The Adoption of DEMO in Practice

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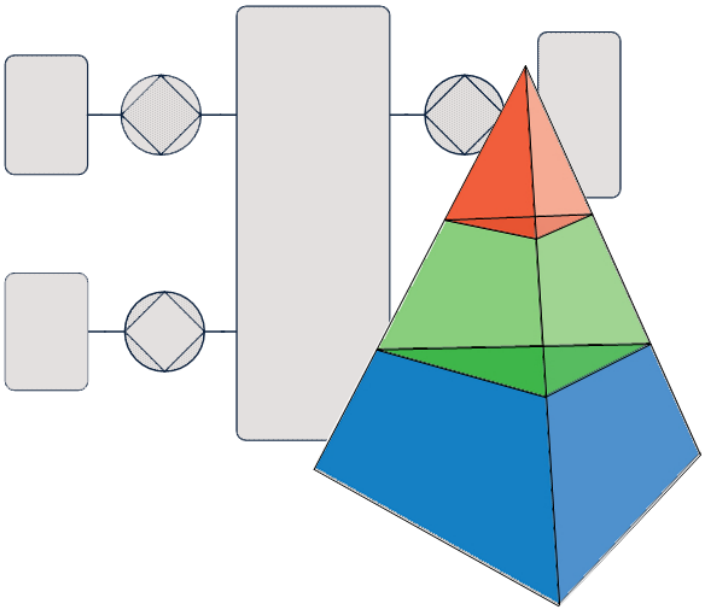

Saman Sattari Khavas

The Adoption of DEMO in Practice

THESIS

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requirements for the degree of

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in

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by

Saman Sattari Khavas
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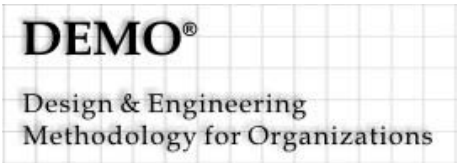

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The Adoption of DEMO in Practice

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Abstract

DEMO is a methodology for designing and engineering organizations which is mostly used for Information System Development (ISD) and redesigning the business processes. DEMO has the ability to reduce the complexity of an organization by providing a conceptual model of that organization [10].

Although DEMO has promising advantages and has provided successful outcome in practice, it hasn't received the deserved attention from The individuals in practical fields. While many of the competitor methodologies are more successful and accepted among the practitioners, DEMO is at the risk of being forgotten among all other methodologies in the *methodology jungle*.

It seems trivial to use effective tactics to increase the acceptance of DEMO among individuals in practice. These tactics can only be effective if they take the reasons behind this specific point of view about DEMO into account. Various factors from a technical anomalies to opinion of others can influence the perception of people about a methodology.

While the acceptance of DEMO by people in practice is very important in the success of the methodology in practical fields, no research was found in the literature that the statistics on reports the adoption rate of DEMO in practice and identifies the reasons behind certain adoption behavior. Therefore, alongside providing such statistics the main goal of this thesis is to identify the factors that can determine certain behavior towards DEMO and propose recommendations to increase the adoption of DEMO based on these factors.

We conducted this research in three phases: *Theoretical, Quantitative and qualitative analysis*. In theoretical analysis we have identified the factors that were proven to influence the adoption of other methodologies. In quantitative analysis we have tried to find out whether these factors have any influence on the adoption of DEMO. At the end, we captured the actual experience of the individuals in practice with DEMO.

In this research we were able to identify several factors that influence the adoption of DEMO. We realized that the support of DEMO by management, coworkers, other individuals with the same skills as the individual and the eagerness of the individual

to keep him self updated about DEMO can increase the adoption of DEMO to a great extent. Furthermore, uncertainty one's position in the organization has a negative effect on the adoption of DEMO. Finally, the ability of the methodology to produce results in a way that can be communicated with all the individuals with different levels of knowledge about DEMO is also influencing the adoption of DEMO.

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Preface

This thesis research is the results of almost a year of research and effort. In this part I would like to thank all of the people who have helped and supported me through out this time.

At first I would like to thank my mother who always supported me in every step of my life. Being a single parent, she devoted her life to provide comfort and support for the progression of her children. I will always be under her oath and I will never forget the sacrifices that she made to make my education possible. Moreover, I would like to thank my sisters and brother who always supported my decisions.

I would also like to thank all of my friends, whom mostly I met during my education in the Netherlands. Moreover, I would like to thank my closest friends, Arman Noroozian, Media Amidi and Ghazaleh Nazarian who have supported me almost every day in the last year.

I would also like to thank my supervisors, Jan dietz, Jan Hoogervorst and Jan van den Berg who have always made the time for my questions and provided the useful comments on the way. Moreover, I would like to thank Jan Dietz and the board of DEMO Knowledge Center who have made this research possible by sponsoring this work.

At the end, I would like to thank all the DEMO Professionals who have made this research possible by their participation in the different steps of the research.

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Chapter 1

Introduction

DEMO is a methodology for designing and engineering organizations which has a sound theory and a philosophical foundation [7]. DEMO looks at the design of the processes of the organizations from a new perspective (in comparison to other methodologies). This methodology provides an abstract (conceptual) model of the organization as the way the organization works. Abstracting away from the implementation, the final models provided by this methodology can show the essence of the organization. This way of looking at the organizations can resolve the complexity that is always attached to the organizations.

The way DEMO looks at the organization and the strong theoretical background of this methodology makes it completely different from other methodologies which are used for managing the complexity of the organization. Other methodologies in this area (like the methodologies in the BPM[1] family) are based on the experience of individuals in practice. Therefore, the correctness of the final results of these methodologies cannot be validated and different experts in those methodologies will not come up with the same results after applying their methodologies to a problem. These methodologies are looking at the organization based on its functionality. As a result, the outcomes of these methodologies are sometime inconsistent with the actual situation within the organization. DEMO on the other hand is focused on the construction of a methodology for which the results of the methodology reflect the organization in a way that is recognizable by the people in the organization. Having a theoretical basis DEMO can provide unique models for the organization which show the essence of the organization. But for every individual to be able to apply DEMO, he should be fully aware of the concepts that are provided in its theory. Moreover, he should have the skills and ability to identify these concepts in any project that he is working on. Furthermore, he should be able to make the models of DEMO correctly.

