MANAGING MEDICAL DEVICES INNOVATION:  
THE DIFFUSION OF THE AUTOMATED EXTERNAL  
DEFIBRILLATOR (AED) IN THE NETHERLANDS  

MASTER THESIS  
by  
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Abstract

Decision-making is a central and vital process within organizations, which fascinate researchers for many decades. The decision to innovate c.q. to adopt an innovation is taken in general by higher managers of organizations. The management’s decision-making process is though influenced by numerous factors, which determine the organization’s decision to adopt or reject an innovation.

To explore the adoption process of a disruptive medical technology, known as the automatic external defibrillator (AED), this study relays on an inductive approach, using the author’s observations made in an AED-business firm, an extended theoretical framework and selected case studies, focusing on the decision-making factors that determine the adoption and implementation of the innovation by organisations.

In confronting the theoretical views by means of a conceptual model against the empirical research findings, this study was able to confirm and highlight a number of factors that influence the innovation’s decision to adopt and implement life saving medical-technology in organizations; the factors ratio, power, politics, intuition, casualty.
This study reveals also the existence of two additional determinant factors; gesture towards personnel and customers, and idealistic views. The uncovered determinants remain to be classified under the existent theoretical views and require therefore additional research.

This study can be used by suppliers of medical technology to shed light on the innovation-decision process. Furthermore, the study can be used as a basis for further explorative research on the decision-making factors that determine the adoption of AED technology.

**Keywords:** decision-making, factors, innovation, adoption, diffusion, medical devices, AED
Preface

This master thesis is the result of an explorative research on factors that influence decision makers to adopt and implement the medical innovation, automatic external defibrillator (AED) within their organisations. The research was performed as the final assignment of the course Master of Science in Business Administration.

During the realisation of this project, I have received help and support from numerous people. In the first place, I would like to thank all interviewees for their valuable information. A special word of gratitude goes to my first supervisor, Drs. Otto Lappohn, for giving me helpful advice, reading my draft versions and inspiring me with all reflective conversations. I would like also to thank my second supervisor, Prof. Dr. Wilfred Dolfsma, for his willingness to judge this thesis.

I dedicate this work to my wife Menja and my daughters Anna and Sophie. They always were there to give me their love and support.

Harkstede, August 2009

Paulo Fitas
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1.0 Introduction

The development of advanced user-friendly medical technology has been gradually revolutionizing the hospital medical care industry. Medical technology, which used to be possessed and applied exclusively by medical professionals, is nowadays also available to non-medical consumers. During the last 20 years, consumers have been experiencing increasingly wide access to medical devices within the pre-hospital, preventive and diagnostic segments. The paradigm shift has been the result of the development of disruptive innovations within the medical devices industry focusing and targeting on effective and cost efficient ways to increase the quality of healthcare.

The emerging consumer medical market segments are a continuous marketing challenge, forcing distribution organizations to develop competitive business models that facilitate the rapid diffusion of disruptive innovations, such as the public access automatic external defibrillation device (AED). Automated external defibrillators have been developed by the medical industry as an answer to sudden cardiac arrest (SCA).

According to the Dutch Heart Foundation, 300 Dutch citizens suffer weekly a sudden cardiac arrest at home, at work or out on the street. In the Netherlands, sudden cardiac arrest causes 15,000 to 16,000 deaths per year.

AED’s provide a medical treatment for sudden cardiac arrest by delivering an automatic electrical shock to the human body within the heart and chest area. AED’s are designed to help non-medical citizens to perform medical live saving procedures when needed. The use of an AED is easy and very rewarding; anyone can press the button of the machine, rescue the life of a human being after sudden cardiac arrest, and reduce by four times the risk of permanent brain damage. One could easily agree that such a problem-solving message is simple, powerful, and on the major interest of humankind. However, and in spite of a general positive attitude towards the AED technology, at this moment the adoption of an AED in the Netherlands is a single and optional innovation decision. So far, the Dutch government has not issued any type of legislation making AED’s mandatory for organisations with personnel or obligatory within strategic public areas. This status allows the disparate between attitudes and actions and makes an interesting field of research to understand the decision-making factors that determine the adoption of the public access medical innovation.
1.1 Motive
Writing a research proposal for a specific subject of interest and consequently performing the intended research is one of the objectives of the final research phase of the Master of Science in Business Administration. This document was written for the purpose of guiding the intended research proposal, and presenting the study results.

1.2 Problem discussion
The total number of research on innovation is quite impressive; however, there are still blanks left in the knowledge and understanding of the innovation process. This has been observed by different innovation researchers and consequent developments of the methodology have been suggested to fill in the gaps by Rogers (2004) and Meyer (2004).

Meyer (2004) states that the research methodology that has for many years dominated the diffusion of innovations landscape was set more than 60 years ago when Ryan and Gross (1943) conceptualized their well-known investigation focused on the diffusion of the hybrid corn seed in Iowa. Of this influential diffusion study, Rogers (2003) noted,

“The research paradigm created by the Ryan and Gross investigation became the academic template that was to be mimicked, first by other rural sociologists in their agricultural research, and then by almost all other diffusion traditions (whether they knew it or not)”

Meyer (2004) notes complementary that the overwhelming majority of studies published since that time have relied on: (1) quantitative data, (2) concerning a single innovation, (3) collected from adopters (4) at a single point in time, (5) after widespread diffusion had already taken place.

Traditionally, buyers of medical devices were hospitals and other type of healthcare organizations. The last decennia though a new trend can be observed where individual consumers with no specific healthcare or medical education do have progressively access to sophisticated medical technology. In this sense, the purchase process has evolved from a medical professional business-to-business trade, into a non-medical business to consumer
trade where the access to healthcare technology seems to be strongly influenced by political and social economic factors.

Using Porter’s terminology: *Innovation = invention + commercialization* (Westland J.C., 2008), the innovation process of medical devices within non-medical environments, becomes now more complex to predict c.q. manage. Looking from the outside, several factors could be recognized as of great influence to the way how the innovation process of medical innovations for non-medical consumers occurs.

Medical devices producers exist in highly dynamic sectors being often small capital venture companies that are entering and leaving frequently the market. New technologies or new medical insights may alter the conditions for medical device manufacturers. Products may become obsolete very fast or get into the commodity segment where other firms compete at a global level at lower prizes. As a consequence of the rapid development and short product life cycles, one could describe the medical device industry as knowledge intensive and niche specialized. In the different areas of the medical specialization, it is usual to find a few large multinational firms, which dominate the market and make it hard for smaller companies to survive. Fusions and acquisitions are therefore regularly observed among (1) large and middle size firms, and (2) large and small-size firms. Acquisition strategies are often the tool of preference to acquire rapidly promising innovations, however they might also be part of a defensive plan to delay c.q. stop the introduction of revolutionary ideas. As a result, promising medical innovative products might never reach mature market segments or even get introduced to consumers (i.e. disruptive innovations). Other existent situations include the exhaustive introduction of slight modifications of existent products, which might never prove their benefits to the users. All in all, the above described scenarios’ may lead to some kind of medical devices market unpredictability.

Introduction of new medical products is directly or indirectly affected, stimulated and controlled by public authorities. Therefore, regulations and guidelines are important aspects of the environment in which medical device companies operate. Medical device firms need to fine-tune their ability to develop and commercialize innovative medical products with the will and intention of the local authorities to develop clear regulations that allow the use of the medical innovations to become accessible to non-medical consumers. The introduction of public access cardiac arrest technology is a good example of a medical device development that has strongly been influenced by the different external mechanisms as
described above. Automated external defibrillators (AED) have been developed by the medical industry during the 80s taking however longer than 20 years to find their way to the consumer markets. AED’s provide a medical treatment for sudden cardiac arrest by delivering an automatic electrical shock to the human body within the heart and chest. The smart technology has been idealized and consequently developed to, allow non-medical citizens to perform live-saving procedures when needed. At the beginning, public access defibrillation technology was marketed for 5,000 Euros, being so prohibitively expensive to the large majority of non-medical consumers. Gradually in time, this live-saving technology became more price-friendly, and nowadays a large number of AED brands are available for less than 2,000 Euros.

The fact that the diffusion of such noble medical technology is taking several decennia to become available outside intramural environments (hospitals, paramedics) speaks for itself and illustrates superbly the complexity confronting the medical device industry.

In summary, consumer adoption and the related diffusion of medical devices seems to be thus influenced by several factors including (1) political trends, (2) Social-economic factors, (3) local regulatory controls, (4) unpredictable medical device markets, and (5) frequent c.q. continuous improvements of the medical knowledge. These factors make adoption and diffusion patterns difficult to predict and confronts the author with a multitude of different stories of diffusion of innovation.

This study attempts in the first place to rebut some of the criticism expressed by Meyer (2004). Therefore, the author intends to use exploratory research methods, and qualitative data collection from independent organizations considered responsible for the introduction of the public access defibrillation technology (AED) in the Dutch market.

Secondly, the study intends to create a more holistic view of the diffusion process of medical technology innovations within non-medical consumer markets, assessing wide accepted diffusion models to the empirical data found.

To guide the case study the following question was formulated:

- Which are the decision-making factors determining the adoption of the public access medical device (AED) in the Netherlands?
1.3 Research objectives

The purpose of this study is to explore the diffusion process of the public access medical resuscitation device, the automated external defibrillator (AED) in the Netherlands, and find out consequently which factors are determinant within the decision-making process of individuals and organisations to adopt the innovation.

The research is composed by a literature review and an exploratory study. The literature study is intended to ultimately back up the development of a conceptual model, integrating relevant variables defined in the literature, and aiming to provide an insight on the array of factors influencing the adoption process of innovative medical devices.

In the exploratory study, the author intends to find out empirically which factors c.q. variables can be classified as the major influencers of the adoption and implementation process of the automated external defibrillator (AED). Being a managing director of an AED company, the author assumes a researchers' role in which relevant findings from written materials, conversations and interviews are reported objectively and professionally, according to his own interpretation as an expert within the specific field of the medical device industry. In this sense the researcher is therefore a participant and observer (interpretative perspective) using inductive methodologies to study specific social phenomena associated to the adoption and diffusion process of the AED technology.

The results of this research aim to provide a more holistic view at the diffusion process of medical innovations within consumer markets by taking a practical look at the Dutch AED diffusion process, the factors influencing the innovation’s adoption, how those factors interact and finally exercising a comprehensive analysis between the theory and found empirical data.

1.4 Delimitations

Inherent to case studies, the context under which a study occurs has a bearing on the research, the data collected, the analysis and the study conclusions. This section aims to help to identify the boundaries of the conducted research and is intended to appoint the areas for possible future research.

The author identifies a first restriction around the empirical study. The research was conducted by making questions and collecting answers around the diffusion process of the AED technology in the Netherlands. While some insights might be provided with regard to
diffusion process of medical devices in general, most of the data collection plan will target the specific area of adoption of a public access life-saving medical device in Dutch territory, and therefore, any conclusions drawn are not necessarily applicable outside of this area.

Furthermore, the study was conducted from the perspective of an AED trade company and the data collected originates from one single company technology (sampling). Therefore, while the theoretical data and original observations might be representative for a larger number of companies in different areas of the medical devices business, conclusions drawn from the empirical data can only be assumed to be applicable within the specific AED medical business segment.

