

Reviewing the use of Success and Failure Frameworks for analyzing the Adoption of Innovations: Proposing a Multi-Actor Multi-Success-and-Failure-Factors Multi-Criteria Approach (MAMSFFMCA)

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Abstract – Many innovations have never or only in limited form been adopted. Therefore, throughout the last decades, academics have been focusing on the success and failure factors (SFF) of the adoption of innovations. This success depends on the objectives of the engaged stakeholders. However, no comprehensive literature review exist that focused on the purpose of the SFF frameworks and the engagement in the innovation process of these frameworks. Therefore, the papers related to SFF frameworks and the adoption of innovations have been reviewed on these knowledge gaps. This review showed that no framework had been developed that engaged stakeholders for using weighted success and failure factors to propose and evaluate solutions to enhance the viability of innovations. Therefore, a multi-criteria approach called the Multi-Actor Multi-Success-and-Failure-Factors Multi-Criteria Analysis (MAMSFFMCA) has been developed and evaluated on a case about online grocery shopping in the Netherlands. This method has been a useful tool to engage stakeholders and experts in efficiently identifying success and failure factors of online grocery shopping, to propose alternatives and to evaluate them. The MAMSFFMCA method can be further developed by providing more guidelines and rule of thumbs that can be used for the data gathering, the selection procedures and the evaluations of every step.

Keywords: *Adoption of innovations, MAMSFFMCA, Multi-criteria analysis, Stakeholders Engagement, Success and Failure factors*

1. Introduction

Many innovations have been proposed, but never or only in limited form been adopted (Feitelson & Salomon, 2004). Asplund and Sandin (1999) and Cozijnsen et al. (2000) even argued that only 20 percent of the initiated projects of innovations were successful. It is important to understand that innovation doesn't necessary mean that something must be invented or that a new design must be made. Innovation is mainly about the clever application of ideas or existing inventions that create an added value for a company, an organization or a society (van Leeuwen, 2006). Among practitioners and academics all over the world, it is known that innovations are very important for firms, since it drives growth and higher profits (van der Panne, et al., 2003). However, the success or failure of the adoption of innovations are affected by certain success and failure factors (SFF) (Feitelson & Salomon, 2004).

Besides Feitelson & Salomon (2004), many academics have been focusing on assessing these factors, categorizing them and developing frameworks for analyzing the adoption of innovations (Geels, 2002; Hekkert, et al., 2007; Maidique and Zirger, 1984; van der Panne, et al., 2003; Weisenfeld, 2003; Widén, et al., 2014). Weisenfeld (2003) believes that innovations evolve by the influence of economic, cultural, social and political factors, while Geels (2002) states that such technological transitions influence changes in user practices, regulations, industrial networks, infrastructure, and symbolic meaning or culture given a dynamic multi-level perspective. Van der Panne et al. (2003) even conducted a literature review to capture a conclusive view on the most important SFF's in the literature by categorizing them in firm, project, product and market related factors. However, none of these papers

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provided a framework to propose solutions for influencing the innovations in order to enhance the success rate while according to Hekkert et al. (2007), “there is a strong need to influence both speed and direction of innovation and technological change”.

This raises the question: What is meant with a successful adoption of an innovation? Traditionally, an innovation is a success if it has reached a certain financial return (Cooper & Kleinschmidt, 1987). However, according to Maidique & Zirger (1984) and Widén et al. (2014), it depends on the objectives that stakeholders want to achieve for a successful partnership, since the introduction of an innovation might lead to limited financial return but can still be considered as a success. For example, if the innovation has a major impact on the market or if it has opened an opportunity window without having a financial return (Cooper & Kleinschmidt, 1987). However, a significant proportion of partnerships fail to meet their objectives that can be the result of a missing structured process of engagement with stakeholders as an integral part of the innovation process (Widén et al, 2014). Besides, no literature review has been conducted yet that instead of reviewing the success and failure factors, focused on reviewing existing frameworks for analyzing the SFF’s for the adoption of innovations.

Given these gaps, the aim of this research is twofold. Firstly, the literature on the SFF’s that influence the adoption of innovations is reviewed on

1. The frameworks used in the papers
2. The purpose of focusing on the success and failure factors in the considered literatures
3. The stakeholder involvements in the innovation process

Secondly, based on this literature review, a framework is proposed that aids for filling the gaps of a missing structured method for engaging stakeholders in the innovation process that also involves a stage for the proposal of solutions to influence the direction of innovations given the set of objectives.

Chapter 2 focusses on the methodology, which is the literature search. Chapter 3 provides the results of the literature review on the three focuses areas. In chapter 4, an integrated framework called the Multi-Actor Multi-Success and Failure Factors Multi-Criteria Analysis (MAMSFFMCA) is presented. This has been applied on the ‘online grocery shopping in the Netherlands’ case, which is described in chapter 5. In the same chapter, the lessons learned from the application on the case has been used to evaluate the method. In chapter 6, the conclusions and recommendations for future research are provided.

2. Literature Review Method

A literature review has been performed in order to capture all the literature about SSF’s frameworks for analyzing the adoption of innovations. According to Van Wee and Banister (2016), “a literature review is a systematic, explicit, and reproducible approach for searching, evaluating, and interpreting the existing academic literatures.” For this review, *Scopus* has been used to identify research papers, because “this abstract and citation database delivers the broadest overview of global interdisciplinary scientific information that has been reviewed and selected by an independent Content Selection and Advisory Board (CSAB)” (Elsevier, n.d.).

In order to capture the core concepts in the literature search in *Scopus*, the following brackets, Boolean operators and keywords are used for the initial search: success AND failure AND factors AND adoption AND innovations AND framework. The words “success”, “failure” and “factors” are not combined as “success and failure factors”, because this has led to zero results. This makes sense, since “success and failure factors” is not a concept. By separating the words, both researches on success factors and failure factors are captured. Besides, the aim of the reviewed papers must be related to the adoption

of innovations. Therefore, the words “adoption” and “innovations” are included. Furthermore, in order to understand how to incorporate success and failure factors in the proposal of innovative collaboration solutions in a structured way, a framework should be used. Therefore, the literature is reviewed on “frameworks” related to success and failure factors and the adoption of innovations. This results in 38 research papers. However, 21 out of 38 papers are documents from the International/Americas conference on information systems that are assemblies of more than 300 papers, which are too time consuming to review. Besides, these conferences have a special focus on information systems, which is not the focus of this research. Therefore, these papers are excluded by adding “AND NOT conference” to the search. This leads to a total of 17 papers that are reviewed (See table 1).

