Implementation Analysis: Method to determine the implementation strength of an invention.

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White Paper

1. Abstract

The process of implementation can be difficult for innovators in practice. Therefore, it is important for innovators to detect implementation problems at an early stage. Implementation problems can occur when requirements of users are not complied to by the invention. However, innovators are not trained to analyze what requirements users have towards the invention. The implementation analysis was developed to foresee difficulties and hurdles in the implementation phase, thereby assessing the 'implementation strength' of the invention and assisting in the improvement of the implementation process. To make this analysis method accessible for innovators a software tool was developed that would enable researchers and practitioners to identify and predict important tendencies of the implementation process connected to the introduction of an invention in daily practice. The method thus assists innovators both in the development of their invention and in its implementation.

Keywords

Implementation / implementation analysis / embedding / adoption / change / implementation strength / invention / innovation /

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2. Background

In the twenty-first-century new modern technology is often designated to improve our wellbeing. Even in the healthcare system, more technological startups take place. If the new technology has passed all hurdles of initial acceptance in healthcare, it can be implemented in the healthcare system. However, much new medical technology will never reach the healthcare system.[1] The new technology faces difficulties when trying to be widely implemented in a healthcare setting.[2] There are several theories

about implementation difficulties that describe solutions to overcome these challenges, but often these cannot be applied in practice. Start-ups and established companies alike, plunge into the production of their product, without adequately considering the implementation problems that negatively influence the broad use of the product, resulting in a troubled implementation process or even failure. The methods to overcome these implementation problems are not accessible for innovators or are too complicated to use in practice.

This paper was introduced to describe a new method to determine the implementation strength of an invention, combining several aspects of existing theories about implementation difficulties, thereby focusing on a practical use for innovators. The method is called: 'The Implementation Analysis'. The implementation analysis as presented in this article, links a set of constructs drawn from existing sociological, psychological and management theories, including the flow of inventions through social networks (e.g. Diffusion of Innovations Theory (DOI) [1, 3]), Normalization Process Theory (NPT) [4-6], Force-field analysis (FFA)[7, 8] and Change Management (CM)[9]. Combined they comprehensively describe and explain elements of the processes by which implementation, embedding, and integration take place in practice. The different theories describe a universal implementation process and this process is used to build the implementation analysis on, foreseeing difficulties and hurdles in the implementation phase, thereby assessing the 'implementation strength' of the invention and assisting in the improvement of the implementation process. To make this analysis method accessible for innovators a software tool was developed that would enable researchers and practitioners to identify and predict important tendencies of the implementation process connected to the introduction of an invention in daily practice. The method thus assists innovators both in the development of their invention and in its implementation.

2.1. **Problems in practice**

In current practice, innovators create all kinds of new and smart inventions. It starts off with a bright idea and eventually leads to the production of the invention. On product release the first persons to use the invention are 'innovators' themselves: customers that are extremely open for new products and ideas and in that sense are co-producers themselves.[3] They are hardly similar to the customer populations that really determine the success of the invention on the market.[3] When the innovator subsequently tries to reach the critical mass with the invention he might run into problems. People might not like the

invention or put it aside after a few tries. At that point, the users of the product have a low appreciation for the invention because requirements have not been met or the change investment connected to using the invention is too large. Users that have a negative experience with the invention will provide bad advertisement and therefore provoke market failure. Innovators often are not adequately equipped to analyze the critical mass and detect what requirements the users have towards the invention.

2.2. **Contribution to the field and main goal of the study**

This Implementation Analysis can assist innovators in bridging the chasm between the early adopters and early majority, as a result of an improved implementation process. Prior to that, the implementation analysis method may assist innovators in determining the implementation strength of their invention, providing the innovator with an indication to what extent the product is capable of acquiring successful sustainable use. A software tool, the Implementation Analyzer (IA), has been developed that can be used to perform the implementation analysis.

The main goal of this study is to introduce the theory of implementation analysis as a method to determine the implementation strength of an invention and introduce the IA software tool to perform an implementation analysis. Moreover, a minor verification of the implementation analysis was performed in a practical situation along with an evaluation of the different aspects of the tool. This paper will be an introductory paper on the implementation analysis. The reliability and sensibility of the software tool used to assist with the implementation analysis will be researched in a later paper.

3. Theoretical framework

3.1. **Definitions**

The literature has several definitions of a product that is being implemented in healthcare, the process of implementation or about the person that introduces new technology.[10, 11] Because the main focus of this paper is to determining the implementation strength of an invention, an ‘invention’ is defined as the creation or design of a new process or device.[12] Subsequently, the creator of the invention is defined as an innovator; “a person who develops a new design, product, process etc.” [13] However, an invention is not used in practice yet. Sustainable use of an invention is needed to transform an invention into an innovation, this process is defined as ‘implementation’. [14] Combining an invention with an implementation process will result in an innovation, resulting in the following definition of ‘Innovation’:

$$Innovation = Invention + Implementation$$

During this process individual, groups and companies are involved in the use of the invention. Therefore, this process is a change process of people. These individuals or groups are described as stakeholders: users, participants, actor, groups or consumer that utilize the invention in a direct or indirect manner. They have a certain stake in the intervention and can be affected by the invention and/or can affect the invention.

Well-known theories on implementation difficulties describe implementation strategies and provide information on how to overcome these specific problems. The development of the method was started to bridge the gap between existing theories about implementation strategies and practice, in order to be able to practically assist innovators in determining the ‘’implementation strength of their invention. Implementation strength is defined as a feature of an invention that indicates to what degree, based on its intrinsic qualities and on the change process that comes with using it, the invention is expected to acquire successful sustainable usage. With this, a forecast of the success of the implementation process can be created and measures can be taken to make improvements.