DEMO is a powerful instrument in the hands of individuals who have the knowledge and skills to use the methodology. The DEMO Knowledge Center [2] has provided training programs to transfer the needed knowledge and skills to the individuals who want to apply DEMO in practice. Moreover, DEMO used to be taught as a course in Information Architecture program curriculum at TUDelft university [3]. After the individuals finish the course

[1] Business Process Management

[2] http://www.demo.nl/

[3] Information Architecture is a master program at the EWI faculty of TUDelft university. Before the study

on DEMO, they have to pass an exam and get a *DEMO Professional* Diploma. DEMO Professionals are the people who have the required knowledge and skills to apply DEMO correctly in practice.

The main function of DEMO is to model the organization in a way that simplifies the complexity of the organization and makes its management easier. Therefore without the practical application of DEMO in the organizations, the purpose of this the methodology will not be fulfilled. The survival of this methodologies in practical fields is dependent on the amount of attention it receives from the people who are in the position to apply such a methodology. Unfortunately DEMO, even though it has been proven to be successful in the practical cases in that it has been applied, has not been given its deserved attention by individuals in practical fields.

To ensure the success of DEMO in practical fields, we have to first identify the percentage of people who are selecting a specific adoption strategy (applying or not applying) in their practical field and their reasons for choosing that certain strategy regarding to DEMO. *Adoption* is the decision of an individual to apply a methodology. This information is not provided by any research on the subject of the acceptance of DEMO in practice. As a result, a research should be conducted to provide such information. Notice that in DEMO only DEMO Professionals have the ability to apply DEMO. So, while investigating the adoption of DEMO we should monitor the adoption strategy of the DEMO Professionals.

1.1 Research Questions

We have argued that to be able to increase the adoption rate of DEMO, we have to first find the reasons behind a certain adoption strategy by the DEMO Professionals. After finding the factors that can influence the adoption rate of DEMO Professionals, by using the appropriate strategies we can increase the adoption rate of DEMO by manipulating the factors that are influencing its adoption. Based on these arguments we can formulate our research questions. Through out this research we are trying to answer the following two questions:

Research Question 1 *What is the adoption rate of DEMO among DEMO Professionals in practice?*

Research Question 2 *What are the factors that can influence the decision of a DEMO Professional to adopt or ignore DEMO?*

1.2 Research Approach

Since adoption is a behavioral strategy, the techniques that are used in behavioral science are applicable to investigating it. Two types of these techniques that we used in this research are *quantitative analysis* and *qualitative research*. Apart from these methods there is a large body of knowledge available that tries to answer the questions regarding adoption and the

year of 2010, DEMO was part of curriculum of this program. `http://www.tudelft.nl/live/pagina.jsp?id=efcdab81-211a-4f7e-b230-5472a457486e&lang=en`

factors that are influencing adoption for similar situations. Therefore, we conducted our research in 3 phases:

Theoretical Analysis: In this phase we are interested to investigate the problem by looking at the literature. There are two goals that should be achieved after this phase. First of all, we are going to investigate DEMO from different perspectives to be able to realize what aspects of DEMO are important and should be taking into account when investigating the adoption of this methodology. Second, we will do an investigation on the literature of adoption of methodologies. The goal of this phase is to identify the influencing factors in literature and their definition. These factors are proven to affect the adoption behavior of individuals regrading other innovative methodologies. So, it is possible that the same factors influence the adoption of DEMO. Using these factors we are able to make a model that represents the adoption of DEMO with respect to the factor which were found in the literature.

Quantitative Analysis: The relations which were hypothesized from the literature for the adoption of DEMO can be a good basis for a preliminary investigation on the adoption of DEMO. Quantitative analysis has the ability to show whether these factors are really influencing the adoption of DEMO. It is concerned with numbers and measurements. In order to provide good measurements, general definitions should become DEMO specific.

Qualitative Analysis: Quantitative analysis can validate the relations between several factors found in the literature and adoption of DEMO. But in a complex sociological problem like the adoption of a methodology, it is not enough to rely only on the literature. The problem situation should also be explored in a more qualitative manner to find the case specific factors that may have been neglected in quantitative analysis. The flexible nature of qualitative analysis can give us a huge amount of possibilities to capture the experience of DEMO Professionals as it is and prevent us from following wrong hypotheses. This step can also lead to identifying new relations for the adoption of DEMO.

After performing these phases, we are able to identify the factors that are influencing the adoption of DEMO and choose the correct strategies to improve the situation regarding the adoption of DEMO.