Table 1. List of reviewed research papers

	Reference	Document Title
1.	Hollick, et al. (2019)	Shaping innovation and coordination of healthcare delivery across boundaries and borders
2.	Audouin, et al. (2018)	Territory matters: Exploring the functioning of an innovation system through the filter of local territorial practices – the example of the adoption of cashew trees in Burkina Faso
3.	Chronopoulos & Lumberras (2017)	Optimal regime switching under risk aversion and uncertainty
4.	Adeshina & Ojo (2017)	Factors for e-voting adoption – analysis of general elections in Nigeria
5.	Rumbo, et al. (2016)	Implementing evidence and implementation research: two different and prime realities
6.	Van de Kaa & de Vries (2015)	Factors for winning format battles. A comparative case study
7.	Sisaye & Birnberg (2014)	Sociological Approaches to Organizational Learning: Applications to Process Innovations in Management Accounting Systems
8.	Matengu & Ashekele (2010)	Impact of technology integration on olive farming in central Namibia
9.	Albano (2010)	Organizational readiness and success of the EHR-S adoption
10.	Ram & Swatman (2008)	Enterprise Resource Planning (ERP) Innovation Process: Towards Development of an Integrated Framework for successful Adoption and Implementation
11.	Green, et al. (2006)	Information system support as critical success factor for chronic disease management: necessary but not sufficient
12.	Ammenwerth, et al. (2006)	IT-adoption and the interaction of task, technology and individuals: A fit framework and a case study
13.	Chakravorti (2004)	The role of adoption networks in the success of innovations: a strategic perspective
14.	Russel & Hoag (2004)	People and information technology in the supply chain: social and organizational influences on adoption
15.	Kukafka et al. (2003)	Grounding a new information technology implementation framework in behavioral science: a systematic analysis of the literature on IT use
16.	Tettey (2000)	Computerization, institutional maturation, and qualitative change: Analysis of a Ghanaian public corporation
17.	Chan & Yung (1999)	Assessment of individual, organizational and environmental variables in the implementation of business process redesign

3. Findings and Discussion

The 17 documents retrieved from the literature search (See table 1) are reviewed in order to find out what frameworks have been used, what the purpose of the papers were by focusing on the success and failure factors, and the stakeholder involvements in the innovations process. The description of the purpose of the papers and the use of success and failure factor frameworks are presented in table 2. The categorizations of the purposes and the used frameworks are presented in table 3. This is followed by the presentation of the findings on involvement of stakeholders in the innovation process in table 4. For the latter, it is presented which papers mentioned ‘stakeholder’, at which stage of the paper and how, in order to determine the involvement of stakeholders in the innovation process. These findings are discussed.

Table 2. Extended description of the purpose of the papers and the use of SFF's

	Reference	Purpose of the papers and the use of SFF frameworks
1.	Hollick, et al. (2019)	The purpose of the analyses was to understand why introduction of a mobile service delivery model met with variable success in diverse countries and organizations by comparing successful and unsuccessful cases. This filled the gap of a lack of adequate methodologies for the implementation and evaluation of interventions in the healthcare.
2.	Audouin, et al. (2018)	The main functions of innovation systems (success factors) were used to develop an approach to identify key players and their practices in order to focus on the interactions between territorial specifications and the systems of innovations.
3.	Chronopoulos & Lumberras (2017)	It is unknown how market incompleteness influences attitudes towards risk, and, in turn, incentives for technology adoption. Therefore, this paper focused on how economic and technical uncertainty can influence incentives for technological change.
4.	Adeshina & Ojo (2017)	The purpose of this paper was to analyze the success and failure factors to build theory in the adoption of e-voting and to provide a checklist of success and failure factors for the adoption of e-voting innovations, since only little research has been focusing on the success and failure factors on the adoption of e-voting
5.	Rumbo, et al. (2016)	In the field of nursing, best practice implementation experiences have increasingly been used, leading to an increased number of studies on this topic. So, a comprehensive study of these studies is missing. Therefore, the purpose of the analyses on success and failure factors of implementation is to enhance the effectiveness and equitability of the implementation of evaluated scientific research in order to improve the health of a population.
6.	Van de Kaa & de Vries (2015)	There is a lack of empirical research on success and failure factors of format dominance. So, this paper focused on how firms can use these factors to understand and enhance the success of their strategy.
7.	Sisaye & Birnberg (2014)	The purpose of understanding the success and failure factors of management accounting innovations is to enhance an organization's strategic position against its competitors. Therefore, the organizational learning framework has been extended.
8.	Matengu & Ashekele (2010)	There has barely been emphasis on the success and failure factors of technology integration. These factors can be used to explain the adoption of innovations.
9.	Albano (2010)	The lack of research on the individual and organizational factors that influences the EHR-S adoption. Identifying the success and failure factors will help getting the internal environment more ready for the adoption of the innovation.
10.	Ram & Swatman (2008)	A more structured and comprehensive research for the identification of critical success factors is missing in the literature. Besides, little is known about the critical success factors and its relationship with the impact that these factors have on the performance of the firms. Lastly, little research has been conducted on the decision stage in the process of innovation. Therefore, the identification of the critical success factors will enhance the chance to adopt ERP projects.
11.	Green, et al. (2006)	Critical success factors have not been identified yet for implementing clinical and operational knowledge on efficient and effective chronic care management in primary care practice. Thus, the factors have been identified in order to rapidly implement and achieve care improvements.
12.	Ammenwerth, et al. (2006)	Existing IT adoption frameworks did not include the interaction between user and task, which is very important. This will enable better prepared and more successful results of the adoption of IT projects.
13.	Chakravorti (2004)	The success and failure of an innovation is mainly due to the adoption network, which is not very well understood now. These factors will have implications in the planning and managing of the adoption of innovations by policymakers and strategists.
14.	Russel & Hoag (2004)	Understand people and their acceptance for technology in order to reduce the failure of IT innovations, since there is a lack of research about social and organizational influences that impact the acceptance of IT supply chain innovations by the users.
15.	Kukafka et al. (2003)	There is a knowledge gap between the IT implementation and the use of scientific models and theories to develop multi-level approaches to identify factors that influences the behavior of the users. These factors will contribute to the understanding why it is very difficult to implement IT interventions and why there is a need for continue develop more insights.
16.	Tetty (2000)	No recognizable studies on feasibility of computerization in the VRA have been carried out so far. These factors could hinder the effective use of ICTs.
17.	Chan & Yung (1999)	The SFF's are useful for exploring BPRs. Therefore, structured framework is needed for producing a sound analysis of a business process reengineering process.