3.2. **Theoretical framework**

The different aspects of the process of implementation are widely described in sociological, psychological and management literature. The theoretical framework to support the implementation analysis as described originates from several theories on implementation strength and solutions. Literature shows different factors that influence implementation of an invention, including “need to match user needs”, “perceived usefulness by user”, “ease-of-use by the user”, “added value of the invention”, “fool-proof use” etc. [3, 4, 15-21] These success and fail factors are requirements that stakeholders have towards an invention. Most of the studies show that understanding user requirements and compliance with these requirements are important predictors of success or failure of new inventions. Additionally, this is enhanced by suppliers that pursuit a technology-push instead of a demand-pull approach.[22]

Rogers (1962) theory of “diffusion of innovations” (DOI) explains how new technology spreads and flows through social networks. [3] A division was created of five groups of consumers adopting a new technology. The innovators and early adopters will accept the new inventions because they will support the innovative status of the invention. However, reaching the early and late can be difficult, causing inventions to fail.[1, 2] Rogers defines that a technology must be widely adopted in order to self-sustain, occurring when reaching critical mass.

The Normalization process theory (NPT) provides information about involvement and investment of stakeholders during interaction with new or modified ways in practice as they interact with dynamic elements of their environments. It defines the implementation, embedding, and integration as a process at which stakeholders interact with a new product in practice. The theory supports this process by focusing on the mechanisms through which participants invest and contribute to this process. It describes the work that stakeholders do as they adopt a new or changed ways of thinking, acting, and organizing. Moreover, it describes four generative mechanisms involving the operationalization of the implementation process. [4-6]

The theory of force field analysis (FFA) by Lewin is widely used to plan and implement organizational changes, describing different forces that are active during a change process. [7, 8] It describes forces that are either driving the movement toward a goal (helping forces) or blocking movement toward a goal (hindering forces). Different stakeholders influence the move from a current equilibrium point to the desired position. In an ideal situation, the helping forces are larger compared to the hindering forces, resulting in a change from status quo to the new invention.

The theory of Lewis (2006, 2007) about stakeholders' perceptions of change context (SP), describes stakeholder interactions and stakeholders' concerns and provides insight on the position of stakeholder involvement during the implementation process. [23, 24] Moreover, a description of success and failure factors are described to overcome resistance when forcing changes on the personal.

Lewin's change management model (CM) is often used to assist companies during a change process, focusing on the change of users or employees.[9, 25, 26] The model divides the change process into three stages: Preparing all individuals for the desired change (unfreezing), implementing the desired change (changing) and solidifying the desired change (refreezing).

3.3. **Synthesis of theories about implementation**

All models describe factors about implementation or change difficulties. However, some theories overlap or differ in a manner. To synthesize the models/theories, a diversion was created between stages of implementation. The implementation process is defined as a process of adoption, change and embedding of the invention by different stakeholders in different stages, similar to CM model describing unfreezing, change and refreeze, however, CM is utilizing a top-down approach. [9] The implementation process uses a bottom-up approach, in which all stakeholders need to be motivated to embrace change. All stakeholders affected by the invention have to go through the implementation process, parallel or in

different stages. In addition to the stages of the implementation process, stakeholder analysis and requirements of stakeholders towards a new invention were analyzed as factors to improve the overall implementation process. Table 1 shows the different aspects and similarities or differences.

Table 1: Different aspects of theories that describe the implementation process.

Theory	Individual Stakeholders	Requirements	Adoption	Change	Embedding
DOI**[3]**	+/-	+/-	+	+	+
NPT**[4-6]**	+/-	+	+	++	+
FFA**[7, 8]**	-	-	-	++	-
SP**[23, 24]**	++	++	-	+	+
CM**[25-27]**	-	-	++	++	++

- not included ; +, included; ++ described extensively

The SP model analyses all stakeholder perceptions that involve the implementation of a product, so does DOI and NPT but in a less advanced way. The individual stakeholder perception is shown to influence the implementation process.[22, 24] All models describe a change model, obvious because all models include some sort of change from an old situation to a new situation, however, some theories clarify the change process. NPT defines an overall investment in change for all stakeholders combined, while SP describes that every stakeholder has an individual investment in change. The DOI and NPT describe the core users of a new invention but do not describe indirect stakeholders who can influence wide implementation. FFA involves all stakeholders that are involved but will put a weight at the location/power of the stakeholder. The energy game between positive and negative forces towards change provide insight into forces that influence implementation and ways to reduce or amplify those forces. SP describes differences in stakeholder perception, concerns, interaction, and outcome but doesn't define different layers of stakeholders. All theories are used to develop the implementation analysis, combining different methods and evidence.

4. Development of the Implementation Analysis

4.1. The implementation process

The goal of an innovator is to bring the invention to the market and achieve market success. This process of transforming a not (yet) used invention into a sustainably used innovation, is defined as an implementation process; a set of interrelated activities that interact to achieve change from status quo to the new product (figure 2). One may try to force this change process upon the people involved, but when stakeholders are intrinsically motivated they will easier and more durably become satisfied users, increasing chances for successful implementation.

Figure 1; the transformation of an invention through the implementation process into an innovation.

