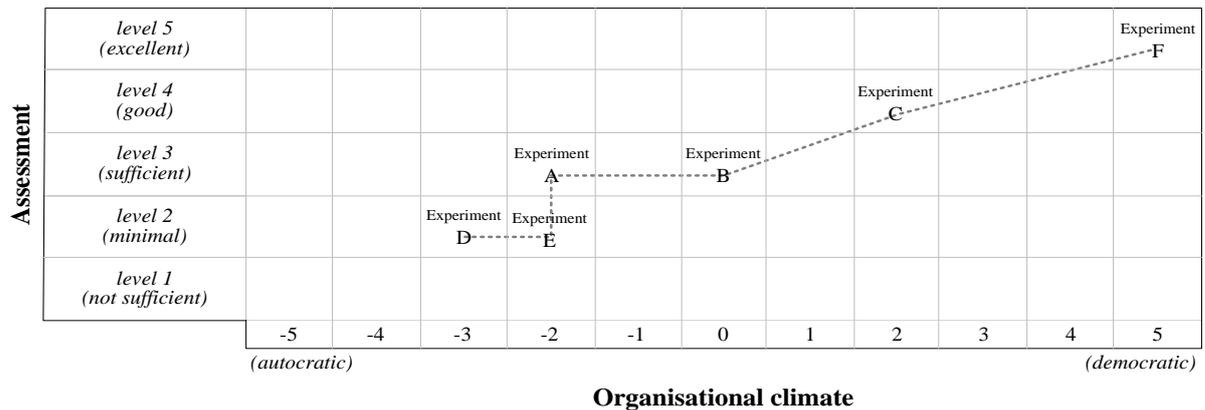


Figure 4.2. Correlation between assessment and organisational climate

Another pattern found was that methods with higher assessment results have less knowledge about the relation between causes and effects in a system. This correlation has a coefficient  $\rho$  of -0.70 and can be seen in Figure 4.3. Strong methods were applied for the systems with no known connections between the causes and effects, while the approaches for systems with at least some knowledge about such connections were weak. This connection indicates that participatory approaches do have the best outcomes in complex systems, while better research systems could have better outcomes with methods that are meant for complicated or simple systems.

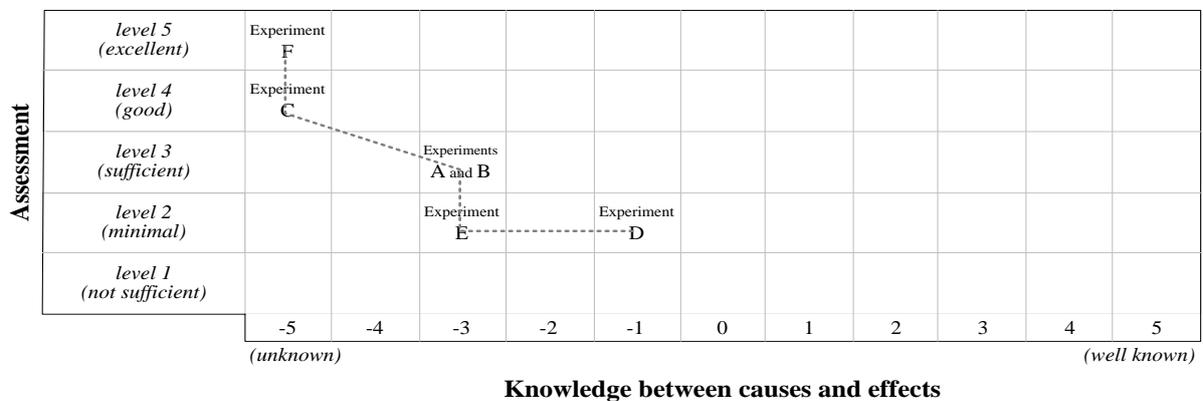


Figure 4.3. Correlation between assessment and knowledge between causes and effects

A pattern was found between the assessment based on the usability of the method and the evaluation of successful change. This parameter refers to specific metrics for successful evaluation of each approach. Figure 4.4 shows strong evidence ( $\rho=0.97$ ) that successful methods can perceive the level of success only in retrospect, while approaches that use pre-made evaluation metrics had weak usability.

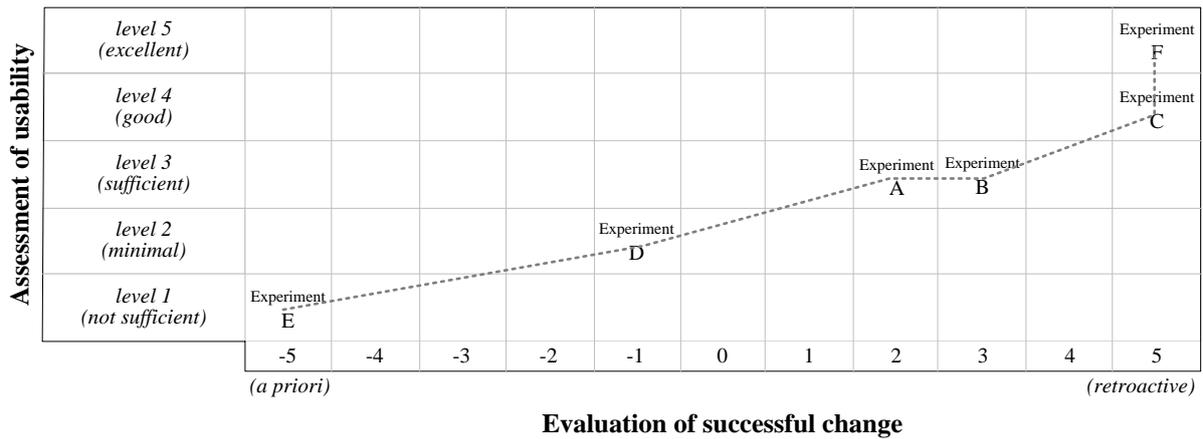


Figure 4.4. Correlation between the assessment of usability and evaluation of successful change

The assessment based on usability also has a high correlation with internal stakeholder collaboration with a correlation coefficient  $\rho$  of 0.94. This correlation is seen in Figure 4.5, and it means that approaches that are designed and performed in high collaboration with internal stakeholders are assessed as more usable.

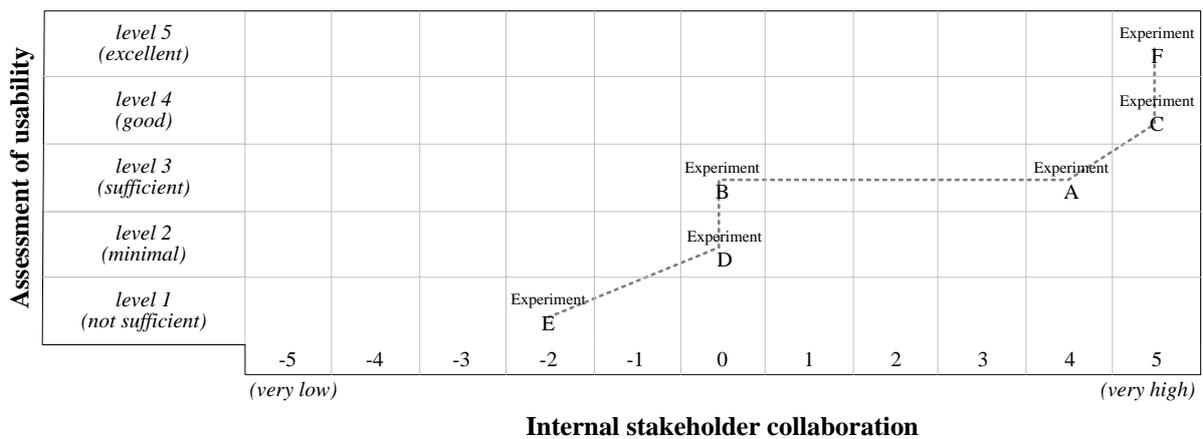


Figure 4.5. Correlation between the assessment of usability and internal stakeholder collaboration

Another pattern was between assessment of usability and communication efficiency. The correlation coefficient  $\rho$  is -0.91, which indicates a strong negative relationship. This correlation means that the more usable implementation of participatory approaches requires more time and resources to apply the method. Likewise, methods that have high communication efficiency and do not require much investment are less usable in the implementation.

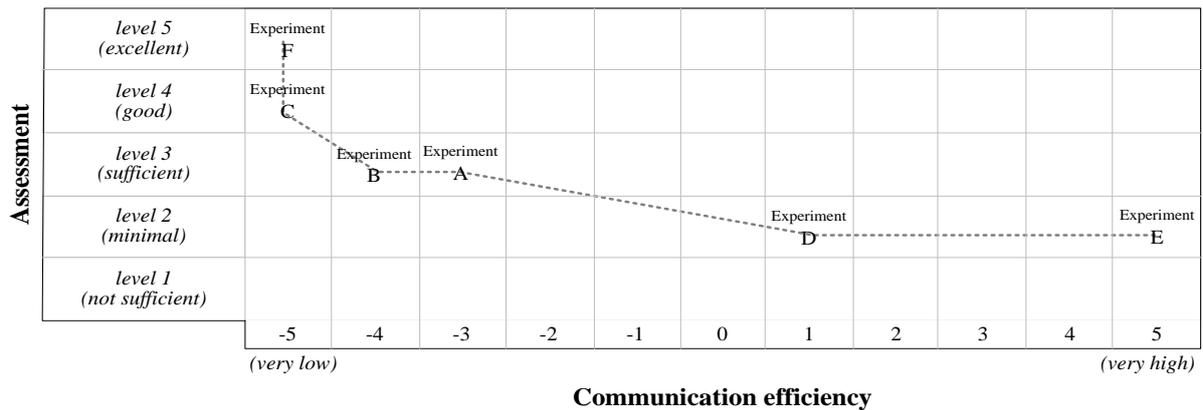


Figure 4.6. Correlation between assessment of usability and communication efficiency

A correlation between the assessment of usability and direction from leadership is found with coefficient  $\rho$  being equal to -0.91. This connection can be seen in Figure 4.7. Methods that had excellent assessment of usability had little directions from leadership and participants were allowed to use their expertise and ideas to help with a change process. On the other hand, methods where the leaders were pushing for a specific outcome were less usable.

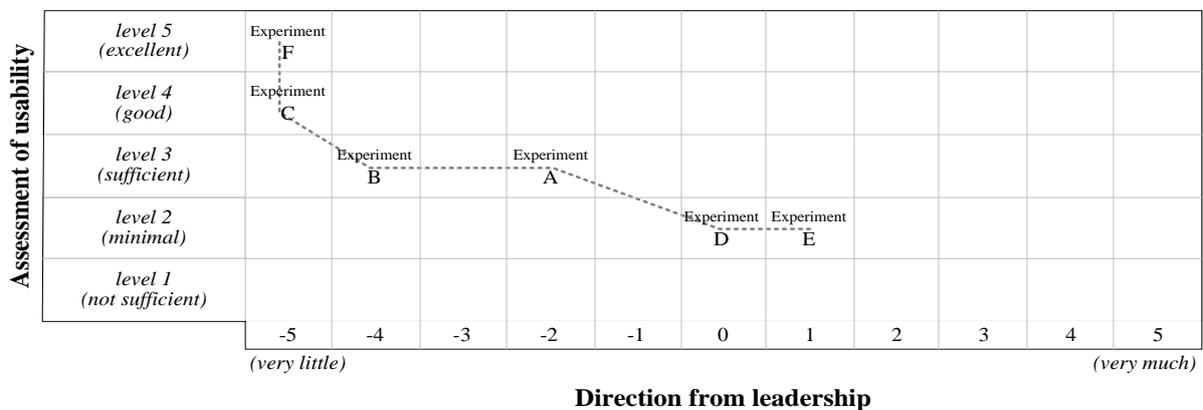


Figure 4.7. Correlation between assessment of usability and direction from leadership

Another pattern was observed between assessment based on usability and the focus of the experiment. Although no experiments were observed with solemn focus on the process of the participatory method, there is a correlation between having stronger usability and focusing on the process and results with a correlation coefficient  $\rho = 0.74$ .