A final delimitation that should be identified is the exclusion of the success or failure of diffusion strategies used in time as this aspect was not taken into account. The purpose of the research is not to determine how to develop successful or unsuccessful diffusion strategies, but instead to look at variables that influence the diffusion process and in particular at the factors determining the adoption of public access medical devices.

Although this section identifies the study delimitations, the author believes that the application of analysis and conclusion will not be affected, as the study will be conducted using a defined and valid research methodology. The delimitations, as outlined here, can though be used by future researchers in order to study further the diffusion process of medical devices within non-medical environments.
2.0 Methodology

The diffusion process of a public access medical device may be researched in general by observation, by study of organizational records, and by interview or questionnaire. Investigation of records is very difficult as (1) the adoption process of innovations which are not directly related to the firm’s direct operations, seldom leaves reliable traces in the files of adopting organizations, (2) information related to the sales and marketing of a new public access medical device is often classified, especially at the beginning stage of a new industry. In spite of these barriers, the researcher intends to collect as much as possible data by means of desk research.

Observation on its turn is certainly a powerful and reliable method, but extremely demanding of research resources because diffusion processes of innovation may span periods of years. Considering all these data-gathering difficulties, the researcher is obliged to rely heavily on interviewing.

The study relies on (semi-structured) interviews (Verhoeven, 2006) taken at an individual level by individuals and organisations involved in the diffusion process of the public access AED-technology in the Netherlands. This method was seen as the best means to gather the necessary in-depth information needed to understand the innovation’s diffusion process. The (semi-structured) interviews have two main objectives: on the one hand, the researcher wants to know the informant’s perspective on the issue but, on the other, he also wants to know whether the informant can confirm insights and information the researcher already holds (Blumberg 2005). Relevant and additional information available through publications in combination with data collected in the study was used to conduct the analysis and draw the final conclusions.

2.1 Research approach

The research design is meant to provide a framework that ensures that the study is relevant to the emphasized problem and guides the researcher through the process of data collection and analysis. As cited in the previous chapter the research question of this study has been formulated in terms of:

- Which are the decision-making factors determining the adoption of the public access medical device (AED) in the Netherlands?
This study applies a generic model of the diffusion process of innovations to investigate the diffusion process of the AED in the Netherlands.

The author is a manager of an AED trade firm and the approach adopted is inductive. Inductive refers to drawing a conclusion from one or more particular facts or pieces of evidence. The conclusion explains the facts, and the facts support the conclusion. The nature of induction however is only a hypothesis. It is one explanation, but there is the possibility that others fit the facts just as well (Blumberg 2005).

The research investigates the diffusion process of the public access AED technology in the Netherlands, firstly introduced to major public by a medical doctor in the role of entrepreneur and owner of a small trade organization.

The purpose of the conceptual framework is to guide the author through the collection of empirical data. Although the conceptual framework plays a central role in the data collection process, the author is aware that this model may induce preconceptions and therefore alternative observations and influences to innovation-decision-making process need also to be explored. This method is presumed to help the author to confirm certain assumptions of the model and discover other areas of importance that may need to be further explored.

2.2 Case studies

As mentioned before, the purpose of this study is to explore the diffusion process of a public access medical device, the automated external defibrillator (AED) in the Netherlands, and therefore a case study approach was selected.

Case studies offer a useful approach for use in theory development as they are especially appropriate for answering explorative questions. Yen defines a case study as ‘an empirical inquiry that investigates a contemporary phenomenon within its real life-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used’ (Blumberg 2005). Moreover, case study research is usually more appropriate if the number of variables that needs to be considered is quite large. Therefore, for this research, a case study approach was appropriate. Examining the innovation diffusion process through case study allows the researcher to use existing theories, models and own observations as a guide in collecting and analyzing the data.
Within the case study research it is possible to distinguish between single and multiple case studies. Investigating an issue in more than one context is comprehensively better than basing results on just one case. The author believed it was important to have more than one case study in order to increase the validity of the results. Therefore, the author decided to use a sampling technique in accordance to the rich diversity of the targeted population and market segments. The research includes data from providers of certifying services, and three organizations sizes (micro-, small-, and middle size). Besides the company’s size, the selected organizations represent also extreme cases within the diversified adopter’s spectrum. The selection criteria are based on researcher’s expertise within the field of public access AED technology. The author believes that through this type of extreme-case sampling the information collected can be applied to shed light on general cases.

2.3 Data collection

Interviews are the most widely used source for collecting information for evidence (Blumberg 2005). The qualitative data produced by interviews is meant to provide valuable insight in views, attitudes, perceptions, and opinions of participants. This research focuses primarily on the memoires of an entrepreneur and the memoires of different public institutions associates. The research aims to collect facts and events directly associated to the evolvement of the diffusion of the AED in the Netherlands. Therefore, the researcher made use of conversational interviews. Furthermore, this research involves also exploration at three other organisations. For this purpose, an interview guide was developed to aid the interviewer with topics that needed to be explored. The goal of the guide was to insure that all major factors relevant to the decision-making process to adopt the innovation would be described in enough detail. The questions were formulated open-ended in order to avoid predetermined responses. The questions were asked in a logical sequence, from generic to more specific, providing so a better context to the participant. The interviews were conducted by an experienced interviewer aiming so to avoid biased results (Blumberg, 2005). All interviews were recorded by means of conversation notes.
2.4 Data analysis

The purpose of the research analysis section is to compare and contrast the theoretical framework with the empirical data found in the case study. For this purpose, the data was classified in a way that assisted the researcher in reaching pertinent conclusions, and that clearly revealed the findings that have led to those conclusions (Blumberg 2005). The data gathered during the interviews were categorized by key issue and put in chronological order, offering a good overview of relevant subjects around the AED diffusion process. Hereafter a comparison to the mentioned theories in chapter 3 was conducted to analyze the encountered data in the case study.
3.0 Theoretical framework

The purpose of this section is to provide a literature overview of the concepts and hypothesis that will have impact on the empirical research being conducted. The literature overview will begin at a broad level and will then narrow to the most relevant issues for the case study. The different areas of discussion will be used as the basis for the preference and choice of a general model to be used.

The structure of this section follows closely the journey that the author took during the literature review. The magnitude of the research topic motivated the author to divide the literature review in two main topics; (1) the diffusion of innovations, and (2) the theory of decision-making. See figure 1.

Figure 1: Structure of the theoretical framework
The author reviewed in first place the research topic from a perspective of diffusion of innovations. This review encloses the basic and necessary knowledge to further understand how the innovation-adoption processes evolve in different contexts, and what potential elements are able to influence the course of developments. The reviewed literature on the theories of decision-making arises from the necessity to understand more in detail how decision-making-units take decisions, as the adoption and implementation of AED technology in the Netherlands has been mainly related to First Aid Programs (Bedrijfshulpverlening/BHV) within governmental-, non-governmental-, profit-, and non-profit-organizations.

3.1 Innovation research

The French sociologist Gabriel de Tarde is recognized to be the first one developing theories around the diffusion process of innovations. In his 1903 book on The laws of imitation, de Tarde, hypothesized that small psychological interactions among individuals are the basic explanation of social change. De Tarde proposed also that the diffusion of inventions could be represented graphically by an S-shaped curve when plotted as a function of the number of users (adopters) over time. Furthermore De Tarde found that diffusion has a central point from which habits spread acknowledging so the role of opinion leaders in the process of diffusion of innovations. Forty years later Bryce Ryan and Neal Gross (1943) published their results on the spread of hybrid-corn use among Iowa farmers. This investigation more than any other, provided the basic framework for the diffusion model. It helped establish the paradigm for diffusion research (Rogers, 2004). Ryan and Gross (1943) found also that the diffusion of hybrid corn among Iowa farmers followed a typical S-shaped pattern. At that time the authors argued that non-economic factors must be involved in the adoption decision of proven beneficial technologies, as they found that 13 years were required for the diffusion process in their two communities of study (Rogers, 2004).

Wejnert (2002) found that since Ryan and Gross (1943) study’s publication, more than 4000 research papers have appeared on the diffusion of such diverse innovations as agricultural practices (Fliegel 1993, Grilliches 1957), technologies (Burt 1987, Coleman et al. 1966, Palmer et al. 1993), fertility control methods (Rogers & Kincaid 1981, Rosero-Bixby &

Rogers (2003) presents a different type of overview on the history of the innovation study and defines eight different types of diffusion analysis. Table 1 shows Roger’s typology including the amount of research attention paid to it.

Research on the variable Innovativeness of members of a social system constitutes approximately 58% of the available diffusion publications and is by far the most popular diffusion research topic. Research on the variables Communication channel use and Earliness of knowing about an innovation by members of a social system may be considered the next topics of most interest in the research ranking.

Table 1 Eight types of diffusion research

<table>
<thead>
<tr>
<th>Type</th>
<th>Main dependent variable</th>
<th>Independent variables</th>
<th>Units of analysis</th>
<th>Approx. % of publications</th>
<th>Representative diffusion research study</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Earliness of knowing about an innovation by members of a social system</td>
<td>Characteristics of members</td>
<td>Members of a social system</td>
<td>5%</td>
<td>Greenberg (1964)</td>
</tr>
<tr>
<td>2</td>
<td>Rate of adoption different innovations in a social system</td>
<td>Attributes of innovations</td>
<td>Innovations</td>
<td>1%</td>
<td>Fliegel and kivlin (1966b)</td>
</tr>
<tr>
<td>3</td>
<td>Innovativeness of members of a social system</td>
<td>Characteristics of members</td>
<td>Members of a social system</td>
<td>58%</td>
<td>Deutschmann and Fals Borda (1962b); Mohr (1969)</td>
</tr>
<tr>
<td>4</td>
<td>Opinion leadership in diffusing innovations</td>
<td>Characteristics of members</td>
<td>Members of a social system</td>
<td>3%</td>
<td>Kelly et al. (1991,1997)</td>
</tr>
<tr>
<td>5</td>
<td>Diffusion networks</td>
<td>Patterns in the network links</td>
<td>Dyadic network links</td>
<td>Less than 1%</td>
<td>Coleman et al. (1966)</td>
</tr>
<tr>
<td>6</td>
<td>Rate of adoption of innovations in different social systems</td>
<td>Systems norms</td>
<td>Social systems</td>
<td>2%</td>
<td>Rogers and Kinkaid (1981)</td>
</tr>
<tr>
<td>7</td>
<td>Communication channel use</td>
<td>Innovativeness and other characteristics of members of a social system</td>
<td>Members of a system</td>
<td>7%</td>
<td>Ryan and Gross (1943)</td>
</tr>
<tr>
<td>8</td>
<td>Consequences of an innovation</td>
<td>Characteristics of members</td>
<td>Members or social systems or innovations</td>
<td>0,2%</td>
<td>Sharp (1952)</td>
</tr>
</tbody>
</table>

Note. Adapted from Rogers (2003).

Other important aspects of the innovation theory are the quantitative academic models, which were developed as a tool to predict more exactly the market penetration of new products.
The Bass forecasting model has been so far a standard for analyzing and predicting the market penetration of new products (Rogers 2003, Sood, James, and Tellis 2009). Sood et al, (2009) proposed a new forecasting model called Functional Regression and shed some light on the scope of prior studies done on the subject (see Appendix A).