To analyze this implementation process, it was divided into steps that describe 3 activities (adoption, change and embedding) and 4 states (visible, accepted to use, first use, sustained use) that all stakeholders encounter in order to achieve sustainable use of the invention (figure 3). When an invention is introduced on the market, it first has to be visible. When the product is visible the stakeholders needs to become ready to accept the invention for first use, executed via the adoption activity. Adoption is an activity in which the innovator presents the invention (visible), preparing all stakeholders for the second state (adoption). With presentations, demonstrations and justifications the stakeholders are informed about the necessity to change current practice, the need, and advantages of the invention. The adoption activity informs the stakeholders and thus generates support for the product, creating intrinsic readiness and even desire for the product. When adoption is successful the stakeholders will be in the next state of the implementation process called: acceptance to use. They are motivated to use the invention and are willing to change the status-quo.

The change activity is the moment when the invention is implemented in current practice. The main goal of this activity is the transition from willing to use to actual first use. Stakeholders need to move from experienced users of the old method towards first time users of the new invention. This

consequently leads to changes in work progress and stakeholders require information about the use of the invention. Instructions are given to all stakeholders (if needed) so they can practice with the new invention. In some cases, change will result in a necessary and often burdening adjustment of the current working process of the stakeholders, before the new invention can be used. In order to stay intrinsically motivated, the advantages of using the invention should outweigh this change burden. Different stakeholders have different change levels for the use of the new invention and often the core users of a product require the most information, instruction and a change of the current process. When the stakeholders have enough information and instruction to work with the invention and in practice are able to make the change, they will enter the state of 'first use'.

The third activity is embedding, which when successful leads to the state of sustained use. In this activity, the (use of the) invention will be evaluated for its effectiveness and added-value to the stakeholders, including financial impact. The main goal is to transform tall stakeholders from new users to experienced users with the invention. This will remove the competition with the old standard or status-quo, stopping the tendency of reversal of the implementation process. When all embedding issues have been solved the invention has become the status-quo and the implementation of the invention has succeeded, resulting in the goal of the implementation process: 'sustained use'. Now, and only now, the invention has transformed into an innovation.

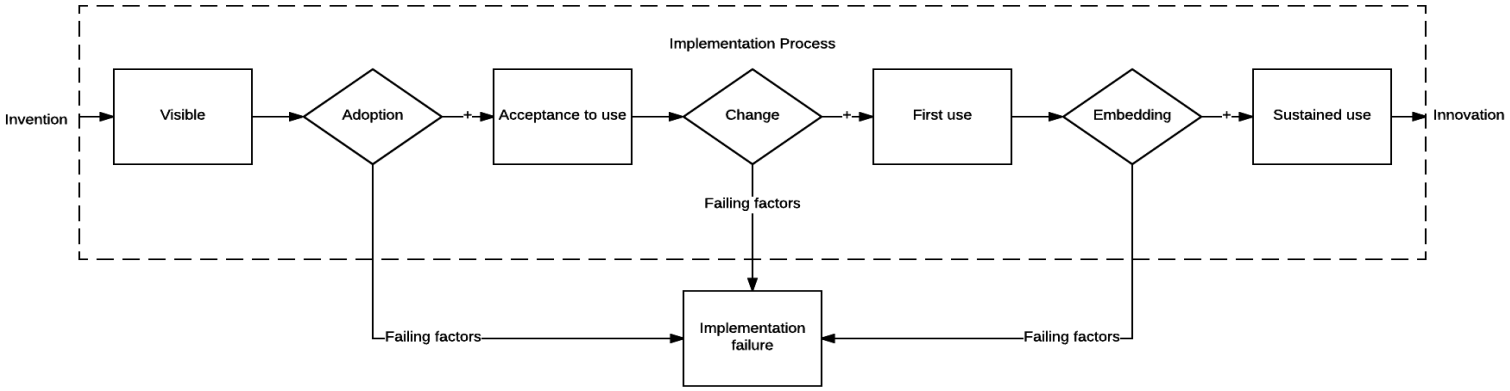


Figure 2: The implementation process to guide an invention becoming an innovation.

4.2. **Implementation Analysis**

The goal during the implementation process is to have as little as possible top-down activity, and instead work with motivated stakeholders that themselves are willing and are enabled to move from adoption to change and ultimately embedding.

In order to achieve such a successful implementation process of an invention, an analysis is needed prior to the implementation process to determine success and failure factors that motivate or hinder the stakeholders in the implementation process. The three activities of the implementation process require different factors/needs and change investment of the stakeholders, which all have to be assessed. The implementation process itself, thus can be divided into two different activities: the implementation analysis and the implementation execution (figure 4)

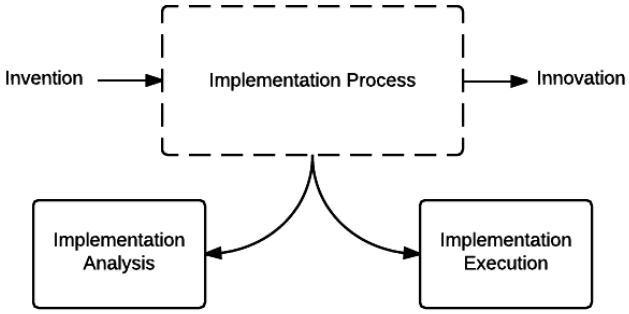


Figure 3: The division of the implementation process in implementation analysis and implementation execution.

The implementation analysis is being performed prior to the implementation process, identifying the requirements of a stakeholder during the implementation process. The implementation execution is the actual implementation process as introduced above and elaborated on next.

3.2.1 **Adoption: Stakeholder requirements**

A successful adoption activity is the case when all stakeholders are willing to use the invention. It is important to make the stakeholder an exultant user of the invention. Before a stakeholder will use the invention they need to appreciate the invention. Therefore, successful implementation of an invention depends on many requirements.[3, 4, 15-20] These requirements are a success and failing factors of the invention. To appreciate the invention, the invention has to comply with those requirements for the stakeholder. Requirements can be predetermined and thus important for the adoption activity.