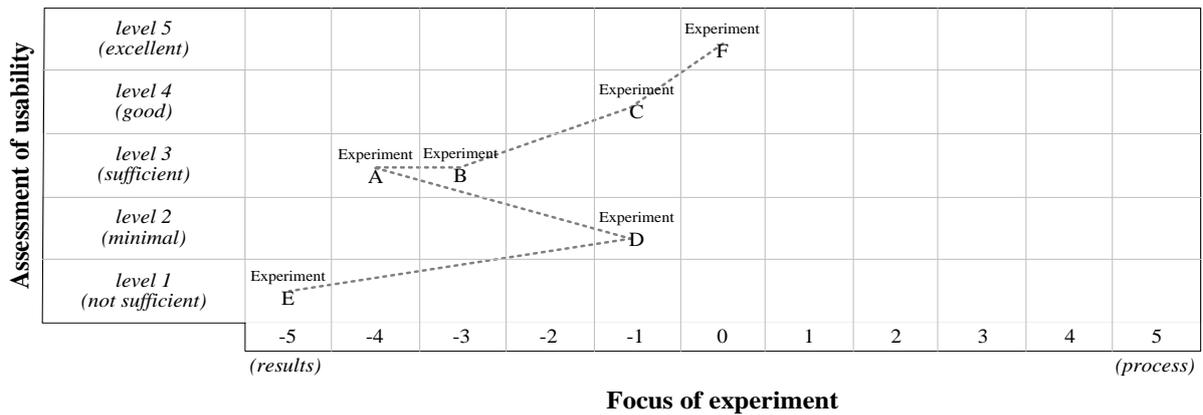


Figure 4.8. Correlation between assessment of usability and focus of the experiment

One more finding from the correlation analysis that contributes to a better understanding of the patterns in the application of participatory methods was the relationship between the assessments of the methods and the targeted outcome. These two parameters have a correlation coefficient  $\rho$  equal to 0, which indicates statistical independence and is shown in Figure 4.9. This means that the success of the participatory approach is not dependent on the planned outcomes of the method. Hence, there can be both strong and weak examples of participatory methods that try to map out diversity and there can be both strong and weak participatory methods that aim to reach consensus.

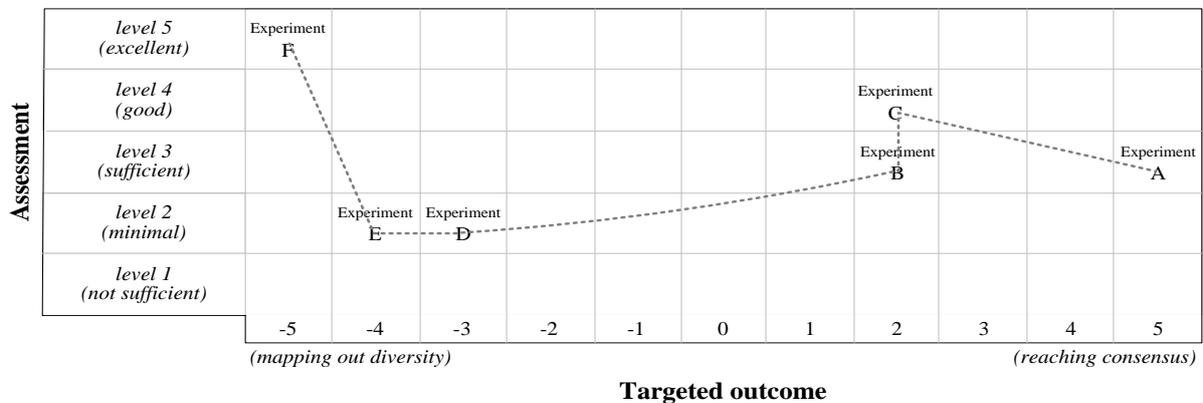


Figure 4.9. Correlation between assessment and targeted outcome



## **Chapter 5**

# **Discussion and Conclusions**

This work assesses the application of participatory methods as an approach to support change processes in the public sector from a complex adaptive system perspective. With the purpose to research more about complexity in the public sector and the benefits of participatory methods for the public sector, six experiments were conducted and analysed. Based on these findings and findings in the papers, this chapter reflects the complexity in the public sector, the application of participatory methods with their strengths and weaknesses, and future work.

### **5.1 Complexity in the Public Sector**

In line with other authors, this thesis argues that the public sector should be truly perceived as a complex adaptive system, and that this sector has a great number of needs for change. The literature study on the identification of needs for change in the public sector presented different fields with a variety of different needs in Section 4.1. While the review showed that not all tasks in the public sector are complex, a gap was identified in the attempt to address issues that occur at the level of an entire public organisation or even across fields, as seen in Paper IV. Furthermore, interviews and focus groups confirmed that the most challenging current issues happen when there is a need for cooperation with other stakeholders, and when these issues are too complex to address with tools that are traditionally applied.

The analysis of the experiments conducted for this thesis showed that fields that are primarily service-orientated tended to have a better understanding of the complexity of their issues and could see their work as complex adaptive systems. The infrastructure-orientated fields focused their discussion and issues more on technical components, but there still was an acceptance that the source of the issues is people and not merely technologies; hence, the problems in infrastructure-orientated fields can be perceived as CAS.

Another finding from the identification of needs for change in the public sector and experiments was related to the level of issues. Issues that were identified in the literature at the sub-system level typically were less complex and could be addressed with tools not meant

for complex adaptive systems. This can be an explanation for why experiments at the sub-systems level in infrastructure-orientated fields were not found: issues at this level are mainly technical or related to services around infrastructure, making issues service-orientated. However, issues at the organisational level or field level are significantly more complex and can generate a lot of diversity in the approaches on how to change processes, as was described in sub-section 4.3.1. The analysis of the experiments suggests keeping field-level issues as open as possible. In the illustrative evidence we can see the relatively weak assessment of the experiment on the collection of perceptions about the road network field caused by strict rules and limited freedom of participants in this experiment.

## **5.2 Participatory Methods in the Public Sector**

The analysis of the experiments showed effective results of applying participatory methods in different fields of the public sector. The methods provide the support needed to deal with complex issues, generate new ideas, help to identify the constraints and perceptions of different stakeholders, collect knowledge and help participants to take responsibility for a change process. The experiments therefore fall in line with the positive assessment of individual cases as we already found in the literature. It was also observed that participatory methods have liabilities. Application of participatory methods required time and resources, a proper structure of the host organisation with a democratic climate and proper specification of the issue.

### **5.2.1 Strengths of participatory methods in the public sector**

During the experiments about the lifecycle perspective of road infrastructure and procurement of road maintenance, participants had produced some new ideas on how the procurement process can be modified to be more innovative, as described in Paper II. By providing more freedom, participatory methods motivate participants to think outside the box, and it is one of the strengths of participatory methods. This finding is in line with the literature (Hofstede, de Caluwé, and Peters 2010).

These methods also help to find constraints and bottlenecks of current systems. The management game for procuring road maintenance and the management game for procuring airport services, which are described in Paper I, showed some of the existing limitations in the system that make it harder to innovate and improve the service level. The use of

participatory methods as a systems analysis tool is less well documented (Grogan and Meijer 2017; Hoogen 2018), and the results found in this thesis strengthen the need for more research on this type of application.

The strength of participatory methods is the ability to identify differences in stakeholder perspectives. The experiment on collecting perceptions about the road network field was entirely dedicated to it, but other experiments, like for example the strategy game about the lifecycle perspective of road infrastructure, also helped to reveal how different stakeholders perceive the system and what differences they had in their approaches that can be seen in Paper IV. Participatory methods also help to connect different stakeholders to discuss issues and systems together. In particular, the model building of mental health in cities allowed the participants, who were experts from various fields of the public sector, to address issues of mental health in their field and thus build connections between different fields that are presented in Paper V. Similar behaviour could be expected from the gamification of energy-efficient services in road maintenance, where participants could also connect with each other to share their experiences and suggestions.

The participatory methods used in the experiments proved to provide support for collection of knowledge from the participants, both generated during the session and explicated during the application of the methods. Paper IV describes the experiment that gathered perceptions about the road network field and was primarily dedicated to knowledge collection. This proves that during participatory methods, various information can be collected: what participants did or said, information about their behaviour, body language or other indicators like stress levels, information about the learned experience of participants, etc. All of this data can be used to provide a more holistic understanding of the change. It is an open question, also from the literature (Klabbers 2009), as to whether this all should be assessed from an analytical science or a design science perspective.

The last, but not least, strength of participatory methods in the public sector is its ability to address complex adaptive systems. As seen during the analysis of patterns across the experiments, the most successful participatory methods are the ones with the least knowledge of a connection between causes and effects. Participatory methods can be applied to a wide range of change processes without the need to sacrifice any elements of the system's complexity or adaptability.

### **5.2.2 Weaknesses of participatory methods in the public sector**

While participatory methods work well in the public sector, they may not always be the best choice to use. To be successful, participatory methods require an in-depth analysis of an issue, which demands resources, time and access to the right people. A study of the experiments showed that successful methods need high communication efficiency, use retroactive evaluation and are done based on high stakeholder collaboration. These costs can outweigh all benefits if the problem is not complex or preparation has not been appropriately performed.

Participatory methods cannot be successful if the organisation does not have a proper infrastructure to support the method. In the case of gamification of energy-efficient services in road maintenance, it was decided not to implement the method, because the organisation was not ready to support communication between stakeholders and collection of the data needed for the method, as was concluded in Paper III. Another element of organisational support is the participants themselves. A successful participatory method requires motivated participants with a sufficient level of expertise. The experiment on collecting perceptions about the road network field also had some issues with getting the right people to participate because of low interest in the project and little support from high-level management. This is in line with earlier discussions on the failures of applying gaming simulation (Meijer 2015).

Another potential source of weakness of participatory methods proved to be the right design and choice of the level of participation. In the case of gamification of energy-efficient services in road maintenance, the potential level of participation was low because it intended to manipulate participants to use pre-made decisions. Additionally, in the case of collecting perceptions about the road network field, participants were very limited in the decisions that could be made and as a result, the method had very weak usability. Hence, the choice of level of participation within the method can strongly affect outputs from such applications.

Lastly, some issues of the public sector are not too complex, but only complicated (Kornevs, Kringos, and Meijer 2014; Koppenjan and Klijn 2015), and application of the participatory methods could only make things worse.