Table 3. Used frameworks and categorization of the main purpose of the papers

	Reference	Description of Used Framework	Category of purpose paper	
			Analyzing SFF's	Developing framework
1.	Hollick, et al. (2019)	The Non-adoption, Abandonment, Scale-up, Spread and Sustainability (NASSS) framework was used for exploration. It has been used to compare case studies and to study interactions of contextual factors that influences the introduction and sustainability of services.	X	X
2.	Audouin, et al. (2018)	Integrated framework of technological innovation systems (TIS) structures and functions coupled with territorial practices		X
3.	Chronopoulos & Lumberras (2017)	A utility-based, regime switching framework has been developed for evaluating different technology-adoption strategies.	X	
4.	Adeshina & Ojo (2017)	An analytical framework based on the combination of existing e-voting adoption models and multi-level innovation adoption model has been used to analyze observations and post-election reports.	X	
5.	Rumbo, et al. (2016)	Key frameworks have been identified: Determinant frameworks and evaluation frameworks.	X	
6.	Van de Kaa & de Vries (2015)	A new framework of success and failure factors of format dominance has been developed in order to improve the understanding on this topic, to make more accurate forecasts about the winner and how to adjust the strategies by exploiting certain factors.	X	
7.	Sisaye & Birnberg (2014)	The organizational learning framework had been used to improve the understanding on the success and failure factors of management accounting innovations	X	X
8.	Matengu & Ashekele (2010)	The existence of a supportive policy and institutional framework will contribute to successfully adopt a new technology.	X	
9.	Albano (2010)	A conceptual readiness framework that supports the analysis and diagnosis of the preparation of the organization to adopt EHR-S.	X	
10.	Ram & Swatman (2008)	Integrated framework for successful adoption and implementation of ERP.	X	X
11.	Green, et al. (2006)	Quality improvement framework for translating direct critical success factors into primary care.	X	
12.	Ammenwerth, et al. (2006)	"Fit between individuals, task and technology" framework was developed to analyze the process of IT adoption during the implementation phase.	X	X
13.	Chakravorti (2004)	A framework that captures the adoption network in order to determine what relevant players are involved, whose choices are crucial to coordinate, and what mechanism should be used to coordinate.	X	
14.	Russel & Hoag (2004)	The diffusion of innovation theoretical framework in order to understand and analyze challenges in the implementation of IT innovations.	X	
15.	Kukafka et al. (2003)	Integrated framework serves to scope, to identify variables and then to make the relationship explicit.	X	X
16.	Tetty (2000)	Social interactionist conceptual framework has been used to analyze computerization of a public corporation.	X	
17.	Chan & Yung (1999)	The structured framework is helpful for the analysis of practitioners.	X	X

Table 4. Findings on stakeholder involvements

	Reference	'Stakeholder' mentioned	At which stage of the paper?	How?
1.	Hollick, et al. (2019)	X	Result	As identified factor that it is important to generate and sustain the motivations of key stakeholders in innovations
2.	Audouin, et al. (2018)	X	Result of literature study	Part of description of innovation system functions
3.	Chronopoulos & Lumbreras (2017)			
4.	Adeshina & Ojo (2017)	X	Result	As key factor to involve stakeholders
5.	Rumbo, et al. (2016)			
6.	Van de Kaa & de Vries (2015)	X	Result of literature study	As key factors for format dominance
7.	Sisaye & Birnberg (2014)			
8.	Matengu & Ashekele (2010)			
9.	Albano (2010)	X	Result of defining success	Stakeholder satisfaction as an important objective for determining success
10.	Ram & Swatman (2008)	X	Introduction	Developed framework can be used by the stakeholders in decision making
11.	Green, et al. (2006)	X	Results	Stakeholders were part of a success factor
12.	Ammenwerth, et al. (2006)			
13.	Chakravorti (2004)			
14.	Russel & Hoag (2004)			
15.	Kukafka et al. (2003)	X	Evaluation	Defining needs and goals of stakeholders for assessing technologies
16.	Tetty (2000)	X	Results of literature study	Managers that become stakeholders in projects that they got involved in
17.	Chan & Yung (1999)			

In table 3, most of the reviewed papers used frameworks to analyze the success and failure factors of implementing or adopting a certain innovation (Adeshina & Ojo, 2017; Albano, 2010; Ammenwerth, et al., 2006; Chakravorti, 2004; Chan & Yung, 1999; Chronopoulos & Lumbreras, 2017; Green, et al., 2006; Hollick, et al., 2019; Kukafka et al., 2003; Matengu & Ashekele, 2010; Sisaye & Birnberg, 2014; Ram & Swatman, 2008; Russel & Hoag, 2004 and Van de Kaa & de Vries, 2015). Sisaye, Birnberg (2014), Van de Kaa and de Vries (2015) agree that a better understanding of success and failure factors for innovations will enhance the success of a strategy. Ngai et al. (2008) say that the identification of critical success factors can help organizations to study the conditions for determining solutions to reduce or avoid failure factors in the pre-adoption and implementation environments and thus enhance the chance of successfully implementing an Enterprise Resource Planning project. Ram and Swatman (2008) even provided a theoretical framework to enhance the chance to successfully adopt Enterprise Resource Planning projects (See table 2). Besides exploration of factors, some other researches focused on the lack of adequate methodologies or frameworks (Ammenwerth, et al., 2006; Chan & Yung, 1999; Hollick, et al., 2019; Kukafka et al., 2003; Sisaye & Birnberg, 2014 and Ram & Swatman, 2008). Ammenwerth et al. (2006) developed a framework to help analyze success and failure factors for the adoption of IT innovations in a healthcare setting based on a case study and literature study. This means that both these methods are very useful for developing a framework to analyze success and failure factors of innovations. It is also important to know that more flexible, nuanced and pluralistic approaches are needed to guide the implementation and the evaluation of interventions in complex sectors like the healthcare (Greenhalgh et al., 2018). Hollick et al. (2019) used the Non-adoption, Abandonment, Scale-up, Spread and Sustainability (NASSS) framework to help coordinate healthcare services from different perspectives by using it to analyze data. However, this method lacks in actual proposing and quantitatively evaluating the solutions. The method rather helps to create narratives for opportunities and threats. Kukafka et al. (2003) made a framework that is useful for the

implementation phase. The researches of Chan & Yung (1999) and Rumbo, et al. (2016) also focused on the implementation phase. However, almost no research has been focusing on involving success or failure factors in the design or evaluation phase in the decision-making process. Only Van de Kaa and de Vries (2015) used a framework of factors to make forecasts about the winners of format battles and how their strategies could be adjusted by exploiting certain success or failure factors. However, one of the identified limitations is that all these unique factors have the same weight, while it might be true that some are more important than others. Van de Kaa and de Vries (2015) proposed to examine this by using multi-criteria analysis (MCA) methods e.g. analytic hierarchy process (AHP). Although they proposed this to assess the importance of factors for format dominance only, this implies that a method is still needed to determine whether some crucial success and failure factors are more important than others and how the results of the analysis on success and failure factors can lead to (new) solutions.