3.1.1 Preliminary conclusions and findings of the section

One could agree that the impressive quantity of research presented in this section must have provided significant insights on the diffusion process of innovations. However, the author identifies at this stage an existent gap within the diffusion research spectrum. Considering the unit of analysis members of a social system, it seems to the author that no specific research has been done on the independent variable; determinant factors responsible for the decision to adopt or reject an innovation. From this perspective, the author believes that to conduct this study, an exhaustive literature review may be required in order to discover essential and relevant psychological components inherent to the process of decision-making. The exhaustive literature review should then allow the development of a conceptual model, in which the process of adoption of innovations can be combined with the psychological components of the decision-making process, offering so an effective framework for the purpose of this study.

3.2 Diffusion of innovations

Diffusion has been defined by Rogers (2003) as:” the process in which an innovation is communicated through certain channels over time among the members of a social system”. Diffusion refers to both the planned and spontaneous spread of new ideas. Communication plays a fundamental role in the diffusion process and has been defined by Rogers (2003) as: “the process in which participants create and share information with one another in order to reach mutual understanding”.

Diffusion of innovations is also a process of social change. Rogers (2003) asserts that the social change occurs as a result of consequences caused by the invention itself, the diffusion, and the adoption or rejection of new ideas or behaviours. This social change can be planned or spontaneous, intended or unintended.
Rogers (2003) definition for innovation is: “an idea, practice or object that is perceived as new by the individual” and the rate of adoption: “the relative speed with which an innovation is adopted by members of a social system”.

The definition of diffusion in terms of a process of innovation-spreading over time opens a new perspective of analysis and identifies five main elements in the diffusion of new ideas: (1) innovation, (2) communication channels, (3) time, and (4) social systems.

3.2.1 Innovation

According to Rogers (2003) the characteristics of an innovation as perceived by the members of the social system determine its rate of adoption. There are five attributes of innovations: (1) Relative advantage, (2) Compatibility, (3) Complexity, (4) Trialability, (5) Observability.

Relative advantage stands for the degree to which an innovation is perceived as being better than the idea it supersedes. The degree of relative advantage can be expressed as economic profitability, as conveying social prestige or in other ways.

Compatibility is the degree to which an innovation is perceived as consistent with the existing values, past experience, and needs of the potential adopters. An innovation can be compatible or incompatible with (1) sociocultural values and beliefs, (2) previously introduced ideas, and or (3) client needs for the innovation.

Complexity is the degree to which an innovation is perceived as relatively difficult to understand and use. This attribute may not be as important as the first two however for some new ideas such as computers, cellular phones or medical devices, complexity is a very important barrier to adoption.

Trialability is the degree to which an innovation may be experimented with on a limited basis. The personal trying out of a innovation is a way for an individual to give meaning to an innovation and to find out how it works under one’s own conditions. This attribute can contribute positively to the reduction of uncertainty of new ideas.

Observability is the degree to which the results of an innovation are visible to others. Some ideas are easily observed and communicated whereas other ideas are more difficult to sense.

3.2.2 Communication channels

According to Rogers (2003) a communication channel is the means by which messages get from one individual to another. Mass media channels are more effective in creating knowledge of innovations, whereas interpersonal channels are more effective in forming and
changing attitudes toward a new idea and thus in influencing the decision to adopt or reject a new idea.

The presence of a certain level of heterophily (the degree of intra-individual differences towards attributes such as beliefs, education, social status, etc) is one of the known problems in the diffusion of innovations, which limits the achieving of effective communication.

### 3.2.3 Time

Time is involved in diffusion in (1) the innovation-diffusion process, (2) innovativeness, and (3) an innovation’s rate of adoption.

Rogers (2003) asserts that an individual takes the decision to adopt or reject an innovation following an overtime and sequential process consisting of a series of actions and decisions. Rogers (2003) describes the innovation-decision process as: "the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision". This conceptualized innovation-decision process is shown in figure 2 and consists of five stages: (1) Knowledge, (2) Persuasion, (3) Decision, (4) Implementation, (5) Confirmation.

![Figure 2: A Model of Stages in the Innovation-Decision Process (Rogers, 2003)]

The time element of the diffusion process allows also the plotting of diffusion curves and the classification of adopters into categories, as individuals do not adopt innovations at the same
time. In this sense Rogers (2003) describes innovativeness as “the degree to which an individual is relatively earlier or later in adopting new ideas than other members of a social system”. Rogers’ diffusion of innovation model presented in figure 3 describes five adopter categories: (1) Innovators, (2) Early Adopters, (3) Early Majority, (4) Late Majority, and (5) Laggards.

Rogers (2003) asserts that the diffusion of innovations follow a bell-shaped curve when adoption is drawn over time on a frequency basis. When plotting the cumulative number of adopters the result is an S-shaped curve.

The adoption segment between 10 and 20 percent is described as the “critical mass” or the “heart of the diffusion process”. This segment stands for the transition from the early adoption level of innovativeness into the early majority phase.

![Figure 3: Adopter Categorization on the Basis of Innovativeness (Rogers, 2003)](image)

The diffusion curve makes it possible to compare the level of innovativeness of individual members of a system. The comparison exercise can be done by relating a group of system members to the adoption of an innovation in a given period of time.

Innovators (Venturesome), are pioneers and the first individuals willing to adopt a new idea. Innovators in relation to their peers are generally more venturesome, cosmopolite, educated, and can deal well with high degrees of uncertainty. Other prerequisites of innovators are substantial financial resources (helpful in absorbing possible losses) and the ability to understand and apply complex technical knowledge. Innovators fill the function of innovation’s gatekeeper within the population they lead.
Early Adopters (Respect), are educated individuals although a more integrated part of the local social system than innovators. Early adopters are localites and have the highest degree of opinion leaders in most systems. Early adopters are respected by their peers and function as a role model for others members of the social system. Early adopters are willing to deal with uncertainty but not at the same level as the innovators. Early adopters decrease uncertainty about a new idea by adopting it and help so to trigger the critical mass. Early Majority (Deliberate), individuals constitutes one third of the population providing interconnectedness in the system’s personal networks. The early majority adopt new ideas just before the average member of a system. Early majority individuals may deliberate for some time before completely adopting a new idea. Their innovation-decision period is longer than of the innovators and early adopters. Late Majority (Sceptical), adopt new ideas just after the average member of a system. The late majority individuals constitute also one third of the population. Members of the late majority tend to require peer-pressure to adopt innovations and are in general terms characterized by their scepticism about new ideas and behaviours. Laggards (Traditional), are the last in a social system to adopt an innovation. Laggards also known as last adopters. Laggards tend to be the least cosmopolite (most localite) and the least educated of all system members not possessing. Laggards can be also characterized as being suspicious towards innovations and take in general long time to adopt innovations. Resistance to innovation on the part of laggards may be entirely rational from their viewpoint considering that their resources are limited and there is no space for adoption fail (uncertainty avoidance).

### 3.2.4 Social System

Rogers (2003) defines a social system as: “a set of interrelated units that are engaged in joint problem solving to accomplish a common goal”.

The social system achieves stability and regularity due to the presence of a system’s structure also described as the patterned arrangements of the units in a system. The diffusion of innovations in a system is facilitated or impeded by the social and communication system’s structure. Members of a social system tend to follow the system’s norms, which comprise the internal established behaviour patterns. Opinion leadership appears in a social system as an element able to influence attitudes or overt behaviours of system’s individuals. The concepts of change agency and changing agent
are introduced as the institution or the individual that attempts to influence client’s innovation decisions.

Rogers (2003) distinguishes three main types of innovation-decisions according to the level of individuality and independence of the adoption choice. The main types are defined as, (1) optional innovation decision, (2) collective innovation decision, (3) authority innovation decisions. Sequential combinations of the three types of innovation decision are also possible and generate a fourth type called, contingent innovation decisions.

Another relevant issue within the context of social systems are the consequences of innovations. Consequences are defined as changes that occur to an individual or to a social system as a result of an innovation’s adoption or rejection. The consequences can be classified in (1) desirable versus undesirable, (2) direct versus indirect, and (3) anticipated versus unanticipated.

### 3.2.5 Rate of adoption

Rate of adoption is the relative speed with which an innovation is adopted by members of a social system. This value consists on the measurement of the number of individuals against the factor time. Therefore, the rate of adoption is a quantitative indicator of the steepness of a innovations’ adoption curve. Figure 4 summarizes all variables (earlier described along this chapter) that influence the rate of adoption of innovations.

![Figure 4: Variables determining the rate of adoption of innovations (Rogers, 2003)](image-url)
3.2.6 Characteristics of adopter categories

Adopter categories enable the classification of the members of a social system according to their degree of innovativeness. Rogers (2003) summarizes the voluminous diffusion research on variables related to innovativeness under three headings: (1) socioeconomic status, (2) personality variables, and (3) communication behaviour. The chosen classification focus on the differences between early adopters and late adopters and highlights many important differences between those (see table 2).

Table 2 Characteristics of early adopters versus later adopters

<table>
<thead>
<tr>
<th>Socioeconomic characteristics</th>
<th>Personality variables</th>
<th>Communication behaviour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early adopters (EA) are no different from later adopters (LA) in age</td>
<td>Early adopters (EA) have greater empathy than do later adopters (LA)</td>
<td>Early adopters (EA) have more social participation than do later adopters (LA)</td>
</tr>
<tr>
<td>EA have more years of formal education than do LA</td>
<td>EA may be less dogmatic (infallible) than are LA</td>
<td>EA are more highly interconnected through interpersonal networks in their social system than are LA</td>
</tr>
<tr>
<td>EA are more likely to be literate than LA</td>
<td>EA have a greater ability to deal with abstractions than do LA</td>
<td>EA are more cosmopolite (degree of orientation outside a social system) than are LA</td>
</tr>
<tr>
<td>EA have higher social status than do LA</td>
<td>EA have greater rationality than do LA</td>
<td>EA have more contact with change agents than do LA</td>
</tr>
<tr>
<td>EA have a greater degree of upward social mobility than do LA</td>
<td>EA have more intelligence than do LA</td>
<td>EA have greater exposure to mass media communication than do LA</td>
</tr>
<tr>
<td>EA have larger-sized units (farms, schools, companies etc) than do LA</td>
<td>EA have a more favourable attitude toward change than do LA</td>
<td>EA have greater exposure to interpersonal communication channels than do LA</td>
</tr>
<tr>
<td>EA are better able to cope with uncertainty and risk than are LA</td>
<td>EA have a more favourable attitude toward science than do LA</td>
<td>EA seek information about innovations more actively than LA</td>
</tr>
<tr>
<td>EA have a more favourable opinion leadership than do LA</td>
<td>EA are less fatalistic (perceived ability to control own future) than are LA</td>
<td>EA have a higher degree of opinion leadership than do LA</td>
</tr>
<tr>
<td>EA have higher aspirations (for formal education, higher status, occupations etc) than do LA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Adapted from Rogers 2003

3.2.7 Preliminary conclusions and findings of the section

Although Rogers’s research has been highly influential in explaining the diffusion processes of innovations, the author believes that one shortcoming is the fact that Rogers focus too narrowly on the explanation of the outcome: rate of adoption of innovations. Rogers’ approach offers an explanation for the outcome based on five variables: (1) perceived attributes of the innovation, (2) the type of innovation decision, (3) the communication
channels, (4) the nature of the social systems, and (5) the extent of the promotion efforts by change agents. These variables enlighten different and essential aspects of the innovation process, however they do not offer yet enough insights on the diversity of factors that influence or determine the decision to adopt AED technology in organisations. In spite of the mentioned shortcoming, the author considers Rogers approach very educative and useful, offering a good platform for further research on the diffusion of the AED technology.