The stakeholder has a list of requirements, partly autonomously his own, partly as a result of his future relation with the invention, but not every requirement is evenly important. Based on empirical evidence a division has been created to rank the importance of the requirements: crucial requirements, important requirements, and relevant requirements. Crucial requirements are the most important and typically a stakeholder has an average of five crucial requirements. The definition of ‘crucial’ is as follows: if the invention does not comply with a single crucial requirement, the stakeholder is not willing to use the invention, even if all other requirements have been met.

With the use of sound judgment, interviews and a database of previously encountered requirements, a list can be created with requirements of the stakeholder. Interviews can also be used to confirm certain requirements of stakeholders.

3.2.2 **Adoption: Appreciation level**

After identifying the stakeholder requirements, the next step is to define to what extent the invention complies to each requirement. In this regard, the implementation analysis executes an in-depth analysis of these compliances, as well as to the substantiation of each of them. As a result of this, the appreciation of the invention by the stakeholder can be forecasted (figure 5). The list of requirements of the stakeholder can be used to check whether or not the invention complies with those requirements. For every requirement, the innovator has to rate the compliance of the invention from -10 to +10 (-10: very negative, 0: neutral and +10 very positive). This is called the 'claim' by the innovator. To be of value to the stakeholder, this claim has to be substantiated: the better the substantiation, the more the stakeholder can be expected to follow the claim in his appreciation. Substantiation of the compliance claim is rated from 0 to 4 (0: None, 1: Initial, 2: Apparent, 3: Strong and 4: Scientific). A scoring algorithm was created to score the compliance and substantiation levels in regard to each wish/demand of the stakeholder, in order to model an appreciation level on this aspect (table 2). The average of the appreciation levels defines the overall appreciation by the stakeholder for the invention.

E.g. a stakeholder has a requirement that concerns medical advantage of the invention: "The

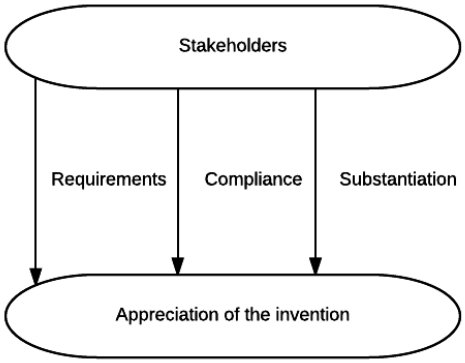


Figure 4, Demands, compliance and substantiation combined determine the appreciation of the stakeholder for the invention.

healthcare improvement delivers a significant medical advantage." The innovator claims the invention complies with strongly positive (Compliance score +7) and has a substantiation of strong, the appreciation for that requirement will be +7. However, if the substantiation is initial because the evidence of a significant medical effect is lacking, the appreciation will be neutral and drop to 0. The stakeholder

is can be positive because of the strong positive compliance, but the lack of substantiation reduces or negates the appreciation level.

A negative compliance (-10 / 0) will have an equal appreciation score, because the substantiation does not influence the appreciation if it is negative. If the compliance is positive (+1 / +10) the following algorithm is used to determine the appreciation level

Table 2: Algorithm to determine appreciation level.

Substantiation	Appreciation level if compliance was positive
0	Equals minus 3
1	Equals zero
2	Divide compliance by 2, to round up
3	Equal to compliance
4	Compliance +1

3.2.3 **Change: Investment**

Typically, an invention put to practice implies a change process for some or most of the stakeholders. This change will cost energy. Stakeholders have to give up their status quo in favour of a new situation. To reach this future situation they require information, instruction and a change of current processes (figure 6). Therefore, it will always be a burden. The amount of change investment depends on the relation the stakeholder has with the invention. The core users of an invention often require the largest change investment, while the management has a low investment in change or none at all. The appreciation level has to be high enough to make up for the energy investment caused by the change.

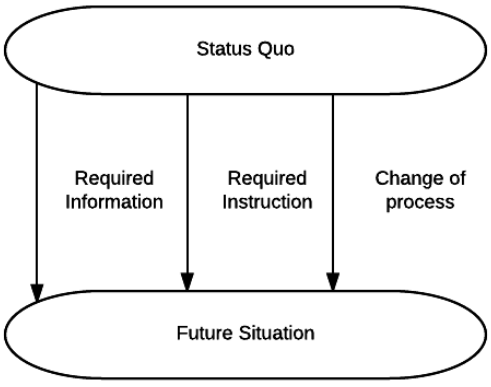


Figure 6, Change investment from current situation to the future situation.

The required information/instruction need explains how much information/instruction the stakeholder needs to be able to use the invention. The change of process describes to what extent it is

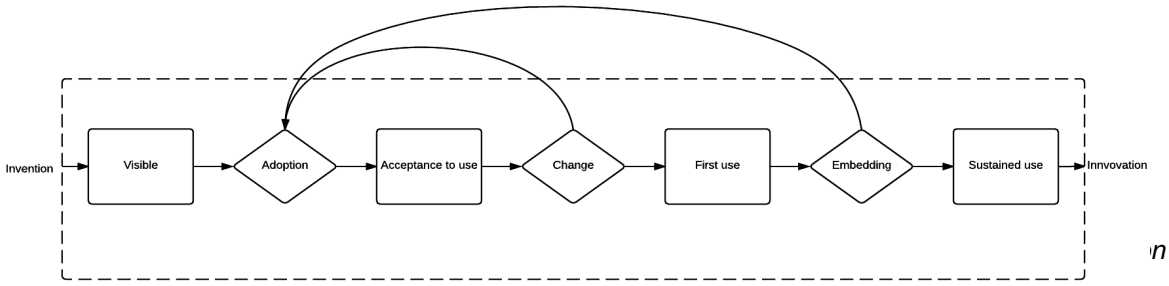
necessary to adjust the current working methods of the stakeholder, in terms of an invention (burden), in order to use the invention. This burden can be temporarily during the implementation, but can also (partly) be permanent. The change investment is scored from 0 to 4 (0: None, 1: Minimal, 2: Limited, 3: Strong and 4: Very strong). With a scorings algorithm an overall investment in change is calculated, ranging from 0 to 10. The change investment can be reasoned, checked during interviews or compared with other stakeholders during the implementation analysis.