1.3 Outline of Thesis

An overview of the outline of the research is provided in 1.1. The order of the chapters are based on the phases of our research approach. Chapters 2 and 3 are about the two steps that should be conducted in theoretical analysis phase. In chapter 2 we will provide some explanations about the different aspects of DEMO and its relation to other methodologies in the same area. Chapter 3 is more focused on the adoption of methodologies in literature and the factors that were found to influence the adoption of methodologies. By the end of this chapter we are able to identify a general model for DEMO which shows the relation between

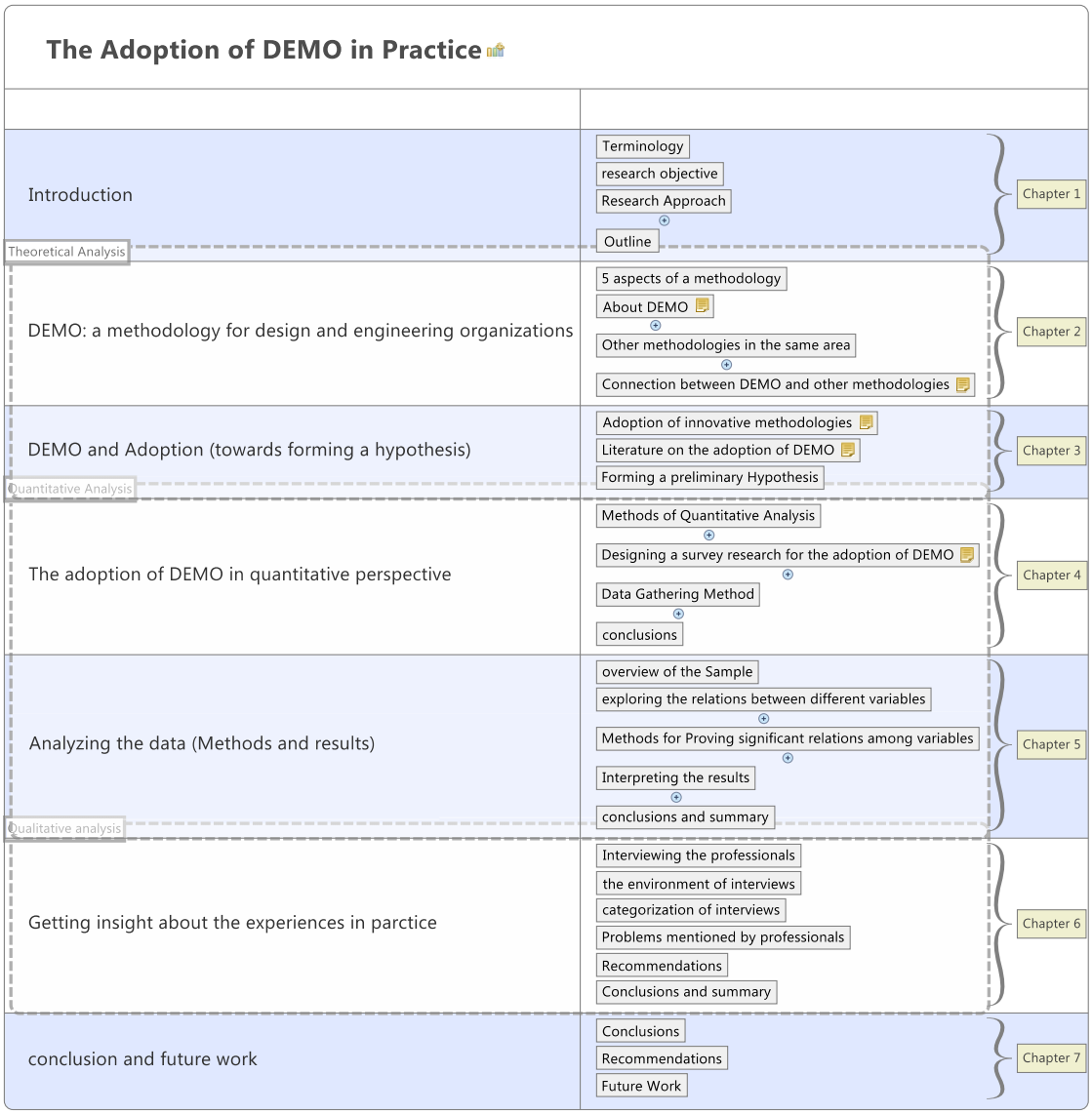


Figure 1.1: Outline of Thesis project

adoption of DEMO and the general factors that were found to influence the adoption. Our quantitative analysis phase is explained in Chapters 4 and 5. In chapter 4, we clarify how we have gathered data in order to perform the quantitative research and in Chapter 5 we explain our data analysis process and the results of these analysis. The results of our qualitative research are summarized in chapter 6. After this chapter we will provide a summary of the results, the conclusions, recommendations and research possibilities for the future in chapter 7.

Part I

Theoretical Analysis

Chapter 2

A Methodology for Design and Engineering Organizations

In this chapter we will give a short explanation about the DEMO methodology and its distinguishing characteristics. First we specify the perspectives from which we are analyzing and evaluating this methodology.

For this purpose we have used a specific framework that was explained in [38, 41]. Section 2.1 introduces this framework which we have used for the purpose of comparing and understanding different methodologies. In section 2.2, DEMO is analyzed based on this framework. In section 2.3, the problems in organizational sciences and the way DEMO and other methodologies in this area are solving these problems will be briefly explained.

2.1 A Framework for Analyzing Methodologies

Wijers [41] and Verhoef [38] presented and explained a framework for understanding, analyzing and comparing methodologies. According to this framework (see figure 2.1), each methodology can be understood with respect to the way it handles five different aspects. These aspects are categorized as: *way of thinking, modeling, working, controlling and supporting*.

Each one of the represented *ways* give us valuable information about the methodology under investigation. Based on [41] and [38] we define these five different ways as follows:

- ***The way of thinking***

  The way of thinking identifies the philosophy behind a methodology. In other words the answers to philosophical questions concerning ontological, epistemological and other related concepts of philosophy [6] are included in this part. For example, the definition of system, environment, nature of entities inside the system, the interaction of these entities with each other and the environment belong to the way of thinking.