The information provided in table 2, comparing the characteristics of early adopters versus later adopters, can be considered relevant to the understanding and further conceptualization of determinant factors, which may be of major importance within the innovation decision-making process.

3.3 The innovation-decision process model

Rogers (2003) presents the innovation-decision process in its essence as “an information-seeking and information-processing activity in which an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation”.

The innovation-decision process consists of five stages: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation. The stages follow each other in a time-ordered manner. The process is shown in Figure 5.

![Figure 5: A model of five stages in the innovation-decision process (Rogers 2003)](image-url)
3.3.1 The Knowledge Stage

In the knowledge stage an individual gets to know about the existence of a certain innovation and starts to understand how it functions. At this stage the individual aims to collect enough information to reduce the uncertainty about the cause and effect relationship related to the specific problem-solve capacity of the innovation. According to Rogers (2003), an innovation typically comes with questions as “What is the innovation?”, “How does it work?” and “Why does it work?” The first question represents one of the three of three types of knowledge about an innovation: (1) awareness-knowledge, (2) how-to-knowledge, and (3) principles-knowledge.

Awareness-knowledge addresses the innovation’s existence and may motivate an individual to learn more about the innovation and to seek the other two types of knowledge. How-to-knowledge consists of information needed to use an innovation correctly. Rogers (2003) considers this type of knowledge an essential variable in the innovation-decision process. Sufficient level of how-to-knowledge prior to an innovation’s trial increases the chance of adoption. In this sense, how-to-knowledge becomes more critical as the complexity level of innovations increases.

Principles-knowledge contains the information necessary to understand how an innovation works. Innovation adoption without this type of knowledge is possible; however, there is a high risk of innovation’s misuse, which can cause the discontinuance of a new idea. The characteristics of an individual or decision-making unit have a strong influence during the knowledge phase of the innovation-decision process (see figure 4).

3.3.2 The Persuasion Stage

At the persuasion stage of the innovation-decision process, an individual forms a positive or negative attitude towards the new idea or behaviour (innovation). According to Rogers (2003) an individual becomes more psychologically involved with the innovation and the perceived characteristics of the new idea play a major role towards the attitude formation. At this stage, the individual seeks innovation evaluation information as a way to reduce the uncertainty about the expected consequences of an innovation. Mass media messages are too general and not capable to provide the specific kind of reinforcement an individual needs to confirm his or her beliefs about the new idea.

The main outcome of the persuasion stage is a favourable or unfavourable attitude toward the innovation and it is assumed that such a persuasion triggers a change in overt behaviour.
However, attitudes and actions may sometimes be disparate. An attitude-use discrepancy is called a KAP-gap (KAP: Knowledge, Attitudes, Practice) and occurs regularly within social systems. Therefore, there is no guarantee that a positive or negative attitude towards a new idea lead directly or indirectly to an adoption or rejection decision.

3.3.3 The Decision Stage

The decision stage occurs when an individual or a decision-making unit engages in activities that lead to a choice to adopt or reject an innovation (Rogers, 2003). Adoption is defined as the full use of an innovation as the best course of action available and rejection as not to adopt an innovation.

Innovations that offer a partial trial basis are usually adopted more quickly. Most individuals show a normal preference to try an innovation in their own situation prior to make any adoption decision. A trial period may speed up the innovation-decision process.

Rejection is possible and may occur in every stage of the innovation-decision process. Rogers defines two types of rejection: (1) active rejection and (2) passive rejection (also called non-adoption).

An active rejection stands for a situation where an individual engages in an innovation’s trial and thinks positively about its adoption, but later the individual turns back the adoption. This type of decision is called a discontinuance decision and may be classified as an active type of decision. In a passive type of decision (rejection), the individual does not consider the adoption of an innovation at all.

3.3.4 The Implementation Stage

During the last two phases (implementation and confirmation) of the innovation-decision process, an individual engages in the process of gathering information and evaluating the new idea, as a mechanism to reduce uncertainty on the expected consequences of the innovation. At these stages an individual wants to know in detail the related advantages, disadvantages of the innovation, and may need some assistance from change agents.

Another important item within the context of the implementation stage is re-invention. Rogers (2003) defines re-invention as “the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation”. The difference between invention an innovation is also addressed. Rogers(2003) defines invention as “the process by which a new idea is discovered or created,” and adoption of an innovation as “the process of using an
existing idea”. Furthermore, three generalizations are brought under attention: (1) Re-invention occurs at the implementation stage for many innovations and for many adopters, (2) A higher degree of re-invention leads to a faster rate of adoption, (3) A higher degree of re-invention leads to a higher degree of sustainability of an innovation.

The implementation stage is reached when an individual starts using the new idea. At this stage the innovation is put into practice. Kirton (2003) sheds more light on the implementation stage by introducing the concept of cognitive adaptive preference and differentiating adaptors versus innovators within the group of decision makers (problems solvers). Kirton (2003) argues that adaptors tend to initially accept a current agreed structure within which the problem is embedded (read innovation) and by using it achieve a solution, thereby prudently altering the structure for later improved use. Innovators on their turn tend to more riskily alter the structure first in order to solve the problem (read innovation) and then in solving the problem effect further change.

Kirton (2003), Adaption-Innovation theory complements Roger’s view on many aspects including the implementation stage of innovations. Therefore one could argue that the relationship between the degree of re-invention and the rate of adaption are even more related than originally assumed by Rogers.

3.3.5 The Confirmation Stage

During the confirmation phase, an individual seeks reinforcement of the implemented innovation-decision. The decision taken may though be reversed once an individual is confronted with conflicting messages about the innovation. Known is also that at the confirmation stage an individual seeks to avoid a state of dissonance or reduce in case it occurs. Dissonance stands for an internal disequilibrium or an uncomfortable state of mind. At the confirmation stage, an individual will decide conclusively to (1) make full use of an innovation (adoption), or to (2) discontinue the adoption (rejection after previous adoption). Discontinuance of a previous adopted innovation may occur in two ways, (1) the replacement of a previous adopted innovation with a better innovation, a so-called replacement discontinuance, or (2) an individual rejects the innovation due to unsatisfying performance, the so called disenchantment discontinuance.
3.3.6 Criticisms of diffusion of innovation research

Rogers (2003) asserts that diffusion research has made numerous important contributions to the understanding of human behaviour change. Its potential has been though also limited by shortcomings and biases, which have not been heard and criticized until the 1970s. Rogers identifies four main criticisms: (1) the pro-innovation bias of diffusion research, (2) the individual-blame bias in diffusion research, (3) recall problem in diffusion research, and (4) the issue of equality in the diffusion of innovations.

Rogers (2003) explains the pro-innovation bias as the implication in diffusion research that: (1) an innovation should be diffused and adopted by all members of a social system, (2) that it should be diffused more rapidly, and (3) that the innovation should be neither re-invented nor rejected. The overseeing of the pro-innovation bias leads diffusion researchers to (1) ignore the study of ignorance about innovations, (2) to underemphasize the rejection or discontinuance of innovations, (3) to overlook re-invention, and last to (4) fail to study anti-diffusion programs designed to prevent the diffusion of “bad” innovations.

Rogers (2003) acknowledges the individual blame bias as the tendency to hold an individual responsible for his or her problems (in the innovation’s adoption context), rather than the system of which the individual is a part. Following the same rationale, the individual-blame bias goes together with the diffusion-research’s tendency to side with innovation promoters such as change agencies or change agents in place of individuals who are the potential adopters. According to Rogers this orientation implies that “If the shoe does not fit, there is something wrong with your foot”. Another way to explain the individual blame bias is the acknowledgement of the fact that variables used in diffusion models to predict innovativeness are conceptualized so as to indicate the success or failure of the individual within the system rather than as indications of success or failure of the system (Havens 1975 cited in Rogers, 2003).

The recall problem bias is explained by Rogers (2003) as that time is an important methodology enemy in the study of the diffusion process. Diffusion occurs over time (which may span over a long period) and therefore there is no other way to research the diffusion process without being dependent on the memories (recall data) from respondents as to their date of adoption of a new idea. Respondents are basically asked to look back in time in order
to reconstruct their past history of innovation experiences and this retrospective analysis is not completely accurate.

The issue of equality is related to the way how the innovation’s socioeconomic benefits are distributed among individuals within the social system. According to Rogers (2003) this topic has not been receiving sufficient attention, and it is evident, that the diffusion of innovations widens the socioeconomic gap between the higher and the lower status segments of a system, especially, but not limited to, resource-poor settings.

3.3.7 Preliminary conclusions and findings of the section

Rogers presents the innovation decision process in terms of a five stage-gate process. Although the stage-gate approach offers good insights on the innovation decision process, the model is presented to the reader in terms of a linear sequence of go/no go decisions without further explanation on the decision-making process. Another shortcoming of the stage-gate model can be addressed to the total absence of additional influencing variables during the third stage, the Decision gate. Despite its incomplete nature, Roger’s stage-gate model still enlightens important aspects of the innovation process, providing so a comprehensive basis and an outstanding platform for further research on the decision-making factors, which are determinant for the adoption of AED technology in organisations.

3.4 Decision-making

Decision making choosing one course of action rather than another, finding an appropriate solution to a new problem posed by a changing world is commonly asserted to be the heart of executive activity in business (Cyert Richard M., Simon Herbert A., Trow Donald B., 1956) In other words decision-making is a core component of the role of management and has been recognized so by Chester Barnard in 1938.

Decision-making is a broad area of research that apparently found the interest of many researchers within the complete spectrum. As a result, “decisions” have been described as discrete an concrete phenomena driven by rational-albeit bounded-minds, stripped of affect, insight, and history (Langley A., Mintzberg H., Pitcher P., Posada E., Saint-Macary J, 1995).
Strategy and strategic decision-making seems though a unending field of research as the changing world keeps pushing the existent academic models to their limits.

During the past decades researchers used empirical data to lead their theories and have developed three dominant paradigms within decision-making:
- Rationality and bounded rationality (Simon H., 1978)
- Politics and power (Salancik G., Pfeffer J., 1974)
- Garbage-Can (Cohen M., March J., Olsen J., 1972)

The rationality and bounded rationality models assume that decision-makers are rational. In other words decision-makers follow a logical process in order to achieve the best conclusions. The remaining theories, politics and power, and garbage-can, contradict the rational model and assume that rational processes are either non-existent or largely ceremonial.

Langley et al. (1995) concludes that most of the literature can be positioned along a continuum between two poles, with the cerebral rationality of sequential theories at one end and the anarchical processes of the garbage-can model at the other. Yet this continuum fails to capture some important characteristics of organizational decision-making.

Complementary ideas on the human process of decision making have been elaborated once researchers focused on the distinction between intuition and reasoning. The labeling of two types of cognitive processes, System 1 (intuition) and System 2 (reasoning) by Stanovich and West in 2000, represent a considerable agreement on the characteristics that distinguishes the two types of cognitive processes (Kahneman, D., 2002). The two-system view model assume that decision makers act according two generic modes of cognitive function: (1) an intuitive mode characterized by rapid and automatically made decision and judgments, (2) a controlled mode characterized by deliberate and slower decision making.