Besides, out of 9 papers that mentioned stakeholders in table 4, only Kukafka et al. (2003) had involved stakeholders in the evaluation process by determining their needs and goals for selecting the most suitable technologies (Adeshina & Ojo, 2017; Albano, 2010; Audouin, et al., 2018; Green, et al., 2006; Hollick, et al., 2019; Kukafka et al., 2003; Ram & Swatman, 2008; Tettey, 2000; Van de Kaa & de Vries, 2015). However, Kukafka et al. (2003) do not offer a structured way of how to involve stakeholders and their needs and goals. Besides, most of these papers do recognize that involving key stakeholders will help to lead to a successful adoption of innovations (Adeshina & Ojo, 2017; Albano, 2010; Green, et al., 2006; Hollick, et al., 2019; Kukafka et al., 2003; Van de Kaa & de Vries, 2015). Thus, there is a practical gap in the literature that offer a structured way of involving stakeholders in the innovation process.

4. A new approach: Multi-Actor Multi-Success-and-Failure-Factor Multi-Criteria Analysis (MAMSFFMCA)

Given the results of the literature review on the use of SFF frameworks for the adoption of innovations, it becomes clear that SFF frameworks have not been used in the design or evaluation phase so far. However, by incorporating success and failure factors in these phases, proposed solutions are more viable. According to van de Kaa and de Vries (2015), MCA methods could be used to examine whether some success and failure factors are more important than others. MCA is used in researches to assess different alternatives against a set of criteria (Gerçek, et al., 2004). However, in the traditional MCA, only the objectives of one actor are involved, which still lead to a significant proportion of partnerships to fail, since not all their objectives are met (Widén et al, 2014). Therefore, a more interesting MCA method is the Multi-Actor Multi-Criteria Analysis (MAMCA). This MAMCA method does allow the incorporation of the objectives and opinions of different stakeholder groups in a structured way through the whole complex decision-making process which enhances the suitability and practicability of the outcomes compared to the traditional MCA methods (Macharis & Bernardini, 2015). The steps described by Macharis (2007) are as followed:

- Step 1: Defining the problem and the alternatives
- Step 2: Stakeholder analysis
- Step 3: Define criteria and weights
- Step 4: Criteria, indicators and measurement methods
- Step 5: Overall analysis and ranking
- Step 6: Result and sensitivity analysis
- Step 7: Implementation

There are different means in MAMCA methods to gather alternatives, criteria and their weights (Macharis & Bernardini, 2015). However, it remains quite vague and general how this process should

be done in a reproducible way that also enhances the adoption of the innovative alternatives. Besides, it is also not clear how the success and failure factors can enhance the adoption of the proposed solutions. Therefore, a new integrated framework has been developed named the Multi-Actor Multi-Success-and-Failure-Factor Multi-Criteria Analysis (MAMSFFMCA). This framework is presented in figure 1. The developed integrated framework has the shape of a pyramid that follows the natural sense of doing an explorative research. It starts at the top where no or just a little is known about a problem (Brown, 2006). Every step is elaborated in more detail. Besides, also the lesson learned from the application on a ‘online grocery shopping in the Netherlands’ case is discussed for every step.

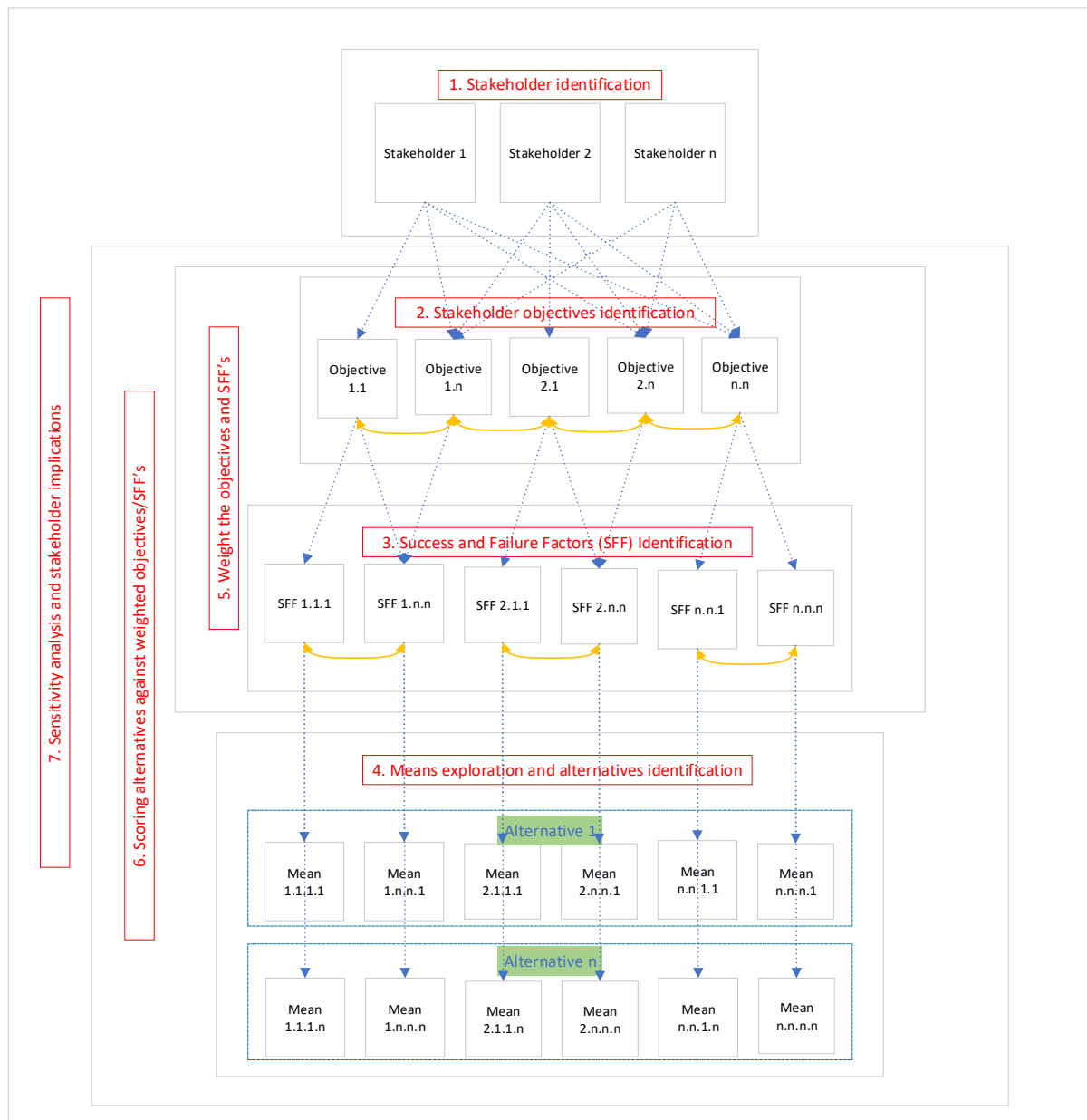


Figure 1. Integrated Framework of Success and Failure Factors with Multi-Actor Multi-Criteria Analysis