### **5.3 Future Work**

This work focused on the assessment of the application of participatory methods for complex adaptive systems in the public sector. Although the experiments and results are sufficient for the current assessment, more could be done to strengthen the analysis. Currently, six experiments were used in the fields of road networks, transit and healthcare using four different participatory methods. A larger variety of methods, fields and number of experiments by both the author and other researchers would enrich the findings of this work. In addition, results from other cultures would be a good addition to these studies as most of the experiments were conducted in Sweden. The assessment framework as used in this study could be replicated in other studies, and it would be a worthwhile endeavour to try to collect the experiences of other researchers by using the same collection and comparison format.

### **5.4 To Conclude**

This work explored the needs for change processes in the public sector from a complex adaptive system perspective. A literature review and open interviews were conducted to identify fields in the public sector and the issues in these fields. Based on these findings six experiments were designed to assess the impact of such methods. As a result, this study assessed the application of participatory methods as an approach to support change processes in the public sector from a complex adaptive system perspective.

## References

- Abdullah, Fadli, and Md Sidin Ahmad Ishak. 2015. "Developing Animation Curricula for Institutions of Higher Learning in Malaysia: Industry and Academic Perspectives." In *Malaysian Media Studies*, 73–85. Kuala Lumpur: University of Malaya Press.
- Abenoza, Roberto F., Oded Cats, and Yusak O. Susilo. 2017. "Travel Satisfaction with Public Transport: Determinants, User Classes, Regional Disparities and Their Evolution." *Transportation Research Part A: Policy and Practice* 95 (January): 64–84.
- Adams, Theodore 'Ted,' Bret W. Butler, Sara Brown, Vita Wright, and Anne Black. 2017. "Bridging the Divide between Fire Safety Research and Fighting Fire Safely: How Do We Convey Research Innovation to Contribute More Effectively to Wildland Firefighter Safety?" *International Journal of Wildland Fire* 26 (2): 107–12.
- Ahsan, Kamrul, and Shams Rahman. 2017. "Green Public Procurement Implementation Challenges in Australian Public Healthcare Sector." *Journal of Cleaner Production* 152: 181–197.
- Akbari, Hashem, Constantinos Cartalis, Denia Kolokotsa, Alberto Muscio, Anna Laura Pisello, Federico Rossi, Matheos Santamouris, Afroditi Synnefa, Nyuk Hien Wong, and Michele Zinzi. 2016. "Local Climate Change and Urban Heat Island Mitigation Techniques—the State of the Art." *Journal of Civil Engineering and Management* 22 (1): 1–16.
- Al Abri, R., Y.m. Al Farsi, P.j. Singh, A.s. Sohal, A. Al Hajri, and S. Al-Balushi. 2014. "Readiness Factors for Lean Implementation in Healthcare Settings – a Literature Review." *Journal of Health Organization and Management* 28 (2): 135–53.
- Alic, John A., and Daniel Sarewitz. 2016. "Rethinking Innovation for Decarbonizing Energy Systems." *Energy Research & Social Science* 21 (November): 212–21.
- Almost, Joan, Angela C. Wolff, Althea Stewart-Pyne, Loretta G. McCormick, Diane Strachan, and Christine D'souza. 2016. "Managing and Mitigating Conflict in Healthcare Teams: An Integrative Review." *Journal of Advanced Nursing* 72 (7): 1490–1505.
- Alvinus, Aida, Alicia Ohlsson, and Gerry Larsson. 2018. "Organizational Challenges and Leaders' Coping Strategies: A Qualitative Study of Swedish Military Staff Organization." *Journal of Military Studies* 1 (ahead-of-print).
- Anthony-McMann, Paula E., Andrea D. Ellinger, Marina Astakhova, and Jonathon R. B. Halbesleben. 2017. "Exploring Different Operationalizations of Employee Engagement and Their Relationships With Workplace Stress and Burnout." *Human Resource Development Quarterly* 28 (2): 163–95.

- Anthun, Kirsti Sarheim, and Siw Tone Innstrand. 2016. "The Predictive Value of Job Demands and Resources on the Meaning of Work and Organisational Commitment across Different Age Groups in the Higher Education Sector." *Journal of Higher Education Policy and Management* 38 (1): 53–67.
- Antony, Jiju. 2015. "Challenges in the Deployment of LSS in the Higher Education Sector: Viewpoints from Leading Academics and Practitioners." *International Journal of Productivity and Performance Management* 64 (6): 893–99.
- Arnstein, Sherry R. 1969. "A Ladder Of Citizen Participation." *Journal of the American Institute of Planners* 35 (4): 216–24..
- Arora, Meenakshi, Hector Malano, Brian Davidson, Rebecca Nelson, and Biju George. 2015. "Interactions between Centralized and Decentralized Water Systems in Urban Context: A Review." *Wiley Interdisciplinary Reviews: Water* 2 (6): 623–34.
- Asselt, Marjolein B.A. van, Joanne Mellors, Nicole Rijkens-Klomp, Sandra C.H. Greeuw, Kirsten G.P. Molendijk, Pieter Jelle Beers, and Philip van Notten. 2001. "Building Blocks for Participation in Integrated Assessment : A Review of Participatory Methods." I01-E003. Maastricht, The Netherlands: International Centre for Integrative Studies (ICIS).
- Astrini, Nidya J, Tri Widiati, Medi Yarmen, Sik Sumaedi, I Gede Mahatma Yuda Bakti, and Tri Rakhmawati. 2016. "Factors Influencing Public Transport Passengers' Satisfaction: A New Model." *Management of Environmental Quality: An International Journal* 27 (5): 585–97.
- Awad, Jihad, Afaq Hyder, and Adi Irfan. 2017. "Development of Smart Cities from Fiction to Reality in Member States of the Gulf Cooperation Council." In *Smart City Networks*, 43–63. Springer.
- Bae, Chang-Hee Christine. 2017. *Urban Sprawl in Western Europe and the United States*. Routledge.
- Baek, Suhyun, and Sunah Kim. 2018. "Participatory Public Service Design by Gov.3.0 Design Group." *Sustainability* 10 (1): 245.
- Baporikar, Neeta. 2016. "Infrastructure Development as a Catalyst for Social-Economic Advancement." *International Journal of System Dynamics Applications (IJSDA)* 5 (4): 101–113.
- Bartunek, Jean M., and Michael K. Moch. 1987. "First-Order, Second-Order, and Third-Order Change and Organization Development Interventions: A Cognitive Approach." *The Journal of Applied Behavioral Science* 23 (4): 483–500.
- Beadle-Brown, Julie, Christine Bigby, and Emma Bould. 2015. "Observing Practice Leadership in Intellectual and Developmental Disability Services." *Journal of Intellectual Disability Research* 59 (12): 1081–1093.

- Beauchamp, Catherine. 2015. "Reflection in Teacher Education: Issues Emerging from a Review of Current Literature." *Reflective Practice* 16 (1): 123–41.
- Bergstrom, John C., and Alan Randall. 2016. *Resource Economics: An Economic Approach to Natural Resource and Environmental Policy, Fourth Edition*. Edward Elgar Publishing.
- Birkland, Thomas A. 2015. *An Introduction to the Policy Process: Theories, Concepts, and Models of Public Policy Making*. Routledge.
- Bizikova, Livia, Darren Swanson, Stephen Tyler, Dimple Roy, and Henry David Venema. 2018. "Policy Adaptability in Practice." *Policy Design and Practice* 1 (1): 47–62.
- Bloom, Nicholas, Renata Lemos, Raffaella Sadun, and John Van Reenen. 2017. "Healthy Business? Managerial Education and Management in Healthcare." National Bureau of Economic Research.
- Boelen, Charles. 2018. "Coordinating Medical Education and Health Care Systems: The Power of the Social Accountability Approach." *Medical Education* 52 (1): 96–102.
- Bond, Brenda J., and Kathryn R. Gabriele. 2018. "Research and Planning Units: An Innovation Instrument in the 21st-Century Police Organization." *Criminal Justice Policy Review* 29 (1): 67–88.
- Bouckaert, Geert, B. Guy Peters, and Koen Verhoest. 2010. "Resources, Mechanisms and Instruments for Coordination." In *The Coordination of Public Sector Organizations: Shifting Patterns of Public Management*, edited by Geert Bouckaert, B. Guy Peters, and Koen Verhoest, 34–66. Public Sector Organizations. London: Palgrave Macmillan UK.
- Bozkurt, Aras, Ela Akgun-Ozbek, Sibel Yilmazel, Erdem Erdogdu, Hasan Ucar, Emel Guler, Sezan Sezgin, et al. 2015. "Trends in Distance Education Research: A Content Analysis of Journals 2009-2013." *The International Review of Research in Open and Distributed Learning* 16 (1).
- Braga, Anthony A., and David L. Weisburd. 2015. "Police Innovation and Crime Prevention: Lessons Learned from Police Research Over the Past 20 Years." SSRN Scholarly Paper ID 2633381. Rochester, NY: Social Science Research Network.
- Brough, Paula, Shannyn Chataway, and Amanda Biggs. 2016. "'You Don't Want People Knowing You're a Copper!' A Contemporary Assessment of Police Organisational Culture." *International Journal of Police Science & Management* 18 (1): 28–36.
- Brown, Barbara B., Carol M. Werner, Ken R. Smith, Calvin P. Tribby, Harvey J. Miller, Wyatt A. Jensen, and Doug Tharp. 2016. "Environmental, Behavioral, and Psychological Predictors of Transit Ridership: Evidence from a Community Intervention." *Journal of Environmental Psychology* 46 (June): 188–96.

- Brynielsson, Joel, Sinna Lindquist, and Linus Luotsinen. 2016. "Efficient Implementation of Simulation Support for Tactical-Level Military Training." In *2016 Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC 2016)*, 1–12. National Training and Simulation Association (NTSA).
- Bryson, John M., Barbara C. Crosby, and Melissa Middleton Stone. 2015. "Designing and Implementing Cross-Sector Collaborations: Needed and Challenging." *Public Administration Review* 75 (5): 647–63.
- Canitez, Fatih. 2018. "Urban Public Transport Systems from New Institutional Economics Perspective: A Literature Review." *Transport Reviews*: 1–20.
- Carayon, Pascale, Peter Hancock, Nancy Leveson, Ian Noy, Laerte Sznclwar, and Geert van Hootegem. 2015. "Advancing a Sociotechnical Systems Approach to Workplace Safety – Developing the Conceptual Framework." *Ergonomics* 58 (4): 548–64.
- Castro-Alvarez, Fernando, Peter Marsters, Diego Ponce de León Barido, and Daniel M. Kammen. 2018. "Sustainability Lessons from Shale Development in the United States for Mexico and Other Emerging Unconventional Oil and Gas Developers." *Renewable and Sustainable Energy Reviews* 82: 1320–1332.
- Ceulemans, Kim, Rodrigo Lozano, and María del Mar Alonso-Almeida. 2015. "Sustainability Reporting in Higher Education: Interconnecting the Reporting Process and Organisational Change Management for Sustainability." *Sustainability* 7 (7): 8881–8903.
- Chambers, Robert. 1994. "Participatory Rural Appraisal (PRA): Analysis of Experience." *World Development* 22 (9): 1253–68.
- Chen, Pin, and Mark Unewisse. 2016. "A Systems Thinking Approach to Engineering Challenges of Military Systems-of-Systems." AR-016-631. Defence Science and Technology Group Canberra BC ACT Australia.
- Chen, Shang-Yu, and Chung-Cheng Lu. 2016. "Exploring the Relationships of Green Perceived Value, the Diffusion of Innovations, and the Technology Acceptance Model of Green Transportation." *Transportation Journal* 55 (1): 51–77.
- Chen, Yuan, Ahmed Bouferguene, Hong Xian Li, Hexu Liu, Yinghua Shen, and Mohamed Al-Hussein. 2018. "Spatial Gaps in Urban Public Transport Supply and Demand from the Perspective of Sustainability." *Journal of Cleaner Production* 195 (September): 1237–48.
- Cheng, Chingwen, Robert L. Ryan, Paige S. Warren, and Craig Nicolson. 2017. "Exploring Stakeholders' Perceptions of Urban Growth Scenarios for Metropolitan Boston (USA): The Relationship Between Urban Trees and Perceived Density." *Cities and the Environment (CATE)* 10 (1): 7.