3.4.1 Rationality and bounded rationality
Researchers within the ‘economic man’ paradigm assume that people (and by extension, organizations) are rational and interpret the objectives of decisions so as to be consistent with this assumption (Allison, 1971 cited in Dean, 1993). This assumption holds that decision-makers keep the interests of their organization central and therefore use a logical model for
decision-making in order to provide the best possible solution. Most decision-makers follow ideologically this standard, at least formally and publicly.

Rationality is a fundamental assumption in economics, which holds that individuals make choices that are based on utility maximization (Bell et al. cited in Dean, 1993). According to this theory, decision-makers will never choose one feasible option over another if they prefer the second. The rational choice theory can be interpreted in the normative sense has it shows what a decision-maker should do, not due to morality but due instead to rationality. Based on the economic model, the rational perspective was first outlined by Simon in 1955 and explains that actors enter decision situations with known objectives, which determine the value of the possible outcomes. The actors in the model, gather data and develop a set of alternatives, and then select the best option. The model basically assumes that human behavior has a purpose, which translates into rational action (March, Simon, 1958 ; Allison, 1971 cited in Eisenhardt K., Zbaracki M., 1992).

Further research into the application of the economic theory in decision-making showed that the process and decisions made did not meet the normative theories. The research showed that the most optimal outcome was not achieved due to the process followed by decision-makers, which turned into the gradual acceptance of the bounded rationality model published for the first time by Cyert and March in 1963. Since then different research work has been published showing the limitations of the rationality theory. Harrison and Phillips presented rationality and bounded rationality in 1991 as a dichotomy or continuum (Eisenhardt et al. 1992).

Einsenhardt et al. (1992) concluded in their review of strategic decision making literature that the original debate which shaped the paradigm over whether decision-makers are rational or boundedly rational is no longer controversial since empirical research clearly supports (1) the existence of cognitive limits to the rational model. Decision makers satisfice instead of optimize, rarely engage in comprehensive search, and discover their goals in the process of searching. (2) many decisions follow the basic phases of the problem identification, development and selection, but that they cycle through the various stages, frequently repeating, often going deeper, and always following different paths in fits and starts. (3) the complexity of the problem and the conflict among the decision makers often influence the shape of the decision path.
3.4.2 Politics and power

The political perspective on strategic decision-making has its roots in the political science literature of the 1950s (Eisenhardt et al. 1992). Politics, have always existed. Politics exist because people argue and disagree, about how things should or not be done and how power tends to be shared or monopolized. In this context politics and power cannot be seen separately.

Perrow (1970) suggested that within organizations not all organizational subunits are equally influential (Salancik et al. 1974). A model for relative subunit power within organizations was developed later by Hickson (1971). This model hypothesized that power was a function of (a) the ability to cope with organizational uncertainty, (b) the substitutability of subunits in their capacity to cope with uncertainty; and (c) the centrality of the subunit in the organization's workflow, a measure of the criticality or importance of the uncertainty to the organization of subunits in their capacity to cope with uncertainty.

A prior case study conducted in 1972 by Hickson and colleagues showed correlation between the measures of perceived subunit power and the theory (Salancik et al. 1974).

The political and power perspective on decision-making takes into account the effect that individuals with (partially) competing interests have on decision-making.

Decision-makers have often access to a wide arsenal of political tactics to influence the power structure within organizations. Coalition formation, cooptation, strategic use of information and employment of outside experts are some of the available tactics.

The politics and power model demonstrates that decisions are a result of a process where decision-makers all have individual goals, and come together through coalitions. The model stands for a political perspective process in which the preferences and desires of the most powerful group become the final decision.

The theory explains also that the most powerful coalition can reach decisions without a great deal of analysis and only after the final decisions are taken additional research is required to prove the choice made (Salancik et al. 1974).

Similar to the boundedly rational model, the application of the political model to strategic decision making was a reaction to the prevailing economic assumptions that organizations possess a single, superordinate goal. While the boundedly rational model was a reaction to
cognitive assumptions about individuals, the political model was a reaction to social assumptions about groups. In the political model, people are individually rational, but not collective so (Eisenhardt et al. 1992).

In this perspective, organizations tend to operate as coalitions and subunit power affects decisions not because organizational participants are necessarily intentionally political, prone to conflict, or interested in self-aggrandizement. Rather, non bureaucratic decision mechanisms are required to resolve differences in preferences and beliefs about what actions will produce what outcomes. Even the most objective indicators are open to different interpretation. When organizational participants derive different meanings from the same set of details, no bureaucratic decision procedures will unambiguously decide the issue (Salancik et al., 1974).

### 3.4.3 Garbage can

The garbage can theory was first presented by Cohen, March and Olsen (1972). The model describes decision-making in highly ambiguous setting called organized anarchies (Eisenhardt et al. 1992). Organized anarchies are organizations characterized by (1) problematic preferences, (2) unclear technology, (3) and fluid participation (Cohen et al. 1972). Problematic preferences refer to the inconsistent and ill-defined preferences that decision-makers often possess. Cohen describes this phenomenon as: “a loose collection of ideas than a clear structure”. Unclear technology refers to people’s loose understanding of means and ends. Organizational knowledge learning occurs by simple trial-and-error procedures without clear understanding of underlying causes. Fluid participation refers to the amount of time participant devote to different domains; therefore involvement of the decision-makers varies from one time to another and is highly dependent on their energy, interest and agenda. Therefore anticipating on who is going to be involved in a particular decision is difficult.

The garbage can model describes the accidental or random confluence of four streams: (1) choice opportunities-occasions which call for a decision, (2) solutions-answers looking for problems, (3) participants-people with busy schedules who might pay attention, and (4) problems-concerns of people within and outside of the organization. Thus decisions occur in random meetings of choices looking for problems, problems looking for choices and solutions...
looking for problems to answer, and decision makers looking for something to decide (Eisenhardt et al. 1992).

In comparison to the political and rational models the garbage can model recognizes chance as new important factor. Eisenhardt (1992) takes the conclusion that what gets decided depends very strongly on timing and luck. Cohen et al (1972) describes the partial uncoupling of problems and choices rather as a major feature of the garbage can process. Furthermore Cohen states that: Although decision making is thought of as a process for solving problems that is often not what happens. Problems are worked upon in the context of some choice, but choices are made only when the shifting combinations of problems, solutions, and decision makers happen to make action possible. Quite commonly this is after problems have left a given choice arena or before they have discovered it (decisions by flight or oversight).

Unfortunately this newer conceptual framework has failed to provide comprehensive solutions (Langley et al., 1995) to the issues that face decision-makers. Cohen(1972) admits that the garbage process might not resolve problems well, however it enable choices to be made and problems to be resolved even when the organization is confronted with goal ambiguity and conflict, poorly understood problems, variable environment and decision makers that may have other things in mind.

3.4.4 The two systems view
The two systems view model describes decision making as a two-system process in which System 1 represents the intuitive determinant and System 2 the reasoning determinant. System 1 is fast, parallel, automatic, effortless, associative and slow learning. System 2 on the other hand is slow, serial, controlled, effortful, rule-governed and flexible. System 1 is influenced by emotions while System 2 is considered emotionally neutral. According to Kahneman, (2002), System 2 can be taught, learned and trained. System 1 is presented as a very difficult process to learn and train due to its subconscious nature, confidence and speed. Hogarth (2002) argues that tacit (intuitive) learning can take place in kind or wicked environments and the quality of the intuitions is affected by the accuracy and timeliness of feedback people receive on their judgements and actions.
Kahneman (2002), states that human nature is governed by System 1 which works subconsciously and is able to respond fast, automatically, confidently and emotionally to the changes in our environment. System 1 does not involve doubt and deliberation. A well working System 1 provides fast useful impulses and a rational and useful network of coherent associations. A bad working System 1 provides still fast impulses and irrational though coherent associations for System 2 (the reasoning) to deal with. System 2 works with and deliberates on the information fed from System 1. In this sense the quality of the information or the level of the associative network supplied by System 1 affect directly the subsequent decisions made in System 2.

3.4.5 The process of decision-making

Theoretical models of decision processes aim at depicting and explaining the process of decision-making. Since these models are based on varying notions of organizations, their conceptualization of decision-making processes can differ significantly. The most distinct differentiation is drawn between two opposed models: (1) the rational-analytical, normative model of strategic decision-making which assume a linear and systematic process of decision behavior and a clear focus on pre-defined goals and (2) the adaptive, external control which focus on decision processes related to firms adapting to environmental circumstances.

According to the rational-analytical model, decisions follow the three basic phases of (a) problem identification, (b) development and (c) selection (Eisenhardt et al., 1992). In the classic rational model of decision-making these three stages occur sequentially. March and Simon 1958 conceptualize the rational process of decision-making as involving three intertwined activities: (1) intelligence activity, (2) design activity and (3) choice activity (Langley 1995). (1) Intelligence activity refers to the identification phase and deals with scanning that involves gathering and processing information. This information gathering provides cues for recognizing potential decision situations and formulating alternatives. (2) Design activity refers to the development phase: decision makers analyze the formulated alternatives to determine likely outcomes and identify alternative outcomes that will satisfy the needs or goals associated with decisions. (3) Choice activity refers to the selection phase: decision makers make judgments choosing among the identified alternatives.
Mintzberg et al. (1976) introduced a variation of the classic rational mode. Mintzberg et al (1976) recognizes that decisions have unique patterns of solution but that the phases have no sequential relationship. Rather, within each phase, decisions follow various routines: decision recognition and diagnosis routines during the (1) identification phase, search and design routines during the (2) development phase and screen, evaluation-choice and authorization routines during the (3) selection phase.

3.4.6 Preliminary conclusions and findings of the section
This section presents dominant theories within the research field of decision-making. The presented literature review is intended to offer complementary insights on the process individuals or organisations go through when making strategic decisions, specifically, decisions to adopt an innovation. The performed literature research reveals the existence of five dominant factors within the decision-making research: (1) ratio, (2) power, (3) politics, (4) casualty, and (5) intuition.
Other relevant finding of this chapter is the existence of iterative patterns on the decision-making process, which are embedded in three phases: (1) identification phase, (2) development phase, and (3) selection phase.
4.0 Conceptual model

As discussed in Chapter 3, within the perspective of innovation-decision process and decision-making process different theories have been proposed explaining how individuals or decision-making units handle the process of making decisions.

Based on a comprehensive literature review, it seems to the author that the innovation-decision process model presented by Rogers (2003) may not offer sufficient holistic views on the way how an innovation-decision process occurs c.q. evolves. Roger’s model is presented to the reader as a five stage-gate process. The five stages are linked sequentially, succeeding each other after a supposed go/ no-go decision. This particular go/ no-go decision process is though not explained nor visualized in Roger’s model. Furthermore one could argue that each stage must have its own individual decision-process, influenced by generic and specific factors (variables), creating so a more complete and holistic view of the innovation-decision process individuals or decision-making units undergo.

To fill this gap the author suggests a combination of several relevant decision-making models highlighting in particular the factors that play a major role in the decision-making process. Roger’s innovation-decision process will be taken as the basis for the conceptual model. Although valuable in describing the innovation-decision process, this model does not account for other factors nor the inter-stage decision-making phases that influence the decision-making process as seen in the literature review. The author has selected the factors (1) ratio, (2) power, (3) politics, (4) casualty, (5) intuition, and the three decision-making phases (1) problem identification, (2) the development and (3) selection. These new elements reflect a careful selection which has been the result of a review of three dominant theories (1) Rationality and bounded rationality (Simon H., 1978), (2) Politics and power (Salancik G. Pfeffer J., 1974), (3) Garbage-Can (Cohen M., March J., Olsen J., 1972), and (3) the Two system-view (Kahneman, D. 2002). By combining these variables with the process described by Rogers (2003) the author proposes a new conceptual model.
4.1 Innovation-decision making process

The framework as developed by Rogers (2003), suggests that an innovation-decision process is based on five stages (1) Knowledge, (2) Persuasion, (3) Decision, (4) Implementation, and (5) Confirmation.