- ***The way of modeling***

  The way of modeling of a methodology can be expressed as a set of models which are represented in that methodology. *Models are the most identifiable aspects of*

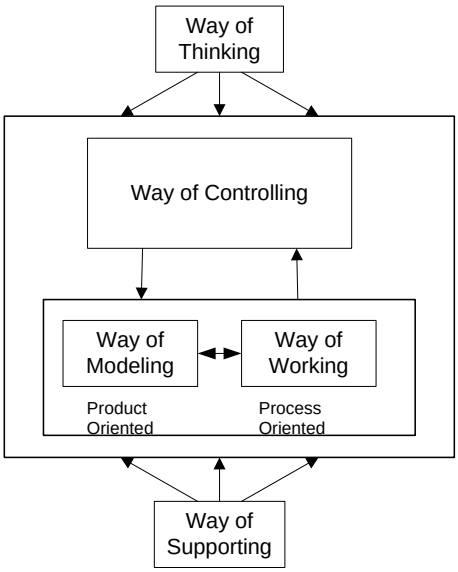


Figure 2.1: The Framework for understanding the information system development process[38]

methodologies. Each model is recognized by several modeling concepts and their representations (signs or graphic symbols). Moreover, each model may include modeling concepts which have interrelations with other modeling concepts. The way of modeling holds the information about these modeling concepts and their interrelation as well.

- ***The way of working***

  The way of Working is composed of a set of tasks with their subtasks and possible orders of those tasks. Also, the available instructions that explain how to perform each task is included in the way of working.

  The set of tasks are categorized into modeling and non-modeling tasks. Any action in which a model is produced or changed in any way is called a modeling task. Other types of tasks are considered as non-modeling tasks (i.e. management reporting or education).

  The scope and information interdependencies of modeling tasks are captured by modeling concepts which clarify the close relation between the way of working and the way of modeling.

- ***The way of controlling***

  Project management is one of the important issues of each project. project management methods try to overcome the problems and constraints (like time, cost or resource constraints) of each project by proper planning and management. The way

of controlling simply includes tasks that are associated with the management issues regarding to the implementation of the design.

Since way of controlling is concerned with the management aspects of the methodology, it is one level higher than the way of modeling and working. But these two different levels are constantly interacting with each other. The way of working provides a list of tasks and the way of modeling represents the deliverables of each stage of the project to the way of controlling. Without having interaction with the way of working and modeling it is almost impossible to make a good plan or to evaluate the progress of the project in the way of controlling.

- ***The way of supporting***

  In [38, 41] the way of supporting refers to the tools that support the way of modeling, working or controlling. Although it is mentioned that any tool from paper or pen to sophisticated software programs can be regarded as a way of supporting, we believe that this definition does not show the diversity of the way of supporting completely. We define any thing that can provide means to perform certain tasks of one of the above mentioned ways is part of the way of supporting. Based on this definition the availability of information and online support can also be included in the way of supporting.

2.2 DEMO

DEMO is a methodology for designing and engineering organizations. The main goal of this methodology is to align the design and development processes to the core processes of an organization. To achieve that, the methodology abstracts away from the detailed description of each process and focuses on the generic concepts and roles [7, chapter 4].

DEMO was first brought out and explained by Jan Dietz in the early 90s [8] and slowly evolved in to a methodology which can represent a coherent, comprehensive, consistent, concise and essential conceptual model of the organization (or enterprise) [7]. Over the time different versions of DEMO have been presented. DEMO-2 is one of the most famous versions of DEMO which was introduced and explained in the book *"Enterprise ontology"* [7]. Recently a new version of DEMO called DEMO-3 has been introduced [9] [1]. DEMO-1, DEMO-2 and DEMO-3 are very similar to each other with small changes and improvements in methods and representations in each version [2].

2.2.1 The Way of Thinking in DEMO

DEMO relies on a sound theory which identifies the principals and definitions of the system and entities within that system. This theory defines the world, the existing entities in it,the behavior of these entities and their interdependencies.

[1] The document on DEMO-3 is available at DEMO Knowledge Center http://www.demo.nl/

[2] Since DEMO-2 is the most known version of DEMO methodology among the people who use it in Practice. From now on we refer to DEMO-2 the generic version of DEMO. The version before DEMO-2 will be called "DEMO-1" and the version after DEMO-2 will be called "DEMO-3"

According to this theory, each system is identified by a set of elements interacting with each other and with the elements in the environment. The environment itself is composed of the same type of elements [7, chapter 6]. The elements in DEMO are human beings who perform specific tasks in the system and have specific responsibilities. These human beings are not known by their physical appearance but by the role they play. So, in DEMO the core elements forming the system and the environment are the *actor roles* [7, chapter 8].

Actor roles are able to perform certain types of acts. They have the ability to interact with each other by performing *coordination acts*. Every coordination act is performed by two actors, the performer and the addressee (At least one of these actor roles, should be inside the system boundaries). By performing a coordination act the performer informs the other party about his intention with respect to a *production*. In coordination acts actor roles can request, promise to deliver, question or declare a production. Production is the result of a production act which is performed by one actor role. Production will be delivered to the environment or another actor role inside the system who has requested that production [7, chapter 9].

The productions are categorized in 3 different layers. Each layer is different from the other by the level of intellect used for producing that production. The highest layer is called *ontological layer* in which the production is a innovation or a decision. In the second layer the level of intellect is reduced to only interpreting the data and producing information out of data (No new innovative idea is created in this layer). This layer is called the *Infological layer*. The lowest layer is called the *Datalogical layer*. The production of this layer is some data or documents [7, chapter 12].

Every action is done based on an agreement between two actor roles through a series of negotiations. This process is called a *transaction*. Basically a transaction is composed of several coordination acts revolving around performing one production act. This way transactions become unique and identifiable by their productions. Since the productions are associated with layers, each transaction can also be associated with layers. Therefore, a transaction can be an ontological, infological or a datalogical transaction.

Sometimes the execution of a production act is in a way dependent on the production of another transaction. This means that actors in a transaction may have to wait for some other actors to finish their transactions before they can proceed with their own [7].