Step 1. Stakeholder identification Step

The first step starts with the identification of the stakeholders. As defined by Freeman (2010), a stakeholder is 'an individual or group of individuals that are influenced by or can influence the achievement of organization's objectives.' Thus, it is first important to determine what parties can influence or are influenced by the system the most. This step is different from the traditional MAMCA approach, that identified stakeholders in step 2 after the problem definition and the alternatives identification. The reason why stakeholders should be identified first, is because early involvement of stakeholders helps to better understand the problem and the priorities of every party and thus enhance the acceptance of the proposed solution (Banville, et al., 1998).

Step 2. Stakeholder objectives identification

The second step is to identify the objectives of every key stakeholder. The objectives of the stakeholders are used as criteria just as described by Macharis et al. (2012) for the MAMCA. As discussed in section 1, the measurement of a success depends on the objectives of the different stakeholders in the system. Overlap of these objectives can occur, since different stakeholders might have the same objectives. Therefore, it is important for the researcher to validate this with the stakeholders in order to avoid double counting. For eliciting the objectives, the questionnaire provided in appendix A can be used. The most important objectives can then be selected based on the frequency or the relevance. This leads to a list of objectives/criteria that are used for the evaluation process.

Step 3. Success and Failure Factors (SFF) identification

The third step is to identify the SFF's for every objective. Success factors define desired conditions that has led to a successful achievement of an objective from which we can learn, while failure factors are undesired challenges that still needs to be overcome in order to reach a certain objective. By using these success and failure factors identified by involving different stakeholders for proposing solutions, the risk of failure of the adoption of the innovations are minimized (Ngai et al., 2008). These success and failure factors are related to objectives of the most important stakeholders identified in step 2. Every stakeholder is asked to determine key factors that has led to the (un)successful achievement of an objective. For this, the questionnaire in Appendix A can be used. For gathering success factors, interviewees are asked to explain how they successfully reached a certain objective. For gathering failure factors, interviewees are asked to explain why certain objectives are still not reached. These SFF's are then categorized and analyzed with a suitable SFF framework. From these, the most important ones must be selected based on the frequency or in collaboration with stakeholders and experts.

Step 4. Means exploration and alternatives identification

The fourth step is to use the success and failure factors to propose new solutions. This step bridges the gap of the practical usefulness of analyzing success and failure factors and using it to design, measure, evaluate and propose (innovative) alternatives. As opposed to the MAMCA that used a pre-determined set of alternatives or performed an extensive literature overview for determining alternatives followed by a feasibility screening (Macharis et al, 2012), the MAMSFFMCA is more suitable for explorative research where there is not a pre-determined set of alternatives or barely any previous research and literature. As can be seen in the same questionnaire in Appendix A, the analysis of success and failure factors leads to the identification of means for the alternatives. Thus, these alternatives are based on the lessons learned from the success factors and have means that avoid the failure factors. Ideally, this part of the questionnaire is filled in after having a final list of objectives, success and failure factors. This is in the form of a morphological chart, that is a tool to help generate alternatives by identifying

means for each function that a system must have (Dym, et al., 2014). See appendix A for the adapted questionnaire based on the morphological chart. This is also used during a brainstorm session or by the researcher to elicit alternatives. After generating the objectives, the SFF's, the alternatives, a final set of alternatives must be selected based on how likely the alternative can overcome the identified failure factors or make use of the success factors. This has led to the bottom of the pyramid since all the qualitative data has been gathered (see figure 1).

Step 5. Weight the objectives and the SFF's

In the fifth step, the gathered data are taken together to compute the analysis. Therefore, in figure 1, these steps are displayed as combinations of the previous steps. The fifth step focused on giving weights to the objectives/criteria and the SFF's. For the MAMSFFMCA, the list of most important identified success and failure factors are used to choose the best solutions, since these factors are crucial for the adoption of the innovation. These factors are thus first weighted. The method also allows us to make use of hierarchical clustering of the success and failure factors per key question related to the success and failure factors. This enables the opportunity to make use of a mixed method of MCA techniques such as Analytical Hierarchy Process (AHP) and the Preference Ranking Organisation MeTHod for Enrichment Evaluations (PROMETHEE) (Macharis, et al., 2004). Also, a 'Direct Matrix Ranking' (DMR) can be used to score the objectives, the success and failure factors on a 5-point Likert Scale instead of a ranking, see appendix A (Chambers, 1998).

Step 6. Scoring alternatives against weighted objectives/SFF's

In step 6, the weights of step 5 are used to assess the alternatives. For this, the analyst, the expert or the stakeholders can score the alternatives on the criteria. This depends on the expertise that every party has on the problem. Besides, the stakeholders may have a strategic bias, since their objectives and identified factors are involved (Macharis, et al., 2012). The alternatives can also be scored against the success and failure factors on a 5-point Likert Scale. In this way, for every success or failure factor, it becomes clear which alternative is the best to adapt. If alternatives have the same rating, then the interviewee can be asked to determine the best alternative. Besides, the interviewee can argue 1. why he or she give a certain rating to an alternative, 2. How the alternatives can be improved and 3. What his point of view is about an alternative besides the rating on likelihood. This enhances the quality and completeness of the alternatives. These rates can then be multiplied with how important a success or failure factor is in order to determine which alternative is the most important for enhancing the viability of online grocery shopping in the Netherlands. Besides, the best alternatives per success and failure factor can also be scored against the stakeholders' objectives on a 5-point Likert Scale. However, a negative impact must be counted as negative, thus the following scores are used for calculations: -2= - - =very negative impact, -1= - = negative impact, 0= +/- = no/barely any impact, 1= + = positive impact and 2= + + = very positive impact. After scoring the alternatives on every objective, these scores are multiplied by the weights of each objective. By summing the scores for every alternative, the weighted sum score (WSC) is calculated that can be compared on which alternative has the highest adoption chance among the other best alternatives. See appendix A for examples.