The five stage-gate process evolve sequentially in a time ordered manner after an inter-stage decision-making process based on three phases, (1) Problem identification, (2) Development and (3) Selection phase.

The innovation-decision process is influenced by the communication channels from the very beginning up to the end. During the Knowledge Stage the characteristics of the decision making-unit are recognized to have a particular influence on the course of developments. At next stage, the Persuasion Stage, the perceived characteristics of the innovation are seen as the main influencing factors.

Although one could argue about the impact of the four influencers (1) ratio, (2) power, (3) politics, (4) casualty, and (5) intuition on the total stage-gate process, the author believes that the chosen factors apply their maximal influence during the Decision Stage of the innovation-decision process. The conceptual model for the innovation-decision making process is presented in figure 6.

![Conceptual model of the innovation-decision making process](image-url)

Figure 6: Conceptual model of the innovation-decision making process
5.0 Empirical findings

This chapter presents the information gathered through reading of written materials (company’s correspondence, articles, industry and journal publications), conversations with industry members’ c.q. organisations, and semi structured interviews.

During the research, two organisations have been identified as the major players within the diffusion process of public access defibrillators in the Netherlands: (1) The Dutch Heart Foundation and (2) M-AED. These organisations are the original providers of training and educational protocols, and certifying services, within the field of Cardio Pulmonary Resuscitation (CPR). The research focuses therefore at first, on the historical role of these two innovators and sheds light on the factors that determined and influenced their decision to adopt the AED technology.

The data for the two case studies was gathered from conversational interviews with M-AED’s founder, and other (in)dependent key players within the field of Cardio Pulmonary Resuscitation, including members of the NRR (Dutch Resuscitation Council), the BHV Platform, and last but not least the Dutch Heart Foundation. Additionally the author has held many conversations with First Aid Instructors and AED retailers. Some of the AED retailers have been involved in the AED diffusion process since the very beginning, often in the double role of First Aid Instructors, becoming so valuable source of information.

The empirical data has been collected during a period of two and half years.

A description of how the two organisations, The Dutch Heart Foundation and M-AED, came into the AED innovation-process and how they have conducted their decisions to adopt the AED technology is provided and presented in the following sections.

In a second stage, the empirical research focuses on the decision-making process of three different adopting companies from the early adopters’ social group. The author used an extreme-case sampling technique to select the case-study companies, aiming so to collect purposeful and qualitative information, which can be applied to enlighten on general cases.

The case-study companies have been identified and selected, according to the author’s expertise within the field of public access AED technology. Hence, the selected organizations represent a micro-, small-, and middle size firm. Furthermore, the author believes that the selected organizations can be considered as reference cases due to their type of core businesses, and place within the diversified adopter’s spectrum. All case organizations were
contacted at first by the author during the sales-stage (in a salesman’s role) and later re-
contacted during the case-study stage (in a researcher’s role). The data was gathered from
semi-structured interviews with the executive directors of the organisations. Each company is
presented in the following sections.
Finally, all information provided through the empirical findings will be used to conduct an
analysis and draw the final conclusions.

5.1 The adoption of the AED by the Dutch CPR certifying organisations
This paragraph compiles ten years of the history of the adoption of AED technology in the
Netherlands. During his research the author identified two major parties that play an
important role in the diffusion process of the AED technology: (1) The Dutch Heart
Foundation, a prominent foundation established to serve health-interests of Dutch citizens by
sponsoring medical research and deploying activities concerned to the prevention, education,
and patient care of heart related diseases, and (2) M-AED, a private company founded by a
medical doctor and considered the Dutch pioneer within the public access AED field.

5.1.1 The Dutch Heart Foundation
The Dutch Heart Foundation (DHF) was created officially on January 1964 with the mission
to reduce cardiovascular diseases. During the 60’s the Dutch Health Ministry started to realize
that heart diseases were no more an exclusive phenomenon of aged people, but in fact it was
perceived as a general population’s disease. Therefore, the Director-General of the Ministry
of Health, Prof. Dr. P. Muntendam, approached H.A. Snellen, the later president of the DHF,
to set up an organization like the American Heart Association: a partnership between
physicians and laypeople. At the end of the 70’s the DHF had finally set up the three pillars of
its existence: (1) research, (2) prevention and (3) education and patient care. Important issues
such as sudden cardiac death and resuscitation got a leading place, in addition to other major
medical issues like high blood pressure and obesity.

The DHF began in the 70’s of the last century a CPR education programme for the Dutch
population, following the American example of the American Heart Association. The CPR
training programmes were originally part of the first responder courses and did not include the
use of defibrillators. The CPR protocol was based exclusively on mouth-to-mouth/artificial respiration and external heart massage.

In the late 90’s, the Dutch government implemented a new bill (Arbo-Wet) regulating the existence of first aid and rescue services (BHV services) within Dutch organisations with personnel. With this measure managing directors of Dutch organisations became directly responsible for the management of security and aid issues within their own organisations, causing so a new demand for BHV products and services.

As the original national provider of training programmes for non-medical citizens, the DHF was confronted with the exponential growth of demand for CPR training and certification. Therefore, the DHF designed and implemented a pyramid system for training and certification services and started building up a large community of CPR teachers and instructors (certified BHV- instructors). The train-the-teachers methodology allowed the DHF to, monitor closely the content and quality of CPR courses provided to national organisations through certified BHV- instructors. The BHV-instructors were trained and certified by the DHF. The participating CPR course members were trained by the BHV-instructors and certified on their turn by the DHF.

At the beginning of the new century, BHV-instructors had emerged in large numbers and could start exploiting commercially the BHV-market. Industry’s estimations suggest a market potential in the Netherlands of approximately 700.000 BHV-courses per year. The market potential estimations are related to the total number of organisations with more than two workers (approx. 363.000 for the year 2008). Within the same market segment, estimations suggest a market potential for AEDs of approximately 390.000 units. More information on this issue can be found on Appendix C. In 2008, the number of BHV-courses has been estimated by the industry around 500.000 per year.

At the end of the 90’s the DHF believed that there were, whether or not alleged, legal barriers and not sufficiently explored clinical hurdles to the widespread of AED technology. The DHF made consequently the choice to avoid all possible legal implications, and to investigate first the AED technology before starting promoting it widely, or even incorporate the defibrillation procedure on their CPR courses. The DHF sought advice from a lawyer specialized in health issues, and took also chair in the committee of the Health Council, whose task was primarily to give advice to the Ministry of Health on the application and use of the AED in the Netherlands. The activities resulted in a report dated February 2002, in which the Health Council advised that every trained rescuer should be able to use an AED. In April 2002, the
Dutch Minister of Health adopted the advice and issued an official statement considering the use of AEDs by non-medical individuals a legal procedure. From that moment, the DHF was free to support and promote the defibrillation procedure. It took the DHF however four additional years to officially adopt the AED, and include the defibrillation protocol in their CPR courses. In 2007, the DHF started a national awareness campaign under the theme [www.6minutes.nl](http://www.6minutes.nl). The campaign presents and positions the use of an AED as a standard procedure during CPR.

5.1.2 The organization M-AED
M-AED is a privately held company based in the Netherlands, founded in 1998 by a medical doctor. The organization’s activities focus exclusively on the marketing and sales of defibrillation technology (AED) for non-medical consumer markets, and offers training and educational protocols including certifying services for CPR courses. M-AED is an exclusive distributor of D-tech Inc, an innovative manufacturer of AED technology based in the United States. To reach end-consumers and satisfy regional market demands in the Netherlands, M-AED uses a network of independent retail- and services companies based in the Dutch territory.

The entrepreneur, a medical doctor and certified CPR instructor, heard for the first time about the AED technology during a European Resuscitation Council Congress in 1997. Surprisingly at that time, during his medical graduation, this CPR instructor had never heard about the innovation or been trained with an AED.

At the end of the 90's of the last century, several international clinical studies had already shown that rapid defibrillation by bystanders would contribute significantly to save many human lives. At the same time, other studies suggested that a person in the general population might not be able to operate successfully an AED, especially in a stressful situation.

Although the international developments were promising and encouraging, in the Netherlands, University Hospitals and the DHF did not care to mention or report the existence of the novelty to their members. Relevant knowledge at this stage is also the fact that in the Netherlands, the use of medical heart-shocking equipment was restricted (by law) to medical professionals. This aspect made the use of AEDs by members of the general population an illegal procedure.
The illegal status was a paradox on itself as the AED technology had been developed (by the medical device industry) as an efficient life-survival tool for the general population, in the first place.

In the late 90’s, the AED started to win seriously the international resuscitation field. In de United States of America, more and more organisations started adopting the technology, contributing so to the wide availability of AEDs in working places and major public areas. In 1998, the entrepreneur, established M-AED, an organisation (initially a foundation) dedicated to the training, education and later marketing of AED technology in the Netherlands. The founder was possessed by the novelty and heavily inspired by his idealistic views of public access defibrillators available to the entire community.

The novelty’s enthusiasm was though restricted to a few. M-AED faced heavy resistance and criticism from all corners, in particular from the professional medical world (intramural), once the AED-promotion activities started and progressively got the attention of the Dutch media, including the national television. The entrepreneur had started a political discussion about the unrealistic illegitimacy of the innovation, the ambiguous role of the government, and the role and function of the Dutch Heart Foundation.

At that time, M-AED developed a full range of written materials and CPR training protocols, based on the standards of the American Heart Association. Additionally, M-AED designed a quality system and a certifying programme, offering BHV-services and BHV-instructors the possibility to adopt the AED and complement their CPR protocols. M-AED stood for the AED-, certification, training, quality assurance, and offered liability insurance to all affiliated BHV-instructors.

At the beginning of the new century M-AED had become a strong competitor of the Dutch Heart Foundation within the field of training, education and certification of CPR courses. In the year 2000, M-AED decided to enlarge its product portfolio with AED equipment, adding so truly commercial values to the initial organization’s mission.

At that time, many saw M-AED’s commercial activities as a serious breach of ethics and an illegal activity. Those (medical community), could not cope with the idea that a medical doctor was making money by selling the AED technology, and teaching the general population to defibrillate (a medical procedure restricted to medical professionals).

In the year 2000, the negative feelings towards M-AED’s activities had reached a climax. The heavy criticism resulted in an audit of the Dutch Health Inspection. The Inspection warned the founder and threatened to confiscate his medical license.
### 5.1.3 Milestones AED diffusion

Many important milestones have been achieved in the ten-year history of the AED diffusion in the Netherlands. Back in the 90’s of last century, the company Laerdal Medical AS, a Norwegian company dedicated to helping save human lives, introduced the AED technology to Dutch general practitioners and physicians. Since then different manufacturers of AED technology have developed their distribution channels in the Dutch market. Today Dutch consumers have access to thirteen different AED brands.

In 2008, the AED market has been estimated at more than 20,000 units by the DHF. The industry forecasts a yearly growth of the AED market at a pace of at least 10,000 units per year for the coming years. Figure 7 offers a complementary overview of several important events and relevant facts related to the adoption of the AED in the Netherlands.