DEMO characterizes an organization as a network of actors, each having specific actor roles. These actor roles can participate in transactions. Since the transactions belong to three different layers, the organization will have 3 layers. These layers are represented in figure 2.2. The B-organization separates the transactions belonging to the ontological layer, I-organization is associated with the transactions belonging to the infological layer and D-organization includes the transactions in the datalogical layer. This kind of representation can abstract the essence of organization from implementation by separating the business layer from other layers of the organization.

2.2.2 The Way Of Modeling in DEMO

The models in DEMO are mostly a representation of the concepts discussed in the way of thinking. DEMO represents each organization in four partial models: *construction Model,*

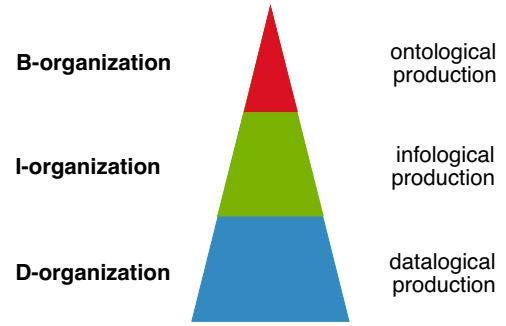


Figure 2.2: The B- I- and D-Organization [7, chapter 13]

Process Model, Action Model and State Model [7]. In [7] the concepts, models and their representation as well as the connection between different models are explained (also see figure 2.3).

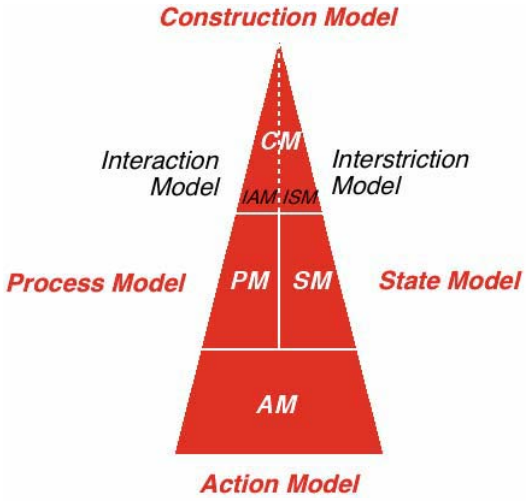


Figure 2.3: DEMO Models and their connection [7, chapter 15]

Several scholars have tried to show the nature and connection between different modeling concepts represented in DEMO models. As an example, Hommes [17] categorized the symbols and concepts of the construction and process model of primitive DEMO and presented a meta-model [3] of DEMO for the construction and process model. Although this meta model is based on a primitive DEMO, the concepts and their relation is still applicable to DEMO and DEMO-3. Another example is the meta-model used in [40, chapter 3].

[3] for the definition of meta-model and its different techniques, please refer to [17, chapter 2 and 3] or [38, chapter 1]

This meta-model shows the concepts and the relations between different concepts which belong to one of the four aspect models of DEMO. The provided meta-model also shows the interrelationships between the different aspect models.

DEMO inspires practitioners to use the models and methods of DEMO all together to attain better results. The integrated aspect models that are presented in DEMO should be used together to cover all relevant issues while keeping the consistency and integrity of the representation.

2.2.3 The Way of Working in DEMO

Regarding the way of working different approaches have been introduced for DEMO (e.g. [7] and DEMO-3 [4]). Generally, the different ways of working for DEMO only show the order of modeling tasks but there is no reference to the non-modeling tasks. Also, a detailed instruction of how to perform each modeling task is available. In other words, the way of working is equal to the process of making a complete conceptual model of the organization (creating all the models).

The difference between the ways of working represented in DEMO and DEMO-3 is both in the order that the modeling tasks have to be performed and the way they are performed. In DEMO each modeling task is equal to the task of creating one model. The process will start from extracting basic concepts from text and will continue by making different models in the order of construction model, process model, action model and state model. In DEMO-3, this process is designed to be recursive. Each concept is created in all the models before the next concept is produced. This way the process starts with building a construction model and finishes when the construction model is formed completely. In each cycle the process starts by putting a new transaction in the construction model then continues by adding the related concept in to the state model, action model and finally in the process model if possible.

2.2.4 The Way of Controlling and the Way of Supporting in DEMO

DEMO provides an abstract conceptual model for the organization but does not explain how this abstract model can be applied and implemented. Enterprise Architecture [18] explained how this process can be handled. Based on Enterprise Architecture, the implementation can be managed by transforming each layer of the organization to the other (starting from the B-layer and getting to the D-layer).

As mentioned before tools are the main concern of the way of supporting. At the moment several tools have been introduced for DEMO. *Xemod* and [5] *Open-modeling* [6] are two of the tools that are developed for this methodology. Also, there is a *Microsoft visio package* designed for DEMO that has a popularity among DEMO users. The impact and usefulness

[4] DEMO Knowledge Center http://www.demo.nl/

[5] Xemod is developed in Xprise. More information about Xemod can be found on Xprise website (in Dutch) http://www.xprise.com/

[6] Open-modeling is an open source software developed by Jan van Santbrink. The software can be found on http://sourceforge.net/projects/open-modeling/

of these tools are unknown at the moment. No sources were found to explain if these tools comply with the requirements of a good tool.

2.3 DEMO and Managing Complexity

Up to now, we have explained that DEMO is a methodology for modeling organizations. But why do we need to have a model of organization anyway? Each organization is an open system with a huge amount of complexity. It has a large number of components interacting with each other and with the environment [2]. This huge amount of complexity causes the behavior of an organization to be unpredictable [2]. The existence of different actors (as complex units themselves) with different points of view and even conflicting interests makes the organizations hard to predict and each small change may cause catastrophic consequences. To understand, predict and manage this complex system with need a model that can explain and simplify the complexity of organizations.