3.2.4 **Change and Embedding: Long-term requirements**

Three different kinds of requirements are distinguished: predetermined requirements, change requirements or embedding requirements following the stages of the implementation process. It is important to look ahead in the implementation process to detect those requirements so they can be complied with. A stakeholder can have doubts during the adoption stage about the change and embedding stage, and may need to be convinced during adoption about the success of these stages. It is, therefore, important to distinguish all requirements so they can be complied with by the invention (figure 7).

E.g. a financial manager is interested in the late financial effects of the invention and is therefore located at the embedding stage. However, if the financial manager does not get any compliance at the adoption stage, the invention could receive resistance in that stage.

Predetermined requirements are present before the adoption activity. E.g. “the invention is not acknowledged by a certain organization”, or “I don’t like the invention”. The change requirements are factors that involve the change process. E.g. “I don’t want to train for 4 weeks before I can use the invention” or “The invention does have a negative impact on my work process”. The embedding requirements are requirements that involve future certainty. If the stakeholder is not convinced that the new invention will be the new status quo in a year, he will not be appreciating the invention at the adoption stage. Moreover, if after one year of using the invention it is shown that the new invention is



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not returning the investment, stakeholders will not appreciate the invention anymore and return to the status quo.

3.2.5 **Embracement level**

As described, the implementation analysis assesses both the compliance to the wishes/demands and the expected investment in the change by each stakeholder. The requirements, compliance, and substantiation will provide information about the perceived benefits that a stakeholder will receive, and therefore indicate a level of appreciation of the invention by this stakeholder. The change process, on the other hand, requires the alteration of the stakeholder and/or surrounding, resulting in his/her investment this change process. The balance between appreciation and change investment, is defined as the embracement level. The embracement level is calculated with a matrix on which the investment in change is located on the x-axis and the appreciation of the invention is located on the y-axis. This will create a dot on the matrix indicating the embracement level of the stakeholder (figure 8). When the appreciation level is high and the investment in change is low, stakeholders will be in the green area and embrace the new invention. If the appreciation is low and they need to invest a lot of energy in the invention, the adoption energy will be in the red area. When a stakeholder has a crucial requirement that is not complied to, it will appear as a red dot on the matrix, indicating the stakeholder will not embrace the invention because of that crucial requirement. Even when the stakeholder is located in the green area, the lack of compliance with a single crucial requirement will result in a negative embracement, unsatisfying the stakeholder because they want to use the invention, but are not able to because of the crucial requirement. If the overall embracement level of an invention is low, the innovator can decide to alter or cancel the development of the invention before large investments are made or make sure that during the adoption activity the stakeholder with a low embracement level will be supported.

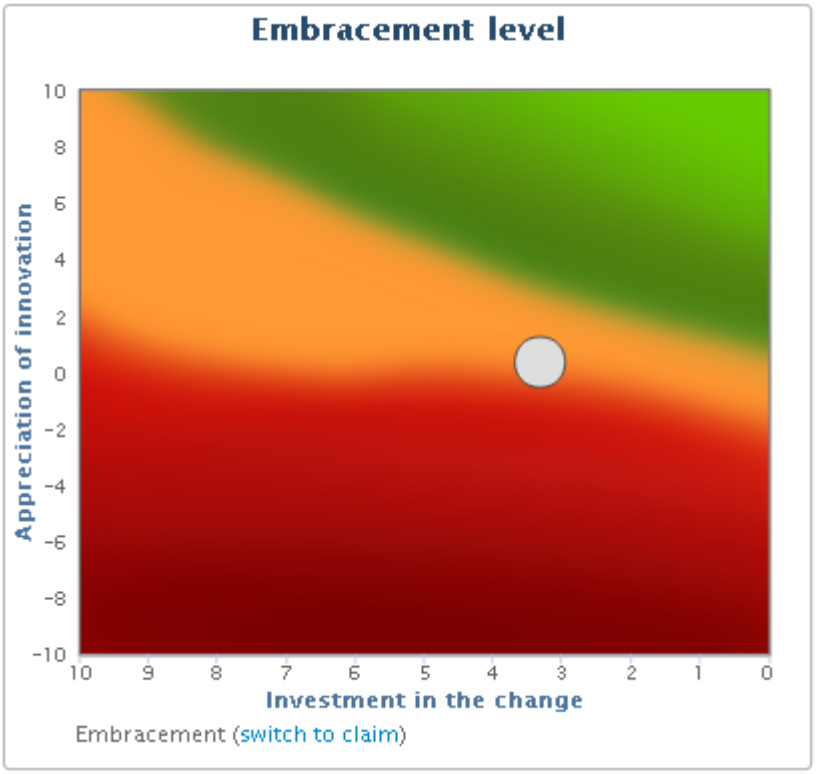

Figure 8; the embracement level of the invention for one stakeholder (dot).

3.2.6 Implementation boundary and context

The embracement of one stakeholder has been defined and provides the innovator with information about the current appreciation and change investment of a single stakeholder. The next step is to repeat this analysis for all stakeholders that have a certain relation with the invention.