Step 7. Sensitivity analysis and stakeholder implications

In the last step, a sensitivity analysis must be performed and the resulted implications for stakeholders. Since a lot is subjective results were gathered e.g. the weighting of the criteria and the scoring of the alternatives, it is important to do a sensitivity analysis. This might influences the result and leads to implications for the stakeholders. This is done by changing the weights of the objectives or the success and failure factors. It is proposed to change all the objectives to the same weight in order to assume

that all the objectives of different stakeholders are equally important. Given this change, it can be seen whether the best solutions are still preferred that show how robust the solution is.

5. Application and lessons learned from a case on online grocery shopping in the Netherlands

The 'online grocery shopping in the Netherlands' case mainly focused on the last mile delivery of the supply chain (delivery from the warehouses to the customers), since this part of the system has become the biggest challenge for grocery retailers (Punakivi et al., 2001). According to Punakivi et al. (2001), it is very challenging to combine companies' profitability and a high consumer service level. Grocery retailers depend on many stakeholders in the system. These dependencies also impact the efficiency of the last mile delivery of the online ordered groceries e.g. customer's non-attendance due to traffic (congestion) that causes a delay delivery or a delay arrival of the customer (Pan et al., 2007). In addition, the last mile delivery of groceries also includes the traditional societal last mile challenges such as increasing number of vehicle movements, which is associated with more congestion, more noise in the urban areas, more pollution and worse traffic safety level (Quak & Van Duin, 2010). Therefore, the MAMSFFMCA has been applied on this case to enhance the viability of online grocery shopping in the Netherlands.

For eliciting objectives of four key stakeholders, eliciting success and failure factors and to have an initial list of solutions, 16 interviews with stakeholders and experts have been conducted. From these interviews, a total of 61 success factors and 103 failure factors have been gathered. From these, 20 success and failure factors has been selected as the most important ones. Based on these success and failure factors, solutions were elicited based on a selection from the list of initial alternatives, a brainstorm session among experts and a list of self-developed solutions by the researcher. After weighting the objectives and success and failure factors on 5-point Likert Scale stakeholders, these solutions were scored on the weighted success and failure factors. Based on these results, the most potential solutions were selected per crucial success and failure factor by the researcher. These solutions were then evaluated by scoring them on the weighted objectives also on a 5-point Likert Scale by the two stakeholders. This was followed by a sensitivity analysis by giving all the objectives the same weighting 5. These results had led to implications for stakeholders. For every step of the MAMSFFMCA, the lessons learned from this case are elaborated.

Step 1. Stakeholder identification Step

Lessons learned from the 'online grocery shopping in the Netherlands' case were that the selection of stakeholders that should be involved in the evaluation process missed a guideline that explained why a certain stakeholder should be involved. This leads to certain biases from the researcher that influence the outcomes since the results are evaluated with the stakeholders' objectives.

Step 2. Stakeholder objectives identification

Lessons learned from the 'online grocery shopping in the Netherlands' case are in line with the previous step. The selection of objectives that should be involved in the evaluation process missed a guideline that explained why a certain objective should be involved. This leads to certain biases from the researcher. This has led to an unbalanced set of objectives that involved 6 objectives of the grocery retailers and only 1 objective of deliverers. The results might not lead to the support of the deliverers for example. Besides, both low costs and profitability were involved in the evaluation process, that have a causal relation. This had led to a double weight for the same objective, even that the objectives have been validated.

Step 3. Success and Failure Factors (SFF) identification

Lessons learned from the 'online grocery shopping in the Netherlands' case are also related to the missing of criteria for identifying success and failure factors. This would have led to success and failure factors of the same level. In this research, some were at a very strategic level, while others were at an operational level. This was very difficult to compare. Besides, a SFF framework that suits the MAMSFFMCA was missing. The self-developed framework to categorize the factors did not exclude factors to belong to several categories. This might have led to the wrong categorization of factors.

Step 4. Means exploration and alternatives identification

Lessons learned from the 'online grocery shopping in the Netherlands' case are that for eliciting the solutions, a best method must be chosen. In this research, solutions were elicited from interviews, a brainstorm session and from the expertise of the researcher. This has led to solutions that were not comparable and were thus excluded from the evaluation. Besides, the solutions during the interviews were held in the same session as gathering the data for the objectives, success and failure factors, which has led to solutions that were not designed for a specific success or failure factor. During the interviews, better solutions might thus have been gathered.

Step 5. Weight the objectives and the SFF's

Lessons learned from the 'online grocery shopping in the Netherlands' case are related to the method for rating the objectives, success and failure factors. For this research, it was chosen to let the interviewees score everything on a 5-point Likert Scale. However, this has been very subjective and led to different results among 2 interviewees, which made both the selection and evaluation procedure of solutions not very objective.

Step 6. Scoring alternatives against weighted objectives/SFF's

The lessons learned from the 'online grocery shopping in the Netherlands' case is the same as in the previous step. The 5-point Likert Scale has been very subjective and led to different results among 2 interviewees, which made both the selection and evaluation procedure of solutions not very objective. Besides, since not the same alternatives were preferred, this had led to some solutions that were only scored by one stakeholder and another by two stakeholders (average score was taken) that made it not fair to compare the solutions with each other.

Step 7. Sensitivity analysis and stakeholder implications

The lessons learned from the 'online grocery shopping in the Netherlands' case are related to the sensitivity method and the next steps for stakeholders. Other sensitivity analysis could have been employed that might have been more suitable for practical use than only changing the scores of the weights of the objectives. This might have led to a better evaluation for the robustness of the solutions. Lastly, a feasibility analysis is missing for implementation of the solutions. It is difficult to determine the next steps based on the MAMSFFMCA for the stakeholders.

6. Conclusions and Recommendations for Future Research

The literature review on the SFF frameworks for the adoption of innovations has showed that no framework had been developed that engaged stakeholders for using weighted success and failure factors to propose and evaluate solutions to enhance the viability of innovations. Therefore, MAMSFFMCA is developed that has been a useful tool to engage stakeholders and experts in efficiently identifying success and failure factors of online grocery shopping, to propose alternatives and to evaluate them. The MAMSFFMCA stands out in three aspects compared to the MAMCA and other MCA

methods: 1. it offers structured guidelines for identifying effective solutions that tackle the most important success and failure factors, whereas it remains quite vague how to identify solutions in the MAMCA or other MCA methods 2. it not only evaluates the solutions on objectives as in the MAMCA and MCA, but also on the most crucial success and failure factors for a viable system, and 3. the MAMSFFMCA also allows the stakeholders and experts to have an effective discussion on the best solutions for every success and failure factor, whereas the MAMCA and MCA only allows to compare the solutions based on the scores on the objectives. However, the main limitation of the MAMSFFMCA is that it is more time consuming than the MAMCA and MCA due to the added new steps of identifying, analyzing and evaluating the success and failure factors.