DEMO can reduce the complexity in the organization by ignoring irrelevant details and focusing on the core aspects of the organization [7]. Focusing on the construction of actors interactions, DEMO can be used to make the complex situation where a lot of actors and parties are involved more understandable (ex. virtual organization [10]).

Apart from DEMO, many other methodologies were introduced to simplify the complexity of an organization and manage the conflict of interests among its actors. Many of these methodologies are founded on the basis of a methodology called BPM (Business Process Management). BPM is an extension of work flow systems [34] which pays more attention to the functional view on the organization.

BPM does not have a sound and standard theoretical basis. Instead it is mostly founded on practical experiences [29]. Therefore, the correctness of the final results of these methodologies cannot be validated and different experts in that methodology will not come up with the same results after applying those methodologies to a problem. Some scholars have attempted to propose a standard method for BPM by specifying some basic components that are used in different approaches to BPM [29, 34].

Based on BPM, the major elements of an organization are a set of processes interconnected to each other. These processes show all the steps of the transformation of customer requirements to the products [29]. Each process should have a defined ownership and a documentation on how to complete a process, document and information usage of the process and the control measures of the process [23]. Moreover, the measurements of cost, quality and time should be provided for each process. Based on such measurements the performance of each process can be calculated [23]. In other words, processes are created in a way to empower the management of the organization (the way of controlling).

While DEMO has a sound theory, BPM is missing a theoretical basis. But this is not the only difference between these methodologies. What makes BPM and DEMO different is the approach they take in explaining organizations. BPM only focuses on the functionality and the end result of each process. This methodology ignores the interaction of actors (coordination) in an organization. The careful specification of the project management issues (like time, cost and resources) for each process (see section 2.1) declares the top-down point of

view that BPM has on the organization. In contrast DEMO ignores these managerial issues and rather focuses on the construction of the organization from a bottom-up point of view.

BPMs are controlling the organization by focusing on the measurements of cost quality and time and inspection that monitors performance [23] rather than the actual system. We believe that this way of looking at the organization does not provide the required control on the organization. For example, imagine we calculate the quality of a health care unit as a factor of the number of patients who are sitting in the waiting room every hour. This approach does not always lead to better performance of the unit. On the other, hand it may lead to unethical behaviors to keep the needed quality. For example, they may dismiss the patients who have a lower risk of fatal sicknesses and only focusing on the patients with extreme problems or only reserve appointments at the time that they are sure the patients cannot attend.

PRONTO (PRocess ONTOlogy) [24] is a methodology which tries to combine DEMO and BPM next to each other. PRONTO can be looked at as an intermediate approach between these two methodologies. This method wants to use the concepts and theories of DEMO along with the control techniques of the BPM approach. One of the advantages of PRONTO is the use of the coordination acts (see 2.2) as a starting point of process analysis, to identify who the customer is and what he wants. On the other hand, this method provides *operational, management and supporting processes* [24] (similar to BPM) which makes it easier for the people who are used to applying BPMs.

Although PRONTO uses the concepts and models of DEMO, the distinction in representations (signs and symbols) and existence of misperceived concepts in this methodology shows a gap between DEMO and PRONTO. For example, instead of recognizing the organization as a set of actor roles, Pronto defines the real parties involved in the organization as actors which can perform transactions. This definition clearly contradicts with one of the basic principles of DEMO (abstracting from details) and undermines the added value assigned to this principle which is capturing the essence of organization [7]. By putting DEMO and BPM concepts Pronto provides both bottom-up and top-down way of looking at the organizations. Since these two ways of looking at the organization are not compatible with each other it is unlikely that the provided combination will provide better results in comparison with DEMO and BPMs.

2.4 Conclusions

In this chapter we presented DEMO as a methodology for analyzing complex organization by using a framework which classifies the methodologies based on their way of thinking, modeling, working, controlling and supporting (see section 2.2 and 2.1). In section 2.3 the differences between DEMO and the BPM family of methodologies were pointed out using the same framework. We saw how PRONTO has tried to combine these two methodologies with each other. But due the contradictions in the nature of these two methodologies, the

[7] Last year PRONTO came to an agreement with DEMO Knowledge Center to comply with all the concepts and models of DEMO. If so, this method will be more appropriate to solve some of the issues which was not taken into account by DEMO

correctness and effectiveness of the results produced by Pronto is doubtful. The framework that was explained in section 2.1 can clearly explain the motives of the inventors of this methodology.

Since the framework that was introduced (see section 2.1) could clearly show the differences between different methodologies, it was concluded that it is a good method classification for further investigations as well. In the case of DEMO adoption, this framework can provide a good understanding about the certain aspects of DEMO which are more adopted and accepted by users and help us to give recommendations for improvements.

Chapter 3

DEMO and Adoption

In the previous chapter we talked about the DEMO methodology. We argued that the goal of methodologies like DEMO is to provide a powerful instrument to practitioners to manage and simplify the complexity of a unit like an organization (or an enterprise). The survival of these methodologies in practical fields is dependent on the amount of attention they receive from these practitioners. DEMO is one of the methodologies that has not been given its deserved attention by practitioners. To ensure the success of DEMO in practical fields, we have to investigate the adoption of DEMO in practice to find out what factors influence it and how we can improve DEMO's adoption rate.

In this chapter we will talk about the adoption of DEMO. In section 3.1 we will start with giving a definition of adoption. In section 3.2, we complement this with a brief survey of research on innovation adoption and the adoption of methodologies from the literature. Section 3.3 elaborates on the adoption of DEMO and its connection to the literature. We end this chapter with explaining how we have approached the adoption of DEMO and our method of analysis for our research.