- Clark, Gordon L., Meric S. Gertler, and John EM Whiteman. 2017. *Regional Dynamics: Studies in Adjustment Theory*. Routledge.
- Cohen-Blankshtain, Galit, and Orit Rotem-Mindali. 2016. "Key Research Themes on ICT and Sustainable Urban Mobility." *International Journal of Sustainable Transportation* 10 (1): 9–17. 94.
- Corder, Gregory W., and Dale I. Foreman. 2014. *Nonparametric Statistics: A Step-by-Step Approach*. 2 edition. Hoboken, New Jersey: Wiley.
- Cornwall, Andrea, and Garrett Pratt. 2011. "The Use and Abuse of Participatory Rural Appraisal: Reflections from Practice." *Agriculture and Human Values* 28 (2): 263–72.
- Cuganesan, Suresh, Alison Hart, and Cara Steele. 2017. "Managing Information Sharing and Stewardship for Public-Sector Collaboration: A Management Control Approach." *Public Management Review* 19 (6): 862–79.
- Darley, Sarah. 2018. "Learning as a Process of Personal-Social Transformation: Volunteering Activity in Health and Social Care Charities." *Mind, Culture, and Activity* 25 (3): 199–215.
- Davies, Amanda, and Amity James. 2016. *Geographies of Ageing: Social Processes and the Spatial Unevenness of Population Ageing*. Routledge.
- Dekker, Sidney. 2016. *Drift into Failure : From Hunting Broken Components to Understanding Complex Systems*. CRC Press.
- Der Zijpp, Teatske van, Eveline JM Wouters, and Janienke Sturm. 2018. "To Use or Not to Use: The Design, Implementation and Acceptance of Technology in the Context of Health Care." In *Assistive Technologies in Smart Cities*. IntechOpen.
- Deuchar, Ross, Johanne Miller, and Mark Barrow. 2015. "Breaking Down Barriers with the Usual Suspects: Findings from a Research-Informed Intervention with Police, Young People and Residents in the West of Scotland." *Youth Justice* 15 (1): 57–75.
- Diao, Mi, Delon Leonard, and Tien Foo Sing. 2017. "Spatial-Difference-in-Differences Models for Impact of New Mass Rapid Transit Line on Private Housing Values." *Regional Science and Urban Economics* 67 (November): 64–77.
- Dillon, Tharam, and Elizabeth Chang. 2016. "Trust and Risk Semantics and Prediction through Big Data Analytics to Encompass Cloud Services, Cyber-Physical Systems, and Social Media: Issues and Challenges." In *Trustcom/BigDataSE/I SPA, 2016 IEEE*, 185–193. IEEE.
- Dooley, Kevin J. 1997. "A Complex Adaptive Systems Model of Organization Change." *Nonlinear Dynamics, Psychology, and Life Sciences* 1 (1): 69–97.
- Drachsler, Hendrik, and Wolfgang Greller. 2016. "Privacy and Analytics: It's a DELICATE Issue a Checklist for Trusted Learning Analytics." In *Proceedings of the Sixth International Conference on Learning Analytics & Knowledge*, 89–98. ACM.

- Driskell, David. 2001. *Creating Better Cities with Children and Youth: A Manual for Participation*. 1 edition. London ; Sterling, VA : Paris: Routledge.
- Du, Zhanwei, Bo Yang, and Jiming Liu. 2017. "Understanding the Spatial and Temporal Activity Patterns of Subway Mobility Flows." *ArXiv:1702.02456 [Cs]*.
- Duarte, Fábio, and Carlo Ratti. 2018. "The Impact of Autonomous Vehicles on Cities: A Review." *Journal of Urban Technology* 25 (4): 3–18.
- Duffhues, Jan, and Luca Bertolini. 2016. "From Integrated Aims to Fragmented Outcomes: Urban Intensification and Transportation Planning in the Netherlands." *Journal of Transport and Land Use* 9 (3): 15–34.
- Dutta, Mohan. 2016. "Social Context of Health and Diversity Issues." In *Handbook of Qualitative Health Research for Evidence-Based Practice*, 7–20. Springer.
- Dyer, Georges, and Michelle Dyer. 2017. "Strategic Leadership for Sustainability by Higher Education: The American College & University Presidents' Climate Commitment." *Journal of Cleaner Production, Systematic Leadership towards Sustainability*, 140 (January): 111–16.
- Ejaz, Waleed, and Alagan Anpalagan. 2019. "Internet of Things for Smart Cities: Overview and Key Challenges." In *Internet of Things for Smart Cities: Technologies, Big Data and Security*, edited by Waleed Ejaz and Alagan Anpalagan, 1–15. SpringerBriefs in Electrical and Computer Engineering. Cham: Springer International Publishing.
- Englund, Claire, Anders D. Olofsson, and Linda Price. 2017. "Teaching with Technology in Higher Education: Understanding Conceptual Change and Development in Practice." *Higher Education Research & Development* 36 (1): 73–87.
- Eppel, Elizabeth Anne, and Mary Lee Rhodes. 2018. "Complexity Theory and Public Management: A 'Becoming' Field." *Public Management Review* 20 (7): 949–59.
- Ervin, Stephen M. 2018. "Turing Landscapes: Computational and Algorithmic Design Approaches and Futures in Landscape Architecture." In *Codify*, 89–114. Routledge.
- Farid, Shahid, Rodina Ahmad, Iftikhar Azim Niaz, Muhammad Arif, Shahaboddin Shamshirband, and Muhammad Daud Khattak. 2015. "Identification and Prioritization of Critical Issues for the Promotion of E-Learning in Pakistan." *Computers in Human Behavior* 51 (October): 161–71.
- Farnell, G. P., A. J. Saddington, and L. J. Lacey. 2019. "A New Systems Engineering Structured Assurance Methodology for Complex Systems." *Reliability Engineering & System Safety* 183: 298–310.
- Figueira, Inês, Ana Rita Domingues, Sandra Caeiro, Marco Painho, Paula Antunes, Rui Santos, Nuno Videira, Richard M. Walker, Donald Huisingh, and Tomás B. Ramos. 2018. "Sustainability Policies and Practices in Public Sector Organisations: The Case

- of the Portuguese Central Public Administration.” *Journal of Cleaner Production* 202 (November): 616–30.
- Fossestøl, Knut, Eric Breit, Tone Alm Andreassen, and Lars Klemsdal. 2015. “Managing Institutional Complexity in Public Sector Reform: Hybridization in Front-Line Service Organizations.” *Public Administration* 93 (2): 290–306.
- Freudental-Pedersen, Malene. 2016. *Mobility in Daily Life: Between Freedom and Unfreedom*. Routledge.
- Fryer, Karen J., Jiju Antony, and Alex Douglas. 2007. “Critical Success Factors of Continuous Improvement in the Public Sector: A Literature Review and Some Key Findings.” *The TQM Magazine* 19 (5): 497–517.
- Gao, L., Z. Fang, W. Gao, T. Gu, L. Zhang, and Q. Li. 2015. “The Construction of Outstanding Engineers’ Training-Oriented Physical Chemistry Curriculum System.” In *Future Communication, Information and Computer Science: Proceedings of the 2014 International Conference on Future Communication, Information and Computer Science (FCICS 2014), May 22-23, 2014, Beijing, China.*, 173. CRC Press.
- Gao, Yiwen, He Li, and Yan Luo. 2015. “An Empirical Study of Wearable Technology Acceptance in Healthcare.” *Industrial Management & Data Systems* 115 (9): 1704–1723.
- Garcia Zambrana, Ivis, and Shabnam Khan. 2018. “Active Transportation and Perceptions of Safety: A Case Study of a Regional Trail and a Transit Corridor in Salt Lake City, Utah.” *Focus* 14 (1).
- Geneletti, Davide, Daniele La Rosa, Marcin Spyra, and Chiara Cortinovis. 2017. “A Review of Approaches and Challenges for Sustainable Planning in Urban Peripheries.” *Landscape and Urban Planning* 165 (September): 231–43.
- Godenhjelm, Sebastian, and Jan-Erik Johanson. 2018. “The Effect of Stakeholder Inclusion on Public Sector Project Innovation.” *International Review of Administrative Sciences* 84 (1): 42–62.
- Goossen, Carolyn, and Michael J. Austin. 2017. “Service User Involvement in UK Social Service Agencies and Social Work Education.” *Journal of Social Work Education* 53 (1): 37–51.
- Gopaldas, Ahir, and Anton Siebert. 2018. “Women over 40, Foreigners of Color, and Other Missing Persons in Globalizing Mediascapes: Understanding Marketing Images as Mirrors of Intersectionality.” *Consumption Markets & Culture*, 1–24.
- Grazia Speranza, M. 2018. “Trends in Transportation and Logistics.” *European Journal of Operational Research* 264 (3): 830–36.
- Green, Lelia, and Donell J. Holloway. 2016. “Communicative Ecologies and the Value of MyFireWatch to the Community of Kununurra.” In *Culture, Technology,*

- Communication. Common World, Different Futures*, edited by José Abdelnour-Nocera, Michele Strano, Charles Ess, Maja Van der Velden, and Herbert Hrachovec, 110–30. IFIP Advances in Information and Communication Technology. Springer International Publishing.
- Grimsey, Darrin, and Mervyn K. Lewis. 2017. *Global Developments in Public Infrastructure Procurement: Evaluating Public–Private Partnerships and Other Procurement Options*. Edward Elgar Publishing.
- Grogan, Paul, and Sebastiaan Meijer. 2017. “Gaming Methods in Engineering Systems Research.” *Systems Engineering* 20 (6): 542–52.
- Guerin, Turlough F. 2017. “Evaluating Expected and Comparing with Observed Risks on a Large-Scale Solar Photovoltaic Construction Project: A Case for Reducing the Regulatory Burden.” *Renewable and Sustainable Energy Reviews* 74: 333–348.
- Haddad, Brent, Nadine Heck, Adina Paytan, and Donald Potts. 2018. “Social Issues and Public Acceptance of Seawater Desalination Plants.” In *Sustainable Desalination Handbook*, 505–25. Plant Selection, Design and Implementation. Santa Cruz, CA, United States: University of California.
- Hafford-Letchfield, Trish. 2016. *Learning in Later Life : Challenges for Social Work and Social Care*. Routledge.
- Hansson, Johan, Elisabet Höög, and Monica Nyström. 2017. “Action Research for Multi-Level Facilitation of Improvement in Health and Social Care: Development of a Change Facilitation Approach for a Local R&D Unit.” *Action Research* 15 (4): 339–56.
- Hashem, Ibrahim Abaker Targio, Victor Chang, Nor Badrul Anuar, Kayode Adewole, Ibrar Yaqoob, Abdullah Gani, Ejaz Ahmed, and Haruna Chiroma. 2016. “The Role of Big Data in Smart City.” *International Journal of Information Management* 36 (5): 748–58.
- Haynes, Philip. 2015. *Managing Complexity in the Public Services*. Routledge.
- He, Sylvia Y., Yannie H. Y. Cheung, and Sui Tao. 2018. “Travel Mobility and Social Participation among Older People in a Transit Metropolis: A Socio-Spatial-Temporal Perspective.” *Transportation Research Part A: Policy and Practice* 118 (December): 608–26.
- Hedlund, Erik, Marcus Börjesson, and Johan Österberg. 2015. “Team Learning in a Multinational Military Staff Exercise.” *Small Group Research* 46 (2): 179–203.
- Helden, Jan van, and Shahzad Uddin. 2016. “Public Sector Management Accounting in Emerging Economies: A Literature Review.” *Critical Perspectives on Accounting, Public Sector Accounting in Emerging Economies – Part 2*, 41 (December): 34–62.