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>The company Laerdal starts commercializing AEDs in the Netherlands. The AEDs are purchased only by physicians as the Dutch law allows exclusively medical professionals to use the technology in patients.</td>
</tr>
<tr>
<td>1998</td>
<td>Establishment of M-AED, a foundation dedicated to the training, education and later marketing of AED technology in the Netherlands</td>
</tr>
<tr>
<td>1999</td>
<td>M-AED launches a quality and certification programme for defibrillation, and starts organizing defibrillation and resuscitation courses for first-aid instructors and teachers.</td>
</tr>
<tr>
<td>2000</td>
<td>M-AED sells the first AED and is soon followed by its certified members.</td>
</tr>
<tr>
<td>2001</td>
<td>First reports of lives rescued after the intervention of BHV personnel equipped with AEDs.</td>
</tr>
<tr>
<td>2002</td>
<td>Dutch government approves the use of AED by non-medical trained citizens.</td>
</tr>
<tr>
<td></td>
<td>Sponsored by the DHF, Dr. R.W. Koster, a cardiologist at the AMC in Amsterdam, starts the first clinical study in the Netherlands with AEDs in police cars and fire brigades.</td>
</tr>
<tr>
<td>2006</td>
<td>The NRR (a Dutch Heart Foundation organization exclusively responsible for training and certification of resuscitation courses) implements the AED in their first-aid and resuscitation protocol.</td>
</tr>
<tr>
<td>2007</td>
<td>The DHF starts the national campaign “6 minutes.nl”, a CPR awareness campaign showing the use of an AED.</td>
</tr>
<tr>
<td>2008</td>
<td>The DHF estimates that more than 20,000 AEDs have been installed in the Netherlands.</td>
</tr>
<tr>
<td></td>
<td>AMC’s study reveal a doubling (25%) of cardiac arrest survival outside hospitals in the province North Holland due to the use of AEDs.</td>
</tr>
<tr>
<td></td>
<td>The Dutch police install AED technology in 3000 police cars.</td>
</tr>
</tbody>
</table>

Figure 7: Milestones of the adoption of the AED in the Netherlands
5.2 The adoption of the AED by Dutch organisations

While the previous paragraph sheds light on the adoption of AED technology by the two CPR certifying organisations, focussing on their historical roles and exploring factors that influenced their decision-making processes, the present paragraph focuses on the decision-making process of three Dutch organisations that decided to adopt the AED technology within their BHV services.

As described before, the implementation of AED technology occurs in the BHV services of organisations. In the Netherlands, each organisation with personnel is required to have its own BHV services. Compliance with this requirement is the responsibility of the managing director of the organisation. Relevant information is also the fact that possession of an AED by an organisation, or the physical presence of an AED in the organisation’s BHV-services, is not a requirement.

From this perspective, the adoption of an AED is a management’s innovation-decision, often taken at senior c.q. executive management level of organisations.

For the purpose of this research, the author has interviewed several executive managers, responsible for the innovation-decision, and collected relevant data on the factors that influenced their decision to adopt an AED in their organisations.

The data of three organisations is presented under the following sub-paragraphs. The names of the organisations are not enclosed in order to guarantee the privacy of the participants.

5.2.1 Organisation 1

Organisation 1 is a marketing company with approximately 20 employees in the age range of 25 to 40 years old. Two partners who are also the managing directors of the company own the firm. The organisation has two certified BHV members. The organisation implemented the AED technology in the year 2008.

The managing directors heard about the AED technology for the first time in the year 2006. At that time, the company had been asked by M-AED to brainstorm about the marketing strategy for the AED in the Netherlands.

The posterior involvement in the marketing project and the strategic character of the subject provided the two managers the opportunity to understand in great detail many aspects of the AED technology, including its market-positioning. The decision-process to adopt the AED technology in this organisation took two years.
When asked to analyse the determinant factors to the decision-making process, the managers came up with three factors: (1) BHV members’ inquiry, (2) the gesture towards personnel and customers, (3) product affordability.

5.2.2 Organisation 2
Organisation 2 is a media company with approximately 150 employees in the age range of 20 to 65 years old. The organisation has eight certified BHV members. The organisation implemented the AED technology in the year 2007.

The decision-process to adopt an AED was initiated by the internal BHV services, after a yearly CPR update course. During the training’s course, the instructor updated the CPR procedure with the AED protocol, and every BHV member was trained according to the new standards. The BHV members became enthusiastic about the innovation and informed the managing director about the AED. The managing director was triggered by the innovation and started gathering information on the issue Sudden Cardiac Arrest (SCA) and the use of AEDs. The search and deliberation process took approximately one month and hereafter the managing director decided not only to implement the technology in the organisation, but also to broadcast a documentary about the AED technology.

When asked to analyse which determinant factors played a major role in his decision to adopt the innovation, the manager came up with five dominant factors: (1) the size of the company and the number of employees, (2) the inquiry of the BHV services, (3) the innovation’s value and impact for the society (live saving), (4) the model’s role of the organisation, (5) his own age and smoking habits as strong SCA risk factors.

5.2.3 Organisation 3
Organisation 3 is a general medical practice office with three employees in the age range of 40 to 55 years old. The general practitioner (GP), who is also the managing director, owns the organisation. The organisation does not have a certified BHV member (GP offices have an exceptional status). The organisation implemented the AED technology in the year 2008.
Medical doctors need to update continuously their medical knowledge and education. In this sense, attending medical congresses and reading professional literature is a common practice among medical doctors.

The general practitioner read for the first time about a public access AED at the beginning of the new century. The GP recognizes however that only since 2006 he had become interested in the innovation and started considering its adoption. According to the doctor, suddenly in 2006, the AED technology got the attention of the GP community. Articles started to appear in the medical magazines and the implementation of AEDs in general medical practices became a topic of discussion during national congresses. In this sense, the GP argues that his decision-process to adopt the AED took approximately two years.

When asked to analyze the determinant factors that made him adopt the innovation, the GP raised up three factors: (1) general acceptance from the GP group, (2) wide publications of clinical results, (3) soon or later the AED will be mandatory for GPs.
6.0 Analysis

The purpose of the analysis section is to compare and contrast the theoretical framework with the empirical data. First a comparative analysis will be conducted on the certifying organizations, Dutch Heart Foundation and M-AED. A second comparative analysis will be conducted on the other three organizations.

6.1 Analysis of the certifying organisations DHF and M-AED

When reviewing and analyzing the collected data on the two certifying organisations, the author recognizes two different ways to deal with the decision to adopt an innovative technology. The Dutch Heart Foundation shows a careful, complex and consequently time-consuming pattern in its innovation decision-making process. M-AED shows a very fast and compelling pattern in its decision to adopt the new technology. In this perspective one could therefore argue that in spite of the fact that both organisations adopted the innovation and play a crucial role within the diffusion of the AED in the Netherlands, the two organisations lay though on two opposite extremes of the innovation continuum. The chosen paths of approach are significantly different and appear to be the result of the influence of social-economic factors, political trends, and regulatory controls on both organisations. In terms of the KAI theory, both organizations are truly problem-solvers, where M-AED shows more innovative characteristics and the DHF more adaptive characteristics.

6.1.1 The Dutch Heart Foundation

The Dutch Heart Foundation is a national institute with strong and complex connections to the Health Ministry and the medical profession. These aspects explain the inherent necessity of using evidence and reasoning in their decision-making. In theory, the component ratio must therefore be leading in the innovation decision-making process. Empirically, the component ratio could be interpreted among the decision to sponsor clinical studies and generate clinical evidence.

The influence of the components power and politics on DHF’s innovation decision-making process seems though very plausible. The institution’s presence and its activities in national health-advice commissions could be seen as the major cause for the emergence of power and politics components in its innovation decision-making.
The DHF’s development c.q. maintenance of dominant positions within the national health system creates automatically a new dimension within the reasoning and argumentation of core values of disruptive innovations (such as the AED). Consequently, the innovation itself may become secondary to the position of the DHF within the system. Having this side-effect in mind, it becomes plausible to assume that any decision to adopt or reject an innovation might also be the result of casualty, as the influence of all possible factor-combinations (ratio, power and politics) on the innovation decision-making process, increases the decision’s complexity and makes it less predictable (rational).

6.1.2 M-AED

M-AED is a small organisation with national ambitions, founded by a medical doctor who refused to accept the exclusive influence of the establishment and installed order on the diffusion of the AED in the Netherlands. These aspects explain the organisation’s necessity to move fast and diversified, creating educational programmes, developing procedure protocols, implementing certifying mechanisms, and using the national media to win the sympathy of the masses and force the national institutions to change whatever necessary to make the implementation of AED technology reality.

Considering the medical education and background of the entrepreneur one could argue that the component ratio must have played a crucial role on the decision to adopt the innovation. This analysis is difficult and complex to realize as the medical science produced clinical studies showing that the AED effectiveness within the public access group is very low. Furthermore, the medical community understands well that SCA death-survival with posterior life-quality can only be achieved when a complex chain of medical procedures is engaged in time and properly. The end of the survival chain is most of the times determined by the logistics and the medical capacity to intervene surgically and by the posterior medication. In the Netherlands, heart and vascular diseases are leading the mortality statistics and SCA causes the yearly death of estimated 16.000 citizens. A simple calculation leads to the conclusion that it is not realistic to assume that the existent national healthcare system have the logistic and economic capacity to deal with such rescue scenario. In this sense, the limited rescue and survival rate is a determinant in the cost of the national healthcare system.

Another relevant statistical issue raised from clinical studies indicates that 80% of all SCA cases outside hospitals occur at home and not during work. With this knowledge in mind, one could automatically draw the conclusion that AED implementation within the BHV services
of organisations is not very efficient and will not contribute sufficiently to the prevention of death caused by a SCA.

Considering the fact that all this information was available to the founder, one could argue that his decision to adopt and promote the AED technology must have been influenced by some other factor of major relevance. As the decision to innovate has been taken by the founder on his own, factors such as power and politics seem to be less probable is this particular situation, due to the absence of group interests within the decision making unit of the organisation. One could though find arguments to consider that the factor intuition might have been decisive in the decision making process to adopt the AED technology.

According to the two-system view theory, intuition is described as the system 1 where the decisions are taken rapidly and automatically. System 1 is supposed to be monitored and controlled by the slower and deliberating system 2, described as the reasoning. As the period between the entrepreneur’s first exposure to the innovation and M-AED’s foundation is almost one year, one could assume that the decision to adopt the innovation was properly deliberated by system 2. Therefore and in this case, system 1 must have produced irrational information, though with coherent associations, to system 2 to deal with. This resulted in the pursuit of a mission that included a fight against gigantic institutes with strong influences and connections in the national healthcare system. The evidence for the system failure described above could be seen in the founder’s idealistic views of public access defibrillators available to the entire community. Such assumption induces though the need for further research in the field of decision-making processes in order to understand the effects of the construct “idealistic views” in the decision making process, especially when related to the adoption of innovations.

6.2 Analysis of three Dutch organisations

The data was collected at three organisations within the field of services, being different though at size and core business level. The general practice office represents a micro organisation within the healthcare sector, the marketing firm represents a small organisation within the consultancy sector, and the media company represents a mid level organisation within the public information sector. Within the frame of innovation’s profile analysis one could argue that all three companies belong to a population’s group that by definition must be found among the innovator’s group and or the early adopters group, as the combination of
their core businesses in conjunction with the type of innovation (public access life saving device) is on itself a strong reason c.q. motivation for their leading position within the diffusion process.