3.1 Definition of Adoption

In this research we want to see how people are using the DEMO methodology in practice. In other words, we would like to know whether they have adopted DEMO in practice. Adoption is the *"decision to make use of an innovation as the best course of action available"* [36]. Since an innovation can be reffed to as *"an idea, practice or object that is perceived as new by an individual or other unit of adoption"* [36], any methodology that is new in its field of application can be recognized as an innovation. Therefore, DEMO which presents new and rather revolutionary concepts and models to the field of organization science and analysis can be acknowledged as an innovative methodology. Hence, the adoption of DEMO falls under the same definition of adoption [36].

The adoption of a methodology may differ in scale. The scale of the adoption answers the question of whether the methodology is accepted at a personal or organizational level [36]. Organizational adoption is mostly influenced by decision makers (e.g. managers) who decide whether or not to use a methodology at an organizational scale and conform the

organization toward that methodology. On the other hand, individual adoption is focused on the adoption of individuals within an organization.

Organizational adoption and adoption by individuals within the organization can influence each other to a certain extent. Individuals can act as *boundary spanners* [36] and bring new innovative methodologies into the organizations. This way the organizational adoption will take a more bottom up approach rather than top down [36]. On the other hand, organizational adoption does not always lead to individual adoption. A study shows that *mandated organizational adoption may not grantee a successful deployment* of a methodology [32].

If we put small organizations aside, DEMO is not yet adopted by an entire organization. Since boundary spanners could influence the organizational adoption, investigating DEMO at the individual level and through boundary spanners is more attractive. We aim to investigate the possibility of this type of adoption for DEMO within organizations.

3.2 Adoption in Literature

The ultimate question in the literature of adoption is to find the factors that in any way can influence the adoption. These factors vary from the actual specifications of a methodology to the social and subjective consequences of the adoption for an individual. Different research studies have used different research approaches and each one of them came up with a set of factors that may influence the adoption of methodologies. We summarize some of this literature in this section.

3.2.1 Adoption as a Behavior

Usually when we try to improve a methodology, we improve and change the actual specifications of that methodology. But in practice the *perception* of the individuals about the specifications of a methodology influences their adoption of that methodology (and not the actual specifications of that methodology). This statement comes from the very core of some behavioral and social models in which *every action of an individual is the result of a "cognitive process" based on which an individual becomes motivated towards performing that action"*. This process is influenced by the perception and beliefs of that individual about a certain object [12]. So, in investigating the adoption behavior it is more useful to ask the individuals about their perception about the methodology rather than analyzing the methodology itself.

TRA (Theory of Reasoned Action) [12] and its follow up theory *TPB (theory of planned Behavior)* [1], are two examples of such behavioral and social studies. These theories proposed a model to predict a certain behavior performed by an individual. Based on this model the performer makes a subjective decision on whether or not he should behave in a certain way. This decision (called *attitude*) is made on the basis of his belief and evaluations about the correctness or desirability and consequences of a behavior.

One important property of TRA is explaining the effect of the beliefs and norms of the others on an individual's behavior. This factor is called *subjective norm* which shows what a third party thinks a certain individual should or should not perform a certain behavior. If the third party's point of view is important for the individual, he will feel a pressure or

Factor	Related Factor(s)	Description
Frequency Of Use		The degree to which individual uses each element of a methodology if he gets the chance to do so.
	Frequency Of Opportunities for Use	The degree to which an opportunity for applying every element of a methodology is provided for an individual. It is apparent that if an individual does not have a chance to use a methodology, he will not use that methodology frequently.
Consistency Of Use		The degree to which an individual follows the instructions and rules of a methodology consistently.

Table 3.1: Implementation Factors

motivation to comply with that point of view [12]. This effect may prevent an individual to behave in a certain way even if he thinks that behavior is the right course of action (or wise versa).

Another property which was introduced by TPB [1] is the effect of availability of the resources and opportunities for an individual on his behavior. This property is called *perceived behavioral control*. Perceived behavioral control, shows the belief of an individual about the level of difficulty of performing a behavior taking into account the available resources [1].

The concepts which predict the behavior of individuals in TPB and TRA have been used to explain adoption behavior by some scholars. Most of the perceived factors investigated in literature of adoption can be categorized into one the beliefs that form the attitude, subjective norm or perceived behavioral control of an individual. Subjective Norm is one of the most popular concepts of TRA and TPB [4, 27, 33] in the literature of adoption. This concept is usually used with the same name and without further explanation.

The concepts represented in TRA and TPB are trying to give an understanding about general behavior of individuals. When it comes to specific behaviors, these concepts should be broken down into a set of "behavior specific beliefs" of an individual. So, for investigating the adoption of methodologies, we have to find out what factors of the methodology, perception of which people and what resources are of importance for individuals to make a decision about the adoption of a methodology.

3.2.2 Measuring the Adoption

When we talk about adoption a distinction should be made between the adoption (as a yes or no decision) and the extend to which an innovative methodology is implemented or used by the individual [33]. It is important to not only identify the adoption but also pay attention to the implementation of a methodology. The implementation can be measured by the number of components and concepts of a methodology that an individual uses over the time. [35]. In [35], several factors were identified which can be used to measure and evaluate the adoption of each component of a methodology by an individual. These factors are defined in table 3.1.

3.2.3 Factors Influencing the Adoption

The studies about adoption which were reviewed for this research have identified different factors that may influence the adoption of methodologies. Table 3.2 shows a summary of these factors. We have tried to find the similarities and categorize different factors accordingly. For each factor the definition, related factors and references to the articles is provided. For each factor, the related factors are those that either have the same or similar definition or can be used to partly measure the former. Please note that all the factors in this table are *perceived* factors (they show the perception of the individuals).