It is important to define the boundary in which the invention is implemented. The implementation boundary describes the physical context of the implementation, e.g. organization, hospital, country etc. This boundary helps the innovator to explore who has a relation with the invention in the implementation process and thus needs to go through some degree of change in order to use the invention. The main question to detect stakeholders is: “Who is affected by the invention and/or who can affect the invention?” The different stakeholders that are involved in the implementation process need to be explored before reliable information can be given about the difficulties during the implementation process. The total of stakeholders is called the stakeholder population. When the stakeholder population is determined it will become an implementation context, the human context in which the invention is implemented. In figure 9 the standard identification of stakeholders is depicted.

The stakeholders that are identified can be randomly grouped inside the boundary (circle). However, to assist the innovator in identifying all stakeholders, a ring model has been created in which they are sorted by relationships with the invention like Cresswell (2009) did.[28] The different relations are defined as layers of stakeholders surrounding the core user of the invention, describing all different stakeholders able to influence implementation. The ring model sorts the stakeholders in 6 different

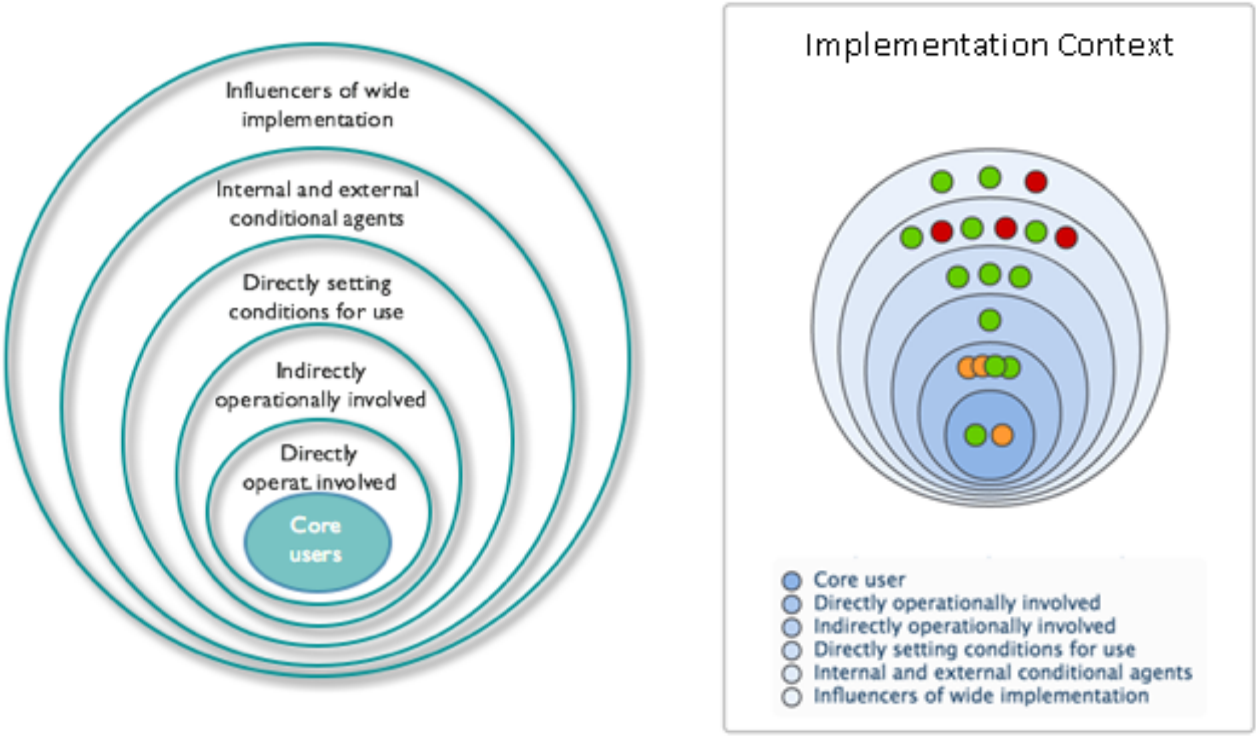

Figure 10; the implementation context. Left: Different relations with the invention to identify all stakeholders. Right: The final implementation context with all stakeholders. Green dots; stakeholders have a positive embracement level; Orange dots, stakeholders with moderate embracement level; Red dots, stakeholders with a negative embracement level.

categories (figure 10). The six categories are: 'core user', 'directly operationally involved', 'indirectly operationally involved', 'directly setting conditions for use', 'internal and external conditional agents' and 'influencers of wide implementation'. Every invention typically has at least one stakeholder located in each ring. Identifying all stakeholders is of great importance because in principle every stakeholder has the power to block or at least hamper the implementation process of the invention. [23-27]. On the other hand, if all stakeholders are happy users and/or advocates of the invention, they will have promoting power, boosting the implementation process.

3.2.7 **Implementation strength**

When the boundary is determined, the stakeholders are located inside the implementation context and the embracement levels have been defined, all stakeholders will be located on the embracement matrix

and a general indication of the implementation strength can be determined. If all stakeholders are in the green area, the implementation process can be expected to have low resistance levels because all stakeholders have a high embracement level and are not burdened too much by the change process. If one or more stakeholders are in the orange area, it will increase the difficulty and if stakeholders are in the red area or have a crucial wish/demand that is not met, implementation will be increasingly difficult. When the implementation analysis is done during the development of the invention, the invention can be adapted to better meet the requirements of all stakeholders and/or to enable for lower investment levels, in order to improve the implementation strength of the invention. When the implementation analysis is done while the invention is already on the market, only interventions to lower change investment are possible.