- Henrique, Daniel Barberato, Antonio Freitas Rentes, Moacir Godinho Filho, and Kleber Francisco Esposto. 2016. "A New Value Stream Mapping Approach for Healthcare Environments." *Production Planning & Control* 27 (1): 24–48.
- Heyer, Garth den, and Jonathan Mendel. 2018. "Shaping the Police Workforce: A State-of-the-Art Literature Review." *Policing: An International Journal*, April.
- Hillier, Jean. 2017. *Stretching beyond the Horizon: A Multiplanar Theory of Spatial Planning and Governance*. Routledge.
- Hofstede, Gert Jan, Léon de Caluwé, and Vincent Peters. 2010. "Why Simulation Games Work-In Search of the Active Substance: A Synthesis." *Simulation & Gaming* 41 (6): 824–43. <https://doi.org/10.1177/1046878110375596>.
- Holden, Erling. 2016. *Achieving Sustainable Mobility: Everyday and Leisure-Time Travel in the EU*. Routledge.
- Hollerbach, Brittany S., Katie M. Heinrich, Walker S.C. Poston, C. Keith Haddock, Ainslie K. Kehler, and Sara A. Jahnke. 2017. "Current Female Firefighters' Perceptions, Attitudes, and Experiences with Injury." *International Fire Service Journal of Leadership & Management*, no. 11: 41–47.
- Holopainen, Riikka Maarit, Mervi Niskanen, and Sari Rissanen. 2019. "Management Accounting and Profitability in Private Healthcare SMEs." *International Journal of Public and Private Perspectives on Healthcare, Culture, and the Environment (IJPPHCE)* 3 (1): 28–44.
- Hoogen, Jop van den. 2018. "The Gaming of Systemic Innovations: Innovating in the Railway Sector Using Gaming Simulation." Delft, the Netherlands: Delft University of Technology.
- Hrelja, Robert. 2015. "Integrating Transport and Land-Use Planning? How Steering Cultures in Local Authorities Affect Implementation of Integrated Public Transport and Land-Use Planning." *Transportation Research Part A: Policy and Practice* 74 (April): 1–13.
- Hsiao, Chun-Hua, and Kai-Yu Tang. 2015. "Examining a Model of Mobile Healthcare Technology Acceptance by the Elderly in Taiwan." *Journal of Global Information Technology Management* 18 (4): 292–311.
- Hsieh, Pi-Jung. 2015. "Healthcare Professionals' Use of Health Clouds: Integrating Technology Acceptance and Status Quo Bias Perspectives." *International Journal of Medical Informatics* 84 (7): 512–523.
- Huchzermeyer, Marie, and Philipp Misselwitz. 2016. "Coproducting Inclusive Cities? Addressing Knowledge Gaps and Conflicting Rationalities between Self-Provisioned Housing and State-Led Housing Programmes." *Current Opinion in Environmental Sustainability* 20: 73–79.

- Hussain, Rizwana Shaheen, Kirti Ruikar, Marcus P. Enoch, Nigel Brien, and David Gartside. 2017. "Process Mapping for Road Works Planning and Coordination." *Built Environment Project and Asset Management* 7 (2): 157–172.
- Hussien, Wa'el A., Fayyaz A. Memon, and Dragan A. Savic. 2017. "An Integrated Model to Evaluate Water-Energy-Food Nexus at a Household Scale." *Environmental Modelling & Software* 93 (July): 366–80.
- Hytti, Ulla, Päivikki Kuoppakangas, Kati Suomi, Chris Chapleo, and Massimo Giovanardi. 2015. "Challenges in Delivering Brand Promise—Focusing on Municipal Healthcare Organisations." *International Journal of Public Sector Management* 28 (3): 254–272.
- Islam, SM Riazul, Daehan Kwak, MD Humaun Kabir, Mahmud Hossain, and Kyung-Sup Kwak. 2015. "The Internet of Things for Health Care: A Comprehensive Survey." *IEEE Access* 3: 678–708.
- Ismail, Zul-Atfi Bin. 2018. "Improving Contractor Social Networking on IBS Infrastructure Maintenance Projects: A Review." *Engineering, Construction and Architectural Management*.
- Janice Elliott, Sara Heesterbeek, Carolyn J. Lukensmeyer, and Nikki Slocum-Bradley. 2006. *Participatory Methods Toolkit. A Practitioner's Manual*. 2nd ed. King Baudouin Foundation; The Flemish Institute for Science and Technology Assessment (viWTA).
- Jarvis, Wade, Ingrid M. O'Brien, and Geoffrey N. Soutar. 2015. "Integrating Social Issues and Customer Engagement to Drive Loyalty in a Service Organisation." *Journal of Services Marketing* 29 (6/7): 547–59.
- Jin, Myung H., and Bruce McDonald. 2017. "Understanding Employee Engagement in the Public Sector: The Role of Immediate Supervisor, Perceived Organizational Support, and Learning Opportunities." *The American Review of Public Administration* 47 (8): 881–97.
- Kai, Weigrich. 2014. "Public Sector." *Encyclopedia Britannica*. March 2014. <https://www.britannica.com/topic/public-sector>.
- Kamrath, Carolin, Srinivasulu Rajendran, Ngoni Nenguwo, Victor Afari-Sefa, and Stefanie Bröring. 2018. "Adoption Behavior of Market Traders: An Analysis Based on Technology Acceptance Model and Theory of Planned Behavior." *International Food and Agribusiness Management Review* 21 (6): 771–90.
- Kankanhalli, Atreyi, Anneke Zuiderwijk, and Giri Kumar Tayi. 2017. "Open Innovation in the Public Sector: A Research Agenda." *Government Information Quarterly*, Open Innovation in the Public Sector, 34 (1): 84–89.
- Kennedy, Monica, Stephen Billett, Silvia Gherardi, and Laurie Grealish. 2015. "Practice-Based Learning in Higher Education: Jostling Cultures." In *Practice-Based Learning in Higher Education: Jostling Cultures*, edited by Monica Kennedy, Stephen Billett,

- Silvia Gherardi, and Laurie Grealish, 1–13. *Professional and Practice-Based Learning*. Dordrecht: Springer Netherlands.
- Klabbers, Jan H. G. 2009. *The Magic Circle: Principles of Gaming & Simulation*. Third and Revised Edition. Rotterdam, The Netherlands: Sense Publishers.
- Klebanov, Pamela Kato, Jeanne Brooks-Gunn, and Greg J. Duncan. 1994. “Does Neighborhood and Family Poverty Affect Mothers’ Parenting, Mental Health, and Social Support?” *Journal of Marriage and the Family*, 441–455.
- Koppenjan, Joop, and Erik Hans Klijn. 2015. *Governance Networks in the Public Sector*. Routledge.
- Kornevs, Maksims, Nicole Kringos, and Sebastiaan Meijer. 2014. “A Research Agenda for Green Procurement of Infrastructures.” In *2014 International ICE Conference on Engineering, Technology and Innovation (ICE)*, 1–7.
- Krieger, Nancy. 2017. “Police Killings, Political Impunity, Racism and the People’s Health: Issues for Our Times.” *Harvard Public Health* 3 (1): 1–3.
- Kuipers, Ben S., Malcolm Higgs, Walter Kickert, Lars Tummers, Jolien Grandia, and Joris Van Der Voet. 2014. “The Management of Change in Public Organizations: A Literature Review.” *Public Administration* 92 (1): 1–20.
- Kuo, Yong-Hong, and W. Y. Szeto. 2018. “Smart Transportation and Analytics.” *Transportmetrica B: Transport Dynamics* 6 (1): 1–3.
- Kuwayama, Yusuke, Sheila Olmstead, and Alan Krupnick. 2015. “Water Quality and Quantity Impacts of Hydraulic Fracturing.” *Current Sustainable/Renewable Energy Reports* 2 (1): 17–24.
- Ladan, Muhammad Awwal, Heather Wharrad, and Richard Windle. 2018. “Towards Understanding Healthcare Professionals’ Adoption and Use of Technologies in Clinical Practice: Using Qmethodology and Models of Technology Acceptance.” *Journal of Innovation in Health Informatics* 25 (1): 027–037.
- Langemeyer, Johannes, Erik Gómez-Baggethun, Dagmar Haase, Sebastian Scheuer, and Thomas Elmqvist. 2016. “Bridging the Gap between Ecosystem Service Assessments and Land-Use Planning through Multi-Criteria Decision Analysis (MCDA).” *Environmental Science & Policy* 62: 45–56.
- Lee, Paul Tae-Woo, Yi-Shih Chung, and Jasmine Siu Lee Lam. 2016. “Transportation Research Trends in Environmental Issues: A Literature Review of Methodology and Key Subjects.” *International Journal of Shipping and Transport Logistics* 8 (6): 612–31.
- Leistner, Deborah L., and Ruth L. Steiner. 2017. “Uber for Seniors? Exploring Transportation Options for the Future.” *Transportation Research Record: Journal of the*