Besides, the MAMSFFMCA also provides a structured method for identifying, analyzing and evaluating success and failure factors. Compared to other SFF frameworks, the MAMSFFMCA 1. not only identifies success and failure factors in a structured way, but also evaluates these factors by assigning weights, and 2. not only analyze success and failure factors, but also propose adequate solutions to cope with these crucial factors. Thus, the MAMSFFMCA has strengthen both the evaluation methods as the SFF frameworks by combining these.

Based on the Dutch online grocery shopping case, it becomes clear that the MAMSFFMCA can also be improved. Firstly, an extensive literature research or the involvement of researchers with the expertise of success and failure factors or evaluation methods should lead to better methods and frameworks for identifying success and failure factors, eliciting solutions, for weighting and scoring the results and for doing a sensitivity analysis. For finding frameworks to identify success and failure factors, also other key words should be used. In order to find better methods for eliciting solutions, more research should be done into design thinking methods. Also, better use of secondary resources and interviews should be made. If an efficient method for selecting a smaller size of success and failure factors, objectives and solutions, a mixed method of MCA techniques such as Analytical Hierarchy Process (AHP) and the Preference Ranking Organisation MeTHod for Enrichment Evaluations (PROMETHEE) can be used for weighting criteria, just as proposed by Macharis et al. (2004) for the MAMCA. A way to enhance the robustness of the solutions is to use scenario analyses for the sensitivity analysis (Hickman, et al., 2012). Secondly, guidelines and rule of thumbs should be provided for every step. This will allow to make better comparisons and selections of the most crucial stakeholders, objectives, success and failure factors, and the best solutions. For this literature studies into every step should be conducted. Thirdly, in order to know what method works best, what guidelines and rule of thumbs are the most applicable and to explore the applicability of the MAMSFFMCA framework, this framework should be applied in other field of researches as well. This will enhance the experience and will lead to incremental improvements of the MAMSFFMCA.

References

- Adeshina, S. A., & Ojo, A. (2017). Factors for e-voting adoption-analysis of general elections in Nigeria. *Government Information Quarterly*, 101257.
- Albano, V. (2010). Organizational readiness and success of the EHR-S adoption. In *Management of the interconnected world* (pp. 145-152). Physica-Verlag HD.
- Ammenwerth, E., Iller, C., & Mahler, C. (2006). IT-adoption and the interaction of task, technology and individuals: a fit framework and a case study. *BMC medical informatics and decision making*, 6(1), 3.
- Asplund, M., & Sandin, R. (1999). The survival of new products. *Review of Industrial Organization*, 15(3), 219-237.
- Audouin, S., Gazull, L., & Gautier, D. (2018). Territory matters: Exploring the functioning of an innovation system through the filter of local territorial practices-the example of the adoption of cashew trees in Burkina Faso. *Journal of Rural Studies*, 63, 130-140.
- Banville, C., Landry, M., Martel, J. M., & Boulaire, C. (1998). A stakeholder approach to MCDA. *Systems Research and Behavioral Science: The Official Journal of the International Federation for Systems Research*, 15(1), 15-32
- Brown, R. B. (2006). Doing your dissertation in business and management: the reality of researching and writing. Sage.
- Chakravorti, B. (2004). The role of adoption networks in the success of innovations: a strategic perspective. *Technology in Society*, 26(2-3), 469-482.
- Chambers, R. (1988). Direct matrix ranking (DMR) in Kenya and West Bengal.
- Chan, W.Q., & Yung, K.L. (1999) Assessment of individual, organizational and environmental variables in the implementation of business process redesign. *International Journal of Business Performance Management*, 1 (4), pp. 388-402
- Chronopoulos, M., & Lumberras, S. (2017). Optimal regime switching under risk aversion and uncertainty. *European Journal of Operational Research*, 256(2), 543-555.
- Cooper, R. G., & Kleinschmidt, E. J. (1987). Success factors in product innovation. *Industrial marketing management*, 16(3), 215-223.
- Cozijnsen, A. J., Vrakking, W. J., & van IJzerloo, M. (2000). Success and failure of 50 innovation projects in Dutch companies. *European Journal of Innovation Management*.
- Dym, C. L., Little, P. & Orwin, E. J., (2014). Engineering design: A project-based introduction, 4th edition. John Wiley and sons.
- Elsevier. (n.d.) Content. Retrieved on the 17th of December 2019, from <https://www.elsevier.com/solutions/scopus/content>
- Feitelson, E., & Salomon, I. (2004). The political economy of transport innovations. In *Transport developments and innovations in an evolving world* (pp. 11-26). Springer, Berlin, Heidelberg.
- Freeman, R. E. (2010). Strategic management: A stakeholder approach. Cambridge university press.

- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. *Research policy*, 31(8-9), 1257-1274.
- Gerçek, H., Karpak, B., Kılınçaslan, T. (2004). A multiple criteria approach for the evaluation of the rail transit networks in Istanbul. *Transportation* 31 (2), 203–228
- Green, C. J., Fortin, P., Maclure, M., Macgregor, A., & Robinson, S. (2006). Information system support as a critical success factor for chronic disease management: Necessary but not sufficient. *International journal of medical informatics*, 75(12), 818-828.
- Hollick, R. J., Black, A. J., Reid, D. M., & McKee, L. (2019). Shaping innovation and coordination of healthcare delivery across boundaries and borders. *Journal of Health Organization and Management*.
- Kukafka, R., Johnson, S. B., Linfante, A., & Allegrante, J. P. (2003). Grounding a new information technology implementation framework in behavioral science: a systematic analysis of the literature on IT use. *Journal of biomedical informatics*, 36(3), 218-227.
- Macharis, C. (2007). Multi-criteria analysis as a tool to include stakeholders in project evaluation: the MAMCA method. *Transport Project Evaluation. Extending the Social Cost–Benefit Approach*, 115-131.
- Macharis, C., & Bernardini, A. (2015). Reviewing the use of Multi-Criteria Decision Analysis for the evaluation of transport projects: Time for a multi-actor approach. *Transport policy*, 37, 177-186.
- Macharis, C., Springael, J., De Brucker, K., & Verbeke, A. (2004). PROMETHEE and AHP: The design of operational synergies in multicriteria analysis.: Strengthening PROMETHEE with ideas of AHP. *European Journal of Operational Research*, 153(2), 307-317.
- Macharis, C., Turcksin, L., & Lebeau, K. (2012). Multi actor multi criteria analysis (MAMCA) as a tool to support sustainable decisions: State of use. *Decision Support Systems*, 54(1), 610-620.
- Maidique, M. A., & Zirger, B. J. (1984). A study of success and failure in product innovation: the case of the US electronics industry. *IEEE Transactions on engineering management*, (4), 192-203.
- Maidique, M. A., & Zirger, B. J. (1985). The new product learning cycle. *Research policy*, 14(6), 299-313.
- Matengu, K. K., & Ashekele, H. M. (2010, July). Impact of technology integration on olive farming in central Namibia. In *PICMET 2010 TECHNOLOGY MANAGEMENT FOR GLOBAL ECONOMIC GROWTH* (pp. 1-6). IEEE.
- Pan, S., Giannikas, V., Han, Y., Grover-Silva, E., & Qiao, B. (2017). Using customer-related data to enhance e-grocery home delivery. *Industrial Management & Data Systems*, 117(9), 1917-1933.
- Punakivi, M., Yrjölä, H., & Holmström, J. (2001). Solving the last mile issue: reception box or delivery box?. *International Journal of Physical Distribution & Logistics Management*, 31(6), 427-439.
- Quak, H., & Van Duin, J. H. R. (2010). The influence of road pricing on physical distribution in urban areas. *Procedia-Social and Behavioral Sciences*, 2(3), 6141-6153.
- Ram, J., & Swatman, P. (2008). Enterprise resource planning (ERP) innovation process: towards development of an integrated framework for successful adoption and implementation. *ACIS 2008 Proceedings*, 25.

- Rumbo, J. P., Martínez, Á. Q., Sobrido, M. P., Raña, C. L., Vázquez, M. C., & Braña, B. M. (2016). Implementing evidence and implementation research: two different and prime realities. *Enfermería clinica*, 26(6), 381-386.
- Russell, D. M., & Hoag, A. M. (2004). People and information technology in the supply chain. *International Journal of Physical Distribution & Logistics Management*.
- Sisaye, S., & Birnberg, J. G. (2012). Sociological Approaches to Organizational Learning: Applications to Process Innovations in Management Accounting Systems. *An Organizational Learning Approach to Process Innovations: The Extent and Scope of Diffusion and Adoption in Management Accounting Systems. Emerald Studies in Managerial and Financial Accounting*, 24, 1-43.
- Tettey, W. J. (2000). Computerization, institutional maturation, and qualitative change: analysis of a Ghanaian public corporation. *Information Technology for Development*, 9(2), 59-76.
- Van de Kaa, G., & de Vries, H. J. (2015). Factors for winning format battles: A comparative case study. *Technological Forecasting and Social Change*, 91, 222-235.
- Van der Panne, G., Van Beers, C., & Kleinknecht, A. (2003). Success and failure of innovation: a literature review. *International Journal of Innovation Management*, 7(03), 309-338.
- Van Leeuwen (2006). Tien succesfactoren voor innovaties. Retrieved from <https://www.indora.nl/wp-content/uploads/2013/06/ZORGMANAGEMENT-10-Succesfactoren-voor-innovatie.pdf>
- Van Wee, B. & Banister, D. (2016). How to write a literature review paper? *Transport Reviews*, 36(2), 278-288.
- Widén, K., Olander, S., & Atkin, B. (2014). Links between successful innovation diffusion and stakeholder engagement. *Journal of management in engineering*, 30(5), 04014018.

Appendix A. Tools for using the MAMSFFMCA

An example of the questionnaire for eliciting objectives, failure factors, success factors and an initial list of alternatives.

The key stakeholders were asked to determine their objectives that must be reached with a certain innovation. This is followed by asking what (failure) factors has blocked the stakeholder from achieving the objective and what (success) factor has been underlying the successful achievement of a certain objective. Lastly, the key stakeholder is asked to provide solutions for reaching the objective, given the success and failure factors.

Objective	Failure factors	Success factors	Alternatives
Objective 1	Failure factor 1	Success factor 1	Alternative 1
Objective 2	Failure factor 2	Success factor 2	Alternative 2
Objective 3	Failure factor 3	Success factor 3	Alternative 3
Objective 4	Failure factor 4	Success factor 4	Alternative 4
Objective 5	Failure factor 5	Success factor 5	Alternative 5

An example of the morphological chart that can be used to elicit alternatives, based on a selected list of most crucial success and failure factors.

This tool can be used to elicit alternatives during interviews with stakeholders or experts, but also during brainstorm sessions of by the researcher.

Success factors	or	failure	Possible alternatives		
Success factor 1	or	failure	Alternative 1.1	Alternative 1.2	Alternative 1.3
Success factor 2	or	failure	Alternative 2.1	Alternative 2.2	Alternative 2.3
Success factor 3	or	failure	Alternative 3.1	Alternative 3.2	Alternative 3.3
Success factor 4	or	failure	Alternative 4.1	Alternative 4.2	Alternative 4.3
Success factor 5	or	failure	Alternative 5.1	Alternative 5.2	Alternative 5.3

An example questionnaire to score the importance of an objective or a success or failure factor for the viability of a certain innovation

For every objective/success and failure factor, the following Likert scale can be used to rate: 1=Unimportant, 2=Slightly important, 3=Moderately important, 4=Important and 5=Very important

Objectives/Success and failure factor	1	2	3	4	5
1. Objectives/Success and failure factor 1					
2. Objectives/Success and failure factor 2					
3. Objectives/Success and failure factor 3					
4. Objectives/Success and failure factor 4					
5. Objectives/Success and failure factor 5					

An example of a questionnaire to score the likelihood that a solution can help to overcome a certain success or failure factor.

For every solution, the following Likert Scale can be used to rate:

1=Definitely not, 2=Probably not, 3=Possibly, 4=Probably and 5=Definitely

Success and failure factor	1	2	3	4	5
1. Solution 1					
2. Solution 2					
3. Solution 3					

An example of a questionnaire to score the impact that a alternative has on the stakeholders' objectives.

For every alternative, the following Likert Scale can be used to rate:

-2= - - =very negative impact, -1= - = negative impact, 0= +/- = no/barely any impact, 1= + = positive impact and 2= + + = very positive impact.

Objectives	Best alternatives				
	1	2	3	4	5
1. Objective 1					
2. Objective 2					
3. Objective 3					
4. Objective 4					
5. Objective 5					