4.3. **Result of the implementation analysis**

When all steps of the implementation analysis are complete, the innovator is aware of the boundary and implementation context, the appreciation levels of the stakeholders for the invention, the change investment of all stakeholders and the overall embracement level of all stakeholders. With the insight and the list of requirements that invention cannot comply to, the innovator can adjust the invention to increase the embracement level. When the embracement level is positive, the innovator can start with the implementation execution, starting with adoption. In every activity stage of the implementation execution, the implementation analysis can be used to convince professionals with the compliance and substantiation with different requirements and prioritize stakeholders with the lowest embracement level. Those stakeholders require support throughout the implementation execution to reach the end goal: durable sustained use of the invention, transforming it into an innovation (figure 12).

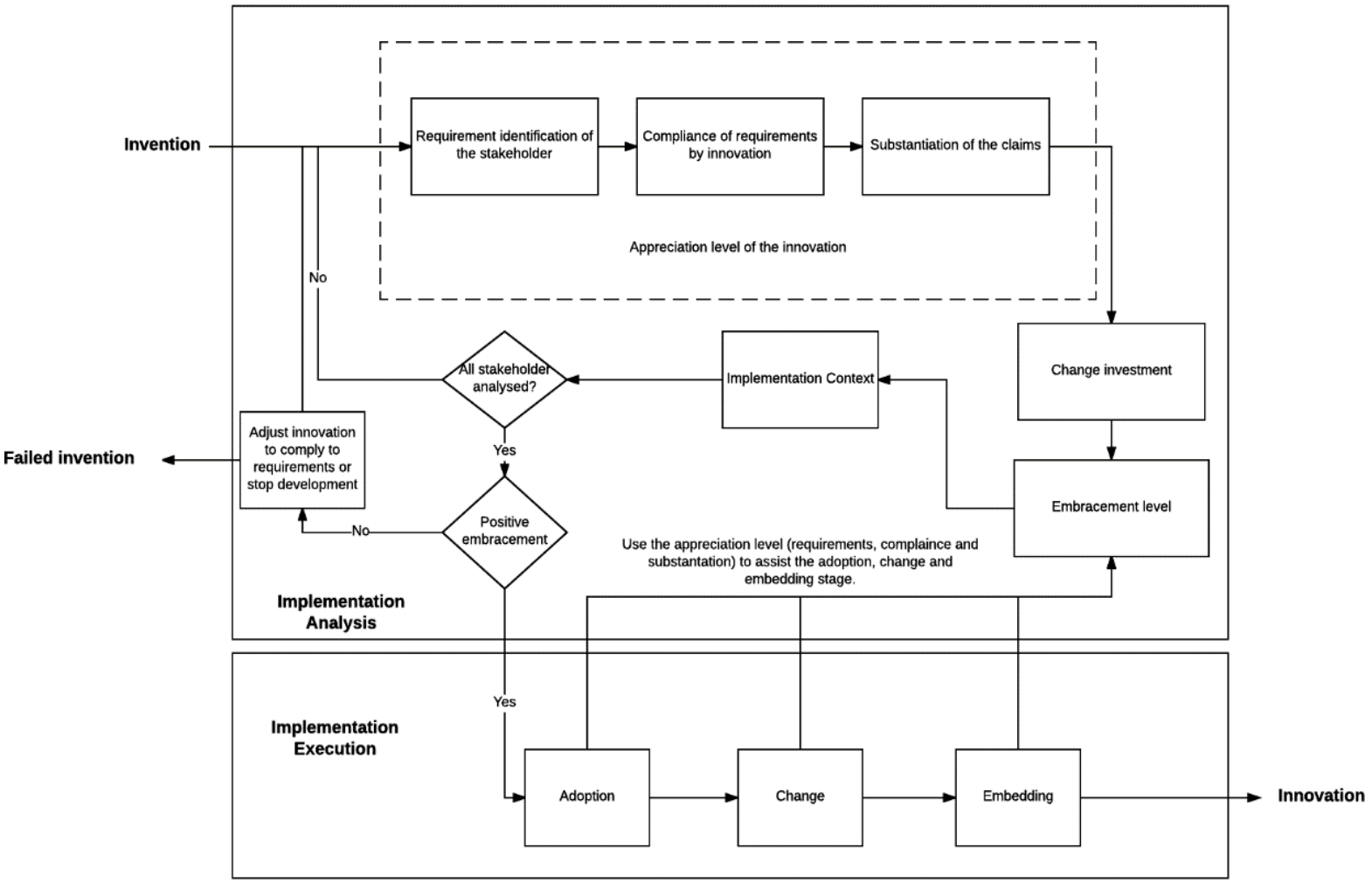

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Figure 12; the overview flowchart with the invention at the start. Moving through the implementation analysis into the implementation execution, ending with an innovation.