- Transportation Research Board* 2660 (January): 22–29. <https://doi.org/10.3141/2660-04>.
- Leventhal, Tama, and Jeanne Brooks-Gunn. 2003. “Moving to Opportunity: An Experimental Study of Neighborhood Effects on Mental Health.” *American Journal of Public Health* 93 (9): 1576–1582.
- Leyden, Kevin M., Amanda Slevin, Thomas Grey, Mike Hynes, Fanney Frisbaek, and Richard Silke. 2017. “Public and Stakeholder Engagement and the Built Environment: A Review.” *Current Environmental Health Reports* 4 (3): 267–77.
- Li, Guijun, Daohan Huang, Chengshuang Sun, and Yulong Li. 2019. “Developing Interpretive Structural Modeling Based on Factor Analysis for the Water-Energy-Food Nexus Conundrum.” *Science of The Total Environment* 651 (February): 309–22. <https://doi.org/10.1016/j.scitotenv.2018.09.188>.
- Li, Jing-Quan. 2016. “Battery-Electric Transit Bus Developments and Operations: A Review.” *International Journal of Sustainable Transportation* 10 (3): 157–69.
- Liang, Xueping, Sachin Shetty, Juan Zhao, Daniel Bowden, Danyi Li, and Jihong Liu. 2017. “Towards Decentralized Accountability and Self-Sovereignty in Healthcare Systems.” In *International Conference on Information and Communications Security*, 387–398. Springer.
- Littlefield, Robert S., Jessica M. Rick, and Jenna L. Currie-Mueller. 2016. “Connecting Intercultural Communication Service Learning with General Education: Issues, Outcomes, and Assessment.” *The Journal of General Education* 65 (1): 66–84.
- Lora Grando, Rafaela, Adelaide Maria de Souza Antune, Fabiana Valéria da Fonseca, Antoni Sánchez, Raquel Barrena, and Xavier Font. 2017. “Technology Overview of Biogas Production in Anaerobic Digestion Plants: A European Evaluation of Research and Development.” *Renewable and Sustainable Energy Reviews* 80 (December): 44–53.
- Maco, Barbara, Paul Bardos, Frederic Coulon, Emerald Erickson-Mulanax, Lara J. Hansen, Melissa Harclerode, Deyi Hou, et al. 2018. “Resilient Remediation: Addressing Extreme Weather and Climate Change, Creating Community Value.” *Remediation Journal* 29 (1): 7–18.
- Marletto, Gerardo. 2019. “Who Will Drive the Transition to Self-Driving? A Socio-Technical Analysis of the Future Impact of Automated Vehicles.” *Technological Forecasting and Social Change* 139 (February): 221–34.
- Mauss, Fredrick, Juan Valencia, Brian Hatchell, Kurt Silvers, and Shannon Crowell. 2015. “System of Systems Approaches for Mobile Source Transit Security.” *INCOSE International Symposium* 25 (1): 1278–89.
- McCann, Philip. 2017. “Urban Futures, Population Ageing and Demographic Decline.” *Cambridge Journal of Regions, Economy and Society* 10 (3): 543–557.

- McDermott, Kevin, Elizabeth C. Kurucz, and Barry A. Colbert. 2018. "Social Entrepreneurial Opportunity and Active Stakeholder Participation: Resource Mobilization in Enterprising Conveners of Cross-Sector Social Partnerships." *Journal of Cleaner Production* 183 (May): 121–31.
- McDonough, Suzanne L., Jonathan S. Phillips, and Travis J. Twilbeck. 2015. "Determining Best Practices to Reduce Occupational Health Risks in Firefighters." *The Journal of Strength & Conditioning Research* 29 (7): 2041..
- Meijer, Sebastiaan. 2009. "The Organisation of Transactions: Studying Supply Networks Using Gaming Simulation." Wageningen.
- . 2015. "The Power of Sponges: Comparing High-Tech and Low-Tech Gaming for Innovation." *Simulation & Gaming* 46 (5): 512–35.
- Miller, Patrick, Alexandre G. de Barros, Lina Kattan, and S. C. Wirasinghe. 2016. "Public Transportation and Sustainability: A Review." *KSCE Journal of Civil Engineering* 20 (3): 1076–83.
- Mirzakhanyan, Ruben, Srбуhi Gevorgyan, and Vladimir Karapetyan. 2016. "Research as a Deliberate Chess Activity Software Testing Platform for Professional Dynamic Development of the Education Sector." *Management Studies* 4 (4): 161–66.
- Mok, Ka Yan, Geoffrey Qiping Shen, and Jing Yang. 2015. "Stakeholder Management Studies in Mega Construction Projects: A Review and Future Directions." *International Journal of Project Management* 33 (2): 446–457.
- Money, Arthur G., Anita Atwal, Katherine L. Young, Yasmin Day, Lesley Wilson, and Kevin G. Money. 2015. "Using the Technology Acceptance Model to Explore Community Dwelling Older Adults' Perceptions of a 3D Interior Design Application to Facilitate Pre-Discharge Home Adaptations." *BMC Medical Informatics and Decision Making* 15 (1): 73.
- Morden, Tony. 2016. *Principles of Strategic Management*. Routledge.
- Moretti, Laura, and Giuseppe Loprencipe. 2018. "Climate Change and Transport Infrastructures: State of the Art." *Sustainability* 10 (11): 4098.
- Morowitz, Harold J. 2018. *The Mind, The Brain And Complex Adaptive Systems*. Routledge.
- Mosse, D. 2001. "'People's Knowledge', Participation and Patronage: Operations and Representations in Rural Development." In *Participation : The New Tyranny*, edited by Bill Cooke and Uma Kothari. London: Zed books.
- Mubita, Aurick, Mundia Libati, and Munalula Mulonda. 2017. "The Importance and Limitations of Participation in Development Projects and Programmes." *European Scientific Journal, ESJ* 13 (5): 238. <https://doi.org/10.19044/esj.2017.v13n5p238>.
- Mutlu, Mehmet. 2016. *Biosensors in Food Processing, Safety, and Quality Control*. CRC Press.

- Nakrošis, Vitalis, Ramūnas Vilpišauskas, and Vytautas Kuokštis. 2015. "Fiscal Consolidation and Structural Reforms in Lithuania in the Period 2008–2012: From Grand Ambitions to Hectic Firefighting." *International Review of Administrative Sciences* 81 (3): 522–40.
- Nelson, Ramona, and Nancy Staggers. 2016. *Health Informatics-E-Book: An Interprofessional Approach*. Elsevier Health Sciences.
- Niakan, Farzad, and Mohammad Rahimi. 2015. "A Multi-Objective Healthcare Inventory Routing Problem; a Fuzzy Possibilistic Approach." *Transportation Research Part E: Logistics and Transportation Review* 80: 74–94.
- Nuzzolo, Agostino, and Antonio Comi. 2016. "Advanced Public Transport and Intelligent Transport Systems: New Modelling Challenges." *Transportmetrica A: Transport Science* 12 (8): 674–99..
- Offenbeek, Marjolein AG van, and Janita FJ Vos. 2016. "An Integrative Framework for Managing Project Issues across Stakeholder Groups." *International Journal of Project Management* 34 (1): 44–57.
- O'Hara, Jane Kathryn, Katja Grasic, Nils Gutacker, Andrew David Street, Robbie Foy, Carl Anthony Thompson, John Wright, and Rebecca Lawton. 2018. "Looking for the Positives? A Mixed-Methods Study Using Routinely Collected, Publicly Available Data to Identify Positive Deviants in Healthcare Quality and Safety." *Journal of the Royal Society of Medicine*.
- Oña, Juan de, Rocio de Oña, Laura Eболи, Carmen Forciniti, and Gabriella Mazzulla. 2016. "Transit Passengers' Behavioural Intentions: The Influence of Service Quality and Customer Satisfaction." *Transportmetrica A: Transport Science* 12 (5): 385–412.
- Palvia, Prashant, Tim Jacks, and Wiley S. Brown. 2015. "Critical Issues in EHR Implementation: Provider and Vendor Perspectives." *CAIS* 36: 36.
- Papagiannakis, Apostolos, Ioannis Baraklianos, and Alexia Spyridonidou. 2018. "Urban Travel Behaviour and Household Income in Times of Economic Crisis: Challenges and Perspectives for Sustainable Mobility." *Transport Policy* 65: 51–60.
- Paul, Partha Sarathi, Krishnandu Hazra, Sujay Saha, Subrata Nandi, Sandip Chakraborty, and Sajal Das. 2017. "Generating Crisis Maps for Large-Scale Disasters: Issues and Challenges." In *Wireless Public Safety Networks 3*, edited by Daniel Câmara and Navid Nikaein, 67–98. Elsevier.
- Pazell, Sara, Robin Burgess-Limerick, Tim Horberry, and Paul Davidson. 2016. "Human-Centred Design in Civil Road Construction: Methods to Inform Procurement and Improve Performance." *Journal of Health and Safety Research and Practice* 8 (1): 3–14.

- Peng, Jian, Mingyue Zhao, Xiaonan Guo, Yajing Pan, and Yanxu Liu. 2017. "Spatial-Temporal Dynamics and Associated Driving Forces of Urban Ecological Land: A Case Study in Shenzhen City, China." *Habitat International* 60: 81–90.
- Peters, B. Guy. 2018. *American Public Policy: Promise and Performance*. Los Angeles: CQ Press.
- Petrovic, Emina K., Brenda Vale, and Maibritt Pedersen Zari. 2017. *Materials for a Healthy, Ecological and Sustainable Built Environment: Principles for Evaluation*. Woodhead Publishing.
- Pettang, Chrispin. 2016. *Decision Support for Construction Cost Control in Developing Countries*. IGI Global.
- Pincetl, Stephanie, Mikhail Chester, and David Eisenman. 2016. "Urban Heat Stress Vulnerability in the U.S. Southwest: The Role of Sociotechnical Systems." *Sustainability* 8 (9): 842.
- Pollitt, Christopher. 2007. "Convergence or Divergence: What Has Been Happening in Europe?" In *New Public Management in Europe: Adaptation and Alternatives*, edited by Christopher Pollitt, Sandra van Thiel, and Vincent Homburg, 10–25. London: Palgrave Macmillan UK.
- Pollitt, Christopher, and Geert Bouckaert. 2017. *Public Management Reform: A Comparative Analysis - Into The Age of Austerity*. Oxford University Press.
- Polo, Antonio J., Bridget A. Makol, Ashley S. Castro, Nicole Colón-Quintana, Amanda E. Wagstaff, and Sisi Guo. 2018. "Diversity in Randomized Clinical Trials of Depression: A 36-Year Review." *Clinical Psychology Review*.
- Princen, Sebastiaan, Karin Geuijen, Jeroen Candel, Oddy Folgerts, and Ragna Hooijer. 2016. "Establishing Cross-Border Co-Operation between Professional Organizations: Police, Fire Brigades and Emergency Health Services in Dutch Border Regions." *European Urban and Regional Studies* 23 (3): 497–512.
- Provan, Keith G., and H. Brinton Milward. 2001. "Do Networks Really Work? A Framework for Evaluating Public-Sector Organizational Networks." *Public Administration Review* 61 (4): 414–23.
- Psomas, Evangelos, and Jiju Antony. 2017. "Total Quality Management Elements and Results in Higher Education Institutions: The Greek Case." *Quality Assurance in Education* 25 (2): 206–23.
- Pucciarelli, Francesca, and Andreas Kaplan. 2016. "Competition and Strategy in Higher Education: Managing Complexity and Uncertainty." *Business Horizons* 59 (3): 311–20.
- Pulido, Lizeth Xiomara Vargas, Nicolás Olaya Villamil, and Giovanni Tarazona. 2017. "E-Learning Platforms Analysis for Encourage Colombian Education." In *Knowledge*