6.2.1 Marketing organisation

The marketing firm became involved at the initial stage of the diffusion process and therefore shares the responsibility for the communication content and the communication channels. From this perspective, this organisation has a symbolic value in the comprehension of the determinant factors that motivated its management to adopt the innovation.

Here we have an organisation that in principle has performed a full analysis of the innovation, its benefits for mankind, the market place and the different target groups, the change agents spectrum, and last but not least, effective triggers to consumer’s psychology.

The marketing firm was committed to develop a communication campaign to reach effectively the decision makers of organisations and accelerate the AED adoption. Curiously, the diffusion mechanism has been engaged, leading to the gradual implementation of AED technology in other organisations but not in the organisation where the communication content was set up. In spite of all possible rational and non-rational reasons to adopt the novelty in the marketing firm, including the symbolic statement towards their customer base, it took the two managing directors two years to adopt the innovation. Somehow the three decisive factors mentioned by decision-makers: (1) BHV members’ inquiry, (2) the gesture towards personnel and customers and (3) product affordability, suggest that the decision-makers did not have a sense of urgency to innovate and only took the decision at the moment the BHV services ask for it. With this case in mind, one could argue that the role of BHV services is leading above symbolic gestures, but the economic-cost component of the innovation still determines its adoption moment. In terms of generic terminology, the data suggests that the predominant influencing factors in this case were (1) ratio, by means of the influence of the economic cost, and (2) power, by means of the influence of BHV group. The earlier mentioned determinant: (2) gesture towards personnel and customers, remains though to be classified and require further research in the field of decision-making, as the performed literature review does not offer a proper qualification or a description of the effects of this construct in the context of adoption of innovations.
6.2.2 Media Organisation

The media company owns a communication channel and has inherently a strong influence on the message content. For this reason, the organisation can be classified as a powerful agent of change. The middle size of the organisation and the considerable number of BHV members provide good arguments for the increased concern showed by the managing director. The well-being of personnel and a well-equipped BHV services have been translated by the managing director into his fast search engagement and fast decision-making. On the other hand, one could argue that the innovation’s decision was already taken by the BHV services and the director’s search role was in its essence complacent and served different objectives: his journalistic intuition and curiosity, and his own interest as a SCA high-risk subject. In this case and in terms of generic terminology the data suggests that the predominant influencing factors were: (1) ratio, by means of concern related to the organisation’s size, (2) power, by means of the strong influence of the BHV services within the decision to innovate, (3) intuition, by means of immediately understanding the value of the innovation in a society’s context, and the organisation’s role as an agent of information and agent of change.

6.2.3 General Practice Organisation

The GP office belongs theoretically to the population’s group that can achieve the most innovation’s benefits, as the AED technology adds direct value to the operational processes of the healthcare organisation. The innovation is on itself a disruptive technological achievement, providing sophisticated (intramural) technology at an affordable price and lower specialization level, being so accessible to people outside hospitals. From this point of view it is hard to match the theoretically value of the innovation with its real diffusion time. The analysis gets even more complex once one takes into account that Dutch general practitioners have always been in the legal position to adopt the innovation. A concept known as group thinking and the hierarchic values of the medical community might offer the best possible explanation to the phenomenon described. Such assumption could be supported by the case’s empirical data, revealing the importance of the innovation’s acceptance by the GP community, prior to the wide availability of clinical results. Therefore, in this organisation and in terms of generic terminology the data suggests that the predominant influencing factors were (1) power, and (2) politics, by means of position and support of the GP community, (3) ratio, by means of the results of the clinical data.
7.0 Conclusions

The purpose of this research was to explore the decision-making factors that determine the adoption of AED technology in the Netherlands. Hence, the innovation decision-making process of different types of organisations became the focus. The author believes that through looking at academic predominant theories, and then conducting case studies, insights could be gained in to the determinant decision-making factors for the adoption of the AED technology.

Through the literature review, the author believes that although there is a lot of information available on the diffusion process of innovations, there is still missing a more holistic approach involving the decision-making factors that determine the adoption of AED technology by organisations.

To provide a more comprehensive approach to the innovation’s decision-making process, a number of influencing factors were gathered from dominant theories and studies. The influencing factors selected were ratio, power, politics, casualty and intuition. The factors were combined with Rogers (2003) innovation-decision model, into a conceptual model, which was used as a guide in the collection of empirical data. From here, empirical data was collected using case studies and by means of conversational interviews and semi-structured interviews. The next step was to use the knowledge gained to confront the conceptual model. In doing so, the strengths and limitations of the conceptual model were examined.

Ratio has been identified in the case study as a decision-making factor. During the interviews, the importance of knowledge has been more or less explicitly mentioned as a decisive factor for the way how the decision to adopt the innovation was made. The empirical findings confirm the theoretical perspective of the rationality and bounded rationality paradigm, which centers its efforts to explain decision-making based on rational elements within the decision-making process applied by the decision-makers. This study indicates that issues such as knowledge, experience and economic cost, play a major role in the decision-making to adopt the AED technology.

Intuition has been identified in the case study as an influencing factor. The intuitive techniques have been in particular recognized at the decision-making process of a medical doctor and entrepreneur as a way to overcome the lack of knowledge. The existence of such a
mechanism is also supported by the bounded rationality theory in which the concept of “satisficing” prevails above optimizing as the existence of cognitive limitations influence the shape and path of decision-making. This study indicates that intuition play a major role in the decision-making to adopt the AED technology although only found at this level within the innovator’s social group.

Power and politics have been identified in the case study as influencing factors. However this study suggests that the impact of power and political support in the decision-making process to adopt the AED technology seems to be more relevant in (1) bigger organizations where the influence of BHV services is notably higher, and in (2) healthcare organizations, with strong tendencies to follow institutional guide lines.

Casualty has been identified in the case study as an influencing factor. Casualty is an influencing factor that is extensively explored and described in the garbage can theory. The author expected the garbage can theory to be more difficult to identify within the context of adoption of medical innovations. However, considering the sequence and range of related events during the beginning of the Dutch AED revolution, one could argue that the government and dominant institutions such as the Dutch Heart Foundations, could be classified as organized anarchies, characterized by their problematic and political preferences, in which a loose collection of ad-hoc ideas (solutions) are carried by decision-makers and organizational learning tends to occur by trial and error. In this sense one could conclude that what gets decided depends strongly on timing and chance. The author agrees though that additional research on this matter is necessary.

The AED as a public access medical device is recognized in general for its relative advantage. The degree of relative advantage is though impossible to be expressed in terms of economic profitability, and must therefore be sought in other areas of measurement such as social and political rewards, including social prestige and political function. Exploring the range of factors that make decision-makers adopt and implement the AED technology in their organisations is therefore not a simple task. The author recognizes the limitations of the conceptual model, by means of the two determinants: (1) gesture towards personnel and customers, and (2) idealistic views of public access defibrillators available to the entire community. The two determinants remain to be classified, as the literature review could not
offer yet a proper qualification or a description of these factors in the context of adoption of innovations.

In summary, this research has identified five decision-making factors that determine the adoption of the AED technology in the Netherlands. The determinant factors are ratio, power, politics, casualty, and intuition. This research uncovered also the existence of two additional decision-making factors, which need to be studied further. Therefore and in conclusion, the author believes that to gain more holistic views on the decision-making factors that determine the adoption of AED technology by organisations, additional research will be needed.
References


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Hogarth, R.M., Deciding analytically or trusting intuition? The advantages and disadvantages of analytic and intuitive thought, ICREA and Pompeu Fabra University, Barcelona, Spain.

Kahneman, D., Maps of bounded rationality: a perspective on intuitive judgement and choice, Prize Lecture, December 8, 2002.


Appendix A: Scope of Prior Studies

<table>
<thead>
<tr>
<th>Authors</th>
<th>Categories</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gatignon et al. (1989)</td>
<td>6 consumer durables</td>
<td>14 European countries</td>
</tr>
<tr>
<td>Mahajan et al. (1990)</td>
<td>Numerous studies</td>
<td>United States, European countries</td>
</tr>
<tr>
<td>Sultan et al. (1990)</td>
<td>213 applications</td>
<td></td>
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<td>16 European countries</td>
</tr>
<tr>
<td>Golder and Tellis (1997)</td>
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<td>United States</td>
</tr>
<tr>
<td>Putsis et al. (1997)</td>
<td>4 consumer durables</td>
<td>10 European countries</td>
</tr>
<tr>
<td>Dekimpe et al. (1998)</td>
<td>1 service</td>
<td>74 countries</td>
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<td>Kumar et al. (1998)</td>
<td>5 consumer durables</td>
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</tr>
<tr>
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<td>United States</td>
</tr>
<tr>
<td>Kohli et al. (1999)</td>
<td>32 appliances, house- wares &amp; electronics</td>
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</tr>
<tr>
<td>Dekimpe et al. (2000)</td>
<td>1 innovation</td>
<td>More than 160 countries</td>
</tr>
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<td>Numerous studies</td>
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</tr>
<tr>
<td>Van den Bulte (2000)</td>
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<td>31 countries</td>
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<tr>
<td>Talukdar et al. (2002)</td>
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<tr>
<td>Agarwal and Bayus (2002)</td>
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<td>Goldenberg et al. (2002)</td>
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<tr>
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<td>Chandrasekaran and Tellis (2007)</td>
<td>16 products and services</td>
<td>40 countries</td>
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</table>

Note. Adapted from Chandrasekaran and Tellis (2008).
Appendix B: Interview guide

Company general information (field; number of employees;)

BHV general information (number of certified BHV members)

When did you hear the first time about the AED? Where? What? By whom?

What do you know about sudden cardiac arrest? Can you perform CPR?

How long did you need to take the decision to have an AED? Hours/Days/Months/Years

Was other manager/person involved in the decision making? Who? Why?

Did you consult someone or take advice about this matter? Who? Why?

Which were the decisive factors when taking the decision to implement an AED in your organisation?

HINTS:
- Impulsive act – no specific reason
- Feeling someone is going to get a sudden cardiac arrest
- BHV people told me we had to have one / we should have one
- I am a heart patient/ people in our organisation are heart patients/someone else
- I belong to the risk group / age/ lifestyle/ work
- Legal consequences
- Gesture to our personnel/ relationships/community
- Was obliged
- Could afford it/ Small investment
- My neighbours have one / someone else have one
- The sales person just convinced me.
- I believe in the technology
- Soon or later companies will be obliged to have one
Appendix C: Overview Dutch organisations and market potential

<table>
<thead>
<tr>
<th>Bedrijven NL</th>
<th>Werkname personeen</th>
<th>Basis: CBS 2008</th>
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<tr>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Bedrijven</td>
<td>Personen</td>
<td>%</td>
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<td>10.000</td>
<td>5.000</td>
</tr>
<tr>
<td>2005-2009</td>
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<td>5.000</td>
</tr>
<tr>
<td>2010-2014</td>
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<tr>
<td>2015-2019</td>
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<tr>
<td>2020-2024</td>
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<td>5.000</td>
</tr>
<tr>
<td>Totaal</td>
<td>50.000</td>
<td>25.000</td>
</tr>
</tbody>
</table>

- P.Fitas