5. Discussion

The existing theories that describe different implementation difficulties have mapped an implementation process that was divided between an implementation analysis and implementation execution. The implementation analysis consists of three tools that together give an indication of the implementation strength of an invention. The implementation strength of an invention is defined as a feature of the invention and the implementation analysis assists the innovator in detecting the implementation strength prior to – and in some cases during - the implementation execution. The existing theories explain several aspects of the implementation difficulty, but a synthesis was never made. The implementation analysis adds a usable and robust framework to current practice for innovators and companies. The theories that were used did not describe the complete implementation process. The DOI and NPT describe the core users of a new invention but do not describe the stakeholders that influence wide implementation. [3-6] FFA accepts all stakeholders but will put a weight at the location of the stakeholder, ignoring that all stakeholders are able to weaken or terminate the implementation process. [7, 8] SP describes differences in stakeholder perception, concerns, interaction, and outcome but does not define different layers of stakeholders and the interaction with the invention and the context it is implemented in. Other articles describe implementation lessons or methods, Edmundson (2003) has analyzed different implementation strategies and used four case studies to illustrate how leaders can influence the implementation success, and confirms that all stakeholders need motivation and support of a leader in order to make a change process successful. [29] Resistance of stakeholders against change plays a major role in the implementation process, Erwin & Garman (2010) performed a study exploring individual resistance to organizational change initiatives. [30] Many of the factors described in the framework are included in the implementation analysis to lower or remove resistance with the change. Straub (2009) combined three implementation theories to focus on the adoption process, describing technology adoption as complex, inherently social and developmental process where individuals construct unique perceptions that influence their adoption decisions.[31] This conclusion is in line with the implementation process and the importance of the adoption stage stated in this paper. Tornatzky & Klein (1982) performed a review with meta-analysis on invention characteristics and adoption-implementation.[32] They indicate that compatibility, relative advantage, and complexity had the most consistent significant relationship to implementation success. These factors can be viewed as requirements of an invention and are included in the implementation analysis. However, no ranking of importance is included in the

implementation analysis, so the results of this study are not used optimally for the implementation analysis.

Most theories that are cited in this paper are sociological or psychological theories about human interaction with a change process. These comprehensive theories describe complicated problems that trouble implementation. Innovators, start-ups or companies can experience difficulties to understand and use this knowledge in practice to improve their product. The implementation analysis method described in this paper does support the innovators with a hands-on method that can be used in a fairly easy manner. The added value of the implementation analysis for innovators is feasibility analysis, development direction guiding, trial assessment focusing, implementation process design and marketing.

The main goal of the implementation analysis was usability in practice. Therefore, the IA was developed to perform the implementation analysis in an intuitive way. The IA has been used over a period of 2 years in the office of Implementation IQ (De Meern, The Netherlands) and over 500 different inventions have been analyzed. A database of different stakeholder requirements was constructed with the use of literature [3, 4, 15-20, 27] and new requirements have been dynamically added when encountered. At the moment, almost no new requirements are discovered by the innovators that use the implementation analysis. In total 323 requirements have been verified. The list of predefined requirements can assist the innovator to identify requirements that are applicable to a specific stakeholder. A preset of stakeholders with a related list of requirements helps to speed up the process of selecting requirements, decreasing the time and effort to perform the implementation analysis.

5.1. **Strengths and limitations**

This paper has several strengths and limitations. First of all, the implementation analysis consists of several widely used sociological and/or management theories about implementation difficulties that exist for an extensive amount of time. These theories contribute to the construct of the implementation analysi,s combined with empirical evidence gained by the authors as implementation professionals. Secondly, the implementation method has been tested over 2 years and a large amount of inventions and stakeholder that have been analyzed assists to increase the database with stakeholder templates and stakeholder requirements. Most surgeons have the same requirements, increasing the ease to find verified stakeholder requirements. The list of requirements that have been found in literature and in

practice has been saturated; almost no new requirements are being found. Typically, innovators are focused on their product, and less aware of implementation difficulties. With the implementation analysis, they are invited to think beyond their normal scope, and explore all factors that can affect the implementation strength of the invention.

However, there are limitations to this paper. As an introductory paper to a new theory, knowledge was drawn from existing theoretical work and empirical evidence. Most theories are dated and might not be representative of implementation problems in the modern era. New technologies and the wide use of internet and smart devices might shift implementation difficulties.

Secondly, the initial response and results from the 500+ cases are positive, however, a reliability and specificity study is needed to determine the quantitative effect of the implementation analysis on the success and failure rate of inventions actually becoming innovations. These factors have to be examined in more depth.

5.2. **Innovator experience in a practical situation**

To verify the usability of the implementation analysis in a first pilot a few innovators that used the analysis have been interviewed on their experiences with the method. In the past they used IA to perform the implementation analysis and in the meantime their product has been released on the market. The purpose of the interviews was to have a first indication of the use of the method, the insights that were provided by the method of implementation difficulties and evaluation of the method for a practical situation.

In interviews with the innovators they described 2 major benefits with the IA:

- Process design. It can be used to assist the innovator when the implementation process is stuck (with unknown reason)
- Development. The tool can be used to alter the product at an early stage to improve the embracement level of the users.

Further research is needed and testing to test the tool and theories in practice.

6. Conclusions

The implementation analysis method offers an integration of known sociological en psychological theories to provide innovators with practical support to implement their product/invention. The method involves stakeholder analysis with the implementation context, identification of requirements of all stakeholders, compliance with the requirements of the invention, substantiation of those claims, change investment and together show the embracement by each stakeholder. All these analyzed factors invite and support the innovator to think beyond the initial development of the product and create awareness of all the different stakeholders that are involved. Moreover, the identification of all the requirements of the stakeholders and verification of those requirements will assist in the adaptation of the invention (if possible) or provide a focus for the adoption stage, resulting in a higher chance on sustainable use of the invention which thus can become an innovation.

7. Declarations

List of abbreviations

Acronym	Definition
IA	Implementation Analyzer (tool)
FFA	Force Field Analysis
CM	Change Management
DOI	Diffusion of Innovation Theory
NPT	Normalization Process Theory

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Competing interests

The authors are working at Implementation IQ, a consultancy firm specialized in implementation difficulties and have much experience with implementation problems in practice. This paper is introducing a method that is used by Implementation IQ. However, the sole purpose of this paper is to

introduce the method to scientists all over the world. No conflict of interest is indicated because the method is free to use and discussions are preferred.

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