- Management in Organizations*, edited by Lorna Uden, Wei Lu, and I-Hsien Ting, 107–18. Communications in Computer and Information Science. Springer International Publishing.
- Quan, Rose, Xinming He, and Diane Sloan. 2016. “Examining Chinese Postgraduate Students’ Academic Adjustment in the UK Higher Education Sector: A Process-Based Stage Model.” *Teaching in Higher Education* 21 (3): 326–43.
- Radnor, Zoe J., Nicola Bateman, Ann Esain, Maneesh Kumar, Sharon J. Williams, and David M. Upton. 2015. *Public Service Operations Management: A Research Handbook*. Routledge.
- Rathore, M. Mazhar, Awais Ahmad, Anand Paul, and Seungmin Rho. 2016. “Urban Planning and Building Smart Cities Based on the Internet of Things Using Big Data Analytics.” *Computer Networks, Industrial Technologies and Applications for the Internet of Things*, 101 (June): 63–80.
- Reece, Ian, and Stephen Walker. 2016. *Teaching, Training and Learning: A Practical Guide*. Business Education Publishers Ltd.
- Rich, Karl M., Magda Rich, and Kanar Dizyee. 2018. “Participatory Systems Approaches for Urban and Peri-Urban Agriculture Planning: The Role of System Dynamics and Spatial Group Model Building.” *Agricultural Systems* 160: 110–123.
- Rieger, Janice, Marianella Chamorro-Koc, Amanda T. Beatson, and Carla Sartori Do Amaral. 2018. “Creating a Culture of Inclusion in the Public Service Sector: Research Report.” Report.
- Riksrevisionen. 2012. “Trafikverkets Upphandling Av Vägar Och Järnvägar– Leder Den till Hög Produktivitet?” RIR 2012:14.
- Rimpiläinen, Sanna, Ciarán Morrison, and Laura Rooney. 2016. “The Potential of Digital Solutions for Integration of Health and Social Care Services.”
- Rode, Philipp, Graham Floater, Nikolas Thomopoulos, James Docherty, Peter Schwinger, Anjali Mahendra, and Wanli Fang. 2017. “Accessibility in Cities: Transport and Urban Form.” In *Disrupting Mobility: Impacts of Sharing Economy and Innovative Transportation on Cities*, edited by Gereon Meyer and Susan Shaheen, 239–73. Lecture Notes in Mobility. Cham: Springer International Publishing.
- Roness, Paul G. 2017. “Types of State Organizations: Arguments, Doctrines and Changes Beyond New Public Management.” In *Transcending New Public Management*.
- Rossum, Lisa van, Kjeld Harald Aij, Frederique Elisabeth Simons, Niels van der Eng, and Wouter Dirk ten Have. 2016. “Lean Healthcare from a Change Management Perspective: The Role of Leadership and Workforce Flexibility in an Operating Theatre.” *Journal of Health Organization and Management* 30 (3): 475–493.

- Rusoja, Evan, Deson Haynie, Jessica Sievers, Navonil Mustafee, Fred Nelson, Martin Reynolds, Eric Sarriot, Robert Chad Swanson, and Bob Williams. 2018. "Thinking about Complexity in Health: A Systematic Review of the Key Systems Thinking and Complexity Ideas in Health." *Journal of Evaluation in Clinical Practice* 24 (3): 600–606.
- Russ, Travis L. 2010. "Programmatic and Participatory: Two Frameworks for Classifying Experiential Change Implementation Methods." *Simulation & Gaming* 41 (5): 767–86.
- Rycroft-Malone, Jo, Christopher R. Burton, Tracey Bucknall, Ian D. Graham, Alison M. Hutchinson, and Dawn Stacey. 2016. "Collaboration and Co-Production of Knowledge in Healthcare: Opportunities and Challenges." *International Journal of Health Policy and Management* 5 (4): 221.
- Rye, Tom, Jason Monios, Robert Hrelja, and Karolina Isaksson. 2018. "The Relationship between Formal and Informal Institutions for Governance of Public Transport." *Journal of Transport Geography* 69 (May): 196–206.
- Sagieva, Galina, and Maxim Kotsemir. 2018. "Measuring Technological Level of Organisations: Methodological Approaches and Assessment." *Foresight* 20 (4): 416–42.
- Sahi, Muneeb Ahmed, Haider Abbas, Kashif Saleem, Xiaodong Yang, Abdelouahid Derhab, Mehmet A. Orgun, Waseem Iqbal, Imran Rashid, and Asif Yaseen. 2018. "Privacy Preservation in E-Healthcare Environments: State of the Art and Future Directions." *Ieee Access* 6: 464–478.
- Sallis, James F, Fiona Bull, Ricky Burdett, Lawrence D Frank, Peter Griffiths, Billie Giles-Corti, and Mark Stevenson. 2016. "Use of Science to Guide City Planning Policy and Practice: How to Achieve Healthy and Sustainable Future Cities." *The Lancet* 388 (10062): 2936–47.
- Saluja, Sonali, Leah Zallman, Rachel Nardin, David Bor, Steffie Woolhandler, David U. Himmelstein, and Danny McCormick. 2016. "Support for National Health Insurance Seven Years Into Massachusetts Healthcare Reform: Views of Populations Targeted by the Reform." *International Journal of Health Services* 46 (1): 185–200.
- Schiller, Maria. 2017. "Authenticity or Skill-Oriented Individualism, Neutrality or Managerialism: Diversity Officers as Modern Public Officials." *Journal of Ethnic and Migration Studies* 43 (10): 1662–1678.
- Schuck, Amie M., and Cara Rabe-Hemp. 2016. "Citizen Complaints and Gender Diversity in Police Organisations." *Policing and Society* 26 (8): 859–74.
- Scott, Kimberly. 2016. "Cross Culture Management: Global Healthcare Workers." *Journal of Continuing Education Topics & Issues* 18 (3): 68.

- Seuwou, Patrice, Ebad Banissi, George Ubakanma, Mhd Saeed Sharif, and Ann Healey. 2017. "Actor-Network Theory as a Framework to Analyse Technology Acceptance Model's External Variables: The Case of Autonomous Vehicles." In *International Conference on Global Security, Safety, and Sustainability*, 305–320. Springer.
- Seyfried, Markus, and Moritz Ansmann. 2018. "Unfreezing Higher Education Institutions? Understanding the Introduction of Quality Management in Teaching and Learning in Germany." *Higher Education* 75 (6): 1061–76.
- Shen, Wenxin, Wenzhe Tang, Wenyang Yu, Colin F. Duffield, Felix Kin Peng Hui, Yongping Wei, and Jun Fang. 2017. "Causes of Contractors' Claims in International Engineering-Procurement-Construction Projects." *Journal of Civil Engineering and Management* 23 (6): 727–739.
- Shengrui, ZHANG, WANG Yingjie, J. U. Hongrun, L. I. Daichao, FANG Lei, Q. I. Junhui, WANG Yingying, and ZHANG Tongyan. 2018. "Spatial Distribution and Influencing Factors of Interprovincial Terrestrial Physical Geographical Names in China." *地理学报 (英文版)* 28 (12): 1845–1859.
- Simmons, J. 2016. *The Education Dilemma: Policy Issues for Developing Countries in the 1980s*. Elsevier.
- Skinner, Mark, and Neil Hanlon. 2015. *Ageing Resource Communities: New Frontiers of Rural Population Change, Community Development and Voluntarism*. Routledge.
- Spearman, C. 1904. "The Proof and Measurement of Association between Two Things." *The American Journal of Psychology* 15 (1): 72–101. <https://doi.org/10.2307/1412159>.
- Srirangam Ramaprasad, Badrinarayan, Nandan Prabhu K.P., Sethumadhavan Lakshminarayanan, and Yogesh P. Pai. 2017. "Human Resource Management Practices and Organizational Commitment: Research Methods, Issues and Future Directions (2001-2016)." *Industrial and Commercial Training* 49 (6): 277–87.
- Srivastava, Sonali, and Madhavi Rajadhyaksha. 2016. "Can Organisation Development Principles in India's Local Governments Improve Governance?" *Commonwealth Journal of Local Governance*, no. 19 (December): 135.
- Stiglitz, Joseph E, and Jay K Rosengard. 2015. *Economics of the Public Sector: Fourth International Student Edition*. W. W. Norton & Company.
- Strudwick, Katie, Jill Jameson, and Jackie Rowe. 2017. "Developing Volunteers in Policing: Assessing the Potential Volunteer Police Community Police Officer." *Policing: A Journal of Policy and Practice*. <https://doi.org/10.1093/police/pax056>.
- Sullivan, Helen, and Chris Skelcher. 2017. *Working Across Boundaries: Collaboration in Public Services*. Macmillan International Higher Education.

- Sumalee, Agachai, and Hung Wai Ho. 2018. "Smarter and More Connected: Future Intelligent Transportation System." *IATSS Research* 42 (2): 67–71. <https://doi.org/10.1016/j.iatssr.2018.05.005>.
- Sutyagin, Igor, and Justin Bronk. 2017. "Geographical Distribution and Mission Assignments of Russian Military Units." *Whitehall Papers* 89 (1): 89–129.
- Tafti, Mojgan Taheri. 2019. "Urban Resilience and the Politics of Scale." In *Resilience and Urban Disasters*. Edward Elgar Publishing.
- Talari, Saber, Miadreza Shafie-khah, Pierluigi Siano, Vincenzo Loia, Aurelio Tommasetti, and João P. S. Catalão. 2017. "A Review of Smart Cities Based on the Internet of Things Concept." *Energies* 10 (4): 421.
- Taylor, Nigel A. S., Hugh H. K. Fullagar, Brendan J. Mott, John A. Sampson, and Herbert Groeller. 2015. "Employment Standards for Australian Urban Firefighters: Part 1 The Essential, Physically Demanding Tasks." *Journal of Occupational and Environmental Medicine* 57 (10): 1063.
- Torfig, Jacob, Eva Sørensen, and Asbjørn Røiseland. 2016. "Transforming the Public Sector Into an Arena for Co-Creation: Barriers, Drivers, Benefits, and Ways Forward." *Administration & Society*.
- Tunji-Olayeni, P. F., Moses Emeteri, and A. O. Afolabi. 2017. "Multilayer Perceptron Network Model for Construction Material Procurement in Fast Developing Cities." *International Journal of Civil Engineering and Technology (IJCIET)* 8 (5): 1468–1475.
- Vrangbaek, Karsten. 2015. "Patient Involvement in Danish Health Care." *Journal of Health Organization and Management* 29 (5): 611–624.
- Warner, Jeroen. 2016. "The Beauty of the Beast: Multi-Stakeholder Participation for Integrated Catchment Management." In *Multi-Stakeholder Platforms for Integrated Water Management*.
- Wilkinson, Mike, Chris Jordan, and Fleur Currie. 2016. "Developing Strategic Systemic Solutions to Complex Problems in the UK Defence Enterprise." In *INCOSE International Symposium*, 26:220–237. Wiley Online Library.
- Young, Celeste, Joanne Pyke, Neelam Maharaj, Bruce Rasmussen, and Roger Jones. 2018. "Diversity and Inclusion: Building Strength and Capability Literature Review." Bushfire and Natural Hazards CRC.
- Yuan, Zhou, and Miao Yao Feng. 2016. "Design of Intelligent Transportation System Based on the Technology of Information and Communication Engineering." *TELKOMNIKA (Telecommunication Computing Electronics and Control)* 14 (2A): 180–188.

Zavadskas, Edmundas, Jurgita Antucheviciene, Tatjana Vilutiene, and Hojjat Adeli. 2018. "Sustainable Decision-Making in Civil Engineering, Construction and Building Technology." *Sustainability* 10 (1): 14.



## Appendix A

A checklist for evaluation of participatory methods design based on works of Arnstein (1969), Asselt *et al.* (2001) and Russ (2010).

<b>1</b>	<b>Level of participation</b>	
1.1	Participants can take part (passive or active) at least at some steps of planning	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
1.2	Participants are informed about change processes and they can comment on the changes	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
1.3	Participants' views are heeded by the power holders	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
1.4	Participants can negotiate and engage in trade-offs with power holders	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
1.5	Participants obtain the majority of decision-making seat	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
<b>2</b>	<b>Targeted outcome</b>	
2.1	A method seeks to uncover a spectrum of options and information (divergence)	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
2.2	A method enables groups to disclose information or makes tacit knowledge explicit	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
2.3	A method tests alternative strategies	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
2.4	A method seeks to define or single out one option or decision (convergence)	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
2.5	A method aims to reach an informed decision on an issue	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
<b>3</b>	<b>Aspiration</b>	
3.1	A method enriches the quality of a change process with contextual knowledge and stakeholder opinions	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
3.2	Participants in a method are part of the decision making process	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1

3.3	Participants in a method are used as a support in decision making	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
3.4	A method enables participants to employ their own knowledge to create options for tackling (policy) issues that directly concern them	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
3.5	A method reveals stakeholders' knowledge, values and ideas that are relevant to the process of decision-making	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
<b>4</b>	<b>Flexibility of implementation</b>	
4.1	A method follows leaders' step-by-step blueprints for implementing organisational change	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
4.2	A method evaluates decisions as right or wrong	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
4.3	A method allows adaption and can address unexpected decisions	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
4.4	A method offers flexibility in how change is implemented	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
4.5	A method fosters dialogic communication	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
<b>5</b>	<b>Direction from leadership</b>	
5.1	A method includes descriptions of a change	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
5.2	A method has implementation instructions for innovation	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
5.3	A method emphasises organic change within implementation process	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
5.4	A method conveys specific expectations for a leader's vision of a change	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
5.5	A method is open to more than one interpretation	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
<b>6</b>	<b>Internal stakeholder collaboration</b>	
6.1	A method allows stakeholders to provide input on where and how to implement a change	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
6.2	A method gives ownership over changes to stakeholders	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1

6.3	A method requires a dialogue between stakeholders on different levels	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
6.4	A method provides an opportunity for stakeholders to express their views	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
6.5	A method elicits great amounts of stakeholder input	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
<b>7</b>	<b>External stakeholder collaboration</b>	
7.1	A method allows stakeholders to provide input on where and how to implement a change	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
7.2	A method gives ownership over changes to stakeholders	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
7.3	A method requires a dialogue between stakeholders from different organisations	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
7.4	A method provides an opportunity for stakeholders to express their views	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
7.5	A method elicits great amounts of input from external stakeholders	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
<b>8</b>	<b>Organisational climate</b>	
8.1	A method fosters perceptions of organisational democracy	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
8.2	A method aims to build consensus and commitment to proposed changes	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
8.3	A method implies that leaders are the “thinkers” and employees are the “doers”	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
8.4	A method is applied in an organisation with organisational inequality	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
8.5	A method uses input from internal stakeholders	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
<b>9</b>	<b>Communication efficiency</b>	
9.1	A method requires significant resources, time, and energy from implementers	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
9.2	A methods requires significant resources, time, and energy from employees	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1

9.3	A method has unique needs, expectations, and requirements for participants	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
9.4	A method is challenging to coordinate and administrate	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
9.5	A method offers leaders flexibility in developing a priori evaluation plans	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
<b>10</b>	<b>Evaluation of successful change</b>	
10.1	A method has specific metrics for evaluating the progress	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
10.2	A method provides continuous, up-to-date feedback that can help monitor the direction of the change process	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
10.3	A method promotes an evolution of organic and unanticipated outcomes	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
10.4	A method can measure outcomes only retroactively	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
10.5	A method offers leaders flexibility in developing a priori evaluation plans	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
<b>11</b>	<b>Priority of action and thoughts</b>	
11.1	The most important outcomes of a method are recorded data	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
11.2	A method focuses on communication process between participants	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
11.3	Physical outcomes from a method are more important than mental models	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
11.4	The most important outcome of a method is debriefing	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
11.5	A method focuses on factors that influenced decision making process of participants	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
<b>12</b>	<b>Focus of experiment</b>	
12.1	The most important outcome of a method is its final data from work of participants	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
12.2	Gained experience of participants is the main outcome of a method	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1

12.3	The highest focus of a method is to observe and evaluate behaviour of participants	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
12.4	Decision making process is a process that is investigated by a method	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
12.5	A method has standardised forms or blanks that participants must fill out as part of the process	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1
<b>13</b>	<b>Knowledge between causes and effects</b>	
13.1	At least some major causes in a system are known	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
13.2	At least some major effects in a system are known	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
13.3	At least some major connections in a system are known	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
13.4	Accurate model(s) of a system is(are) available	<input type="checkbox"/> yes +1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no -1
13.5	A system has at least some major unknown factors	<input type="checkbox"/> yes -1 <input type="checkbox"/> in between 0 <input type="checkbox"/> no +1

## Appendix B

Evaluation of experiments based on the checklist for evaluation of participatory methods design.

	Experiment A	Experiment B	Experiment C	Experiment D	Experiment E	Experiment F
<i>Level of participation</i>						
1.1	yes	yes	yes	no	yes	yes
1.2	yes	yes	yes	no	no	yes
1.3	yes	yes	yes	no	no	yes
1.4	yes	no	yes	no	no	yes
1.5	yes	no	no	no	no	yes
<b>Total</b>	<b>1</b>	<b>1</b>	<b>3</b>	<b>-5</b>	<b>-3</b>	<b>5</b>
<i>Targeted outcome</i>						
2.1	no	no	no	in between	yes	yes
2.2	no	yes	yes	yes	yes	yes
2.3	no	in between	in between	yes	in between	yes
2.4	yes	yes	yes	no	no	no
2.5	yes	yes	yes	yes	no	no
<b>Total</b>	<b>5</b>	<b>2</b>	<b>2</b>	<b>-3</b>	<b>-4</b>	<b>-5</b>
<i>Aspiration</i>						
3.1	no	yes	no	yes	no	no
3.2	no	no	yes	no	yes	yes
3.3	yes	yes	in between	yes	yes	no
3.4	no	no	yes	yes	yes	yes
3.5	yes	yes	no	yes	no	no
<b>Total</b>	<b>3</b>	<b>5</b>	<b>-4</b>	<b>3</b>	<b>-3</b>	<b>-5</b>
<i>Flexibility of implementation</i>						
4.1	yes	yes	no	yes	yes	no
4.2	in between	in between	no	yes	in between	no
4.3	no	no	yes	no	yes	yes
4.4	yes	yes	yes	in between	no	yes
4.5	no	no	yes	in between	no	yes
<b>Total</b>	<b>-2</b>	<b>-2</b>	<b>5</b>	<b>-3</b>	<b>-2</b>	<b>5</b>
<i>Direction from leadership</i>						
5.1	in between	in between	no	yes	no	no
5.2	no	no	no	no	no	no
5.3	yes	yes	yes	yes	no	yes



5.4	yes	no	no	yes	yes	no
5.5	yes	yes	yes	in between	no	yes
<b>Total</b>	<b>-2</b>	<b>-4</b>	<b>-5</b>	<b>0</b>	<b>1</b>	<b>-5</b>
<b><i>Internal stakeholder collaboration</i></b>						
6.1	yes	yes	yes	in between	in between	yes
6.2	in between	in between	yes	no	no	yes
6.3	yes	no	yes	in between	no	yes
6.4	yes	yes	yes	yes	no	yes
6.5	yes	no	yes	in between	yes	yes
<b>Total</b>	<b>4</b>	<b>0</b>	<b>5</b>	<b>0</b>	<b>-2</b>	<b>5</b>
<b><i>External stakeholder collaboration</i></b>						
7.1	no	no	no	yes	in between	yes
7.2	no	no	no	no	no	yes
7.3	no	no	yes	in between	no	yes
7.4	no	no	in between	yes	no	yes
7.5	no	no	no	in between	yes	yes
<b>Total</b>	<b>-5</b>	<b>-5</b>	<b>-2</b>	<b>1</b>	<b>-2</b>	<b>5</b>
<b><i>Organisational climate</i></b>						
8.1	no	no	no	no	no	yes
8.2	yes	yes	no	no	no	no
8.3	in between	in between	no	yes	yes	no
8.4	yes	no	in between	yes	in between	no
8.5	yes	yes	yes	no	no	yes
<b>Total</b>	<b>-2</b>	<b>0</b>	<b>2</b>	<b>-3</b>	<b>-2</b>	<b>5</b>
<b><i>Communication efficiency</i></b>						
9.1	yes	yes	yes	yes	no	yes
9.2	in between	in between	yes	no	no	yes
9.3	yes	yes	yes	in between	no	yes
9.4	no	yes	yes	in between	no	yes
9.5	no	no	no	no	yes	no
<b>Total</b>	<b>-2</b>	<b>-4</b>	<b>-5</b>	<b>-1</b>	<b>5</b>	<b>-5</b>
<b><i>Evaluation of successful change</i></b>						
10.1	in between	no	no	yes	yes	no
10.2	no	no	no	in between	yes	no
10.3	yes	yes	yes	yes	no	yes
10.4	no	no	yes	no	no	yes
10.5	no	no	no	in between	yes	no
<b>Total</b>	<b>2</b>	<b>3</b>	<b>5</b>	<b>-1</b>	<b>-5</b>	<b>5</b>
<b><i>Priority of action and thoughts</i></b>						
11.1	yes	yes	in between	yes	yes	no

11.2	in between	no	yes	no	yes	no
11.3	yes	yes	yes	in between	yes	no
11.4	in between	yes	yes	no	no	yes
11.5	no	in between	yes	yes	no	yes
<b>Total</b>	<b>-2</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>-5</b>	<b>5</b>
<i>Focus of experiment</i>						
12.1	yes	yes	yes	yes	yes	no
12.2	yes	yes	yes	in between	yes	no
12.3	no	no	no	yes	no	in between
12.4	no	no	yes	no	no	no
12.5	yes	no	no	in between	yes	no
<b>Total</b>	<b>-4</b>	<b>-3</b>	<b>-1</b>	<b>-1</b>	<b>-5</b>	<b>0</b>
<i>Knowledge between causes and effects</i>						
13.1	in between	in between	no	yes	in between	no
13.2	in between	in between	no	yes	in between	no
13.3	no	no	no	no	no	no
13.4	no	no	no	no	no	no
13.5	yes	yes	yes	yes	yes	yes
<b>Total</b>	<b>-3</b>	<b>-3</b>	<b>-5</b>	<b>-1</b>	<b>-3</b>	<b>-5</b>

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