Table 3.2: Factors which may influence the adoption of methodologies

Factor	Related to	Description	study
Usefulness[1]	Job Fit	The degree to which an individual believes that using a particular methodology would enhance his/her job performance (compared to before using the methodology) [2].	[4, 5, 15, 27, 28]
	Relative Advantage	The degree to which using a methodology is better than not using it [3].	[27, 32, 33, 35]
	Job Relevance	The degree to which the methodology is applicable to individual's job.	[37]
Complexity		The degree to which an innovation is perceived as relatively difficult to understand and read [33] or use [35] [4].	[32, 33, 35]
	Ease Of Use [5]	has the reversed meaning of complexity (see [4, 28]) [6].	[4, 5, 15, 27, 28, 37]
	Ease Of learn [7]	The degree to which a methodology is easy to learn and become skillful in.	[28]
	Knowledge accessibility	The degree to which a it is easy to obtain knowledge about a methodology [8].	[35]

Table continues on next page

[1] This factor was first introduced for technology acceptance.

[2] In contrast with the definition of Davis [4], in the analysis done by Segars and Grover [28] *increase of job performance* does not have a significant effect on usefulness. While, factors like *"productivity"* and *"easier job"* influence the perceived usefulness.

[3] Tornatzky and Klein [33] define relative advantage as the degree to which an innovation is better than its predecessor (other methodologies) which is almost the same as the Vavpotic and Bajec [35] definition

[4] This definition is the combination of definitions provided by [35] and [33]. While one is only focusing on using, the other one is focusing on understanding a methodology

[5] This factor was first introduced for technology adoption

[6] In [27] no significant relation was found between ease of use and adoption of a methodology.

[7] This factor was first introduced for technology adoption

[8] This factor is more focused on the ways a person can obtain knowledge about a methodology (like training, books and websites)

Factor	Related to	Description	Study
(Social) Compatibility		The degree to which a methodology is consistent with the existing values, past experience and needs of the receivers.	[27, 32, 33, 35]
	Methodology Experience [9]	The degree to which an individual has the knowledge and experience with the methodology under study.	[35]
	Field Experience[9]	The degree to which an individual has knowledge and experience in the field in which a methodology is applicable (ex. knowledge about other methodologies).	[35]
Subjective Norm		The degree to which individual perceives that most people who are important to him think he should adopt the methodology.	[1, 5, 12, 27, 35, 37]
	Social Approval, Image	The degree to which an individual perceives that use of a methodology can enhance his status in his reference group.	[27, 33, 37]
	Management Support	The degree to which management supports introducing and using a methodology [10].	[35].
	Voluntariness	The degree to which the adoption of a methodology is optional for an individual [10].	[27, 35]
Observability		The degree to which results of an innovation are visible to others.	[32, 33]
	Communicability Result Demonstrability	The degree to which aspects(results) of a methodology can be communicated or expressed to the individuals.	[33, 35, 37]
Divisibility		The degree to which an innovation can be tried on a small scale prior to adoption.	[33]
	Trialability	The degree to which an innovation may be experimented on limited scale.	[32, 33]
Profitability and cost		The degree to which using an innovation provides certain level of profit.	[33]
Career consequences		The degree to which applying a methodology has longterm consequences for an individual's career.	[27].
	Organizational Uncertainty	The degree to which the future of an organization is uncertain.	[35]

Not all the factors represented in table 3.2 can be directly linked to the adoption of

[9] This factor is not equal to compatibility but can be used as an indication of past experience and knowledge of an individual.

[10] There is a relation between the level of compulsoriness of a methodology and its adoption by individual. Vavpotic and Bajec [35] explain that if a methodology is not suggested by management, individuals will not adopt a methodology while Riemenschneider et al. [27] argue that dictating a methodology to individuals may decrease their adoption rate

methodologies in general. Apart from some scholars who have tried to identify factors which can be used to explain the adoption of all innovative methodologies [33], many of the articles are about the adoption of methodologies in a specific field like *SDM (Software Development Methodologies)* [27, 32, 35]. In this specific field some scholars used the adoption framework of other fields to investigate the adoption of methodologies. For example, Riemenschneider et al. [27] investigated the relevancy of the factors identified in *Technology Acceptance Model (TAM)*[11] *[4, 5]* and *TAM2* for the adoption of SDMs. Based on this research some of these factors were relevant for the adoption of SDMs. To be sure that we took all the factors into account the factors identified in TAM, TAM2 and TAM3[37] which could have been transformed into appropriate factors for the adoption of methodologies were included in the table as well.

In a study by Dumay [10], DEMO was used as a SDM in about 50% of the projects. So, the factors identified for the adoption of SDMs can be applied to DEMO as well. But, It is important to notice that not all relevant factors found in the literature have an influence on the adoption of DEMO. In the next section we will elaborate on the reasons.

3.2.4 Generalization of the Results

Some of the factors in table 3.2 may not be able to explain the adoption of different methodologies. Specific design decisions of each study (like method of investigation, population under study and the number of methodologies analyzed in each study) indicate the ability of the results of that study to explain the adoption of different methodologies.

Tornatzky and Klein [33] capture different aspects of this problem perfectly. In their article they investigated seventy five articles about innovation adoption. They have identified ten *innovation adoption factors* out of which only three have been largely agreed upon by reviewed articles. The effect of the rest of the adoption factors were not fully agreed upon by different articles. For example, some articles showed increasing effect of a factor on the adoption while another reported decreasing effect of the same factor.

Tornatzky and Klein [33] argue that the definition provided for some the factors are either too general or too vague. So, we do not know whether different scholars were measuring the same factor or they were referring to different factors with a same name. To elaborate more on this problem, we take *"Relative advantage"* (which is presented in table 3.2) as an example. The concept of "being better" in the definition of Relative advantage is very broad. One person may interpret being better as the amount of profit a methodology makes while another person may use other advantages of a methodology like the amount of time using a methodology saves or the social benefits using a methodology has [33]. Naturally, the results of such studies with each of these different definitions for Relative Advantage will have different or even contradicting outcome.

Another problem which was pointed out by Tornatzky and Klein [33] was the low number of methodologies investigated in each study. In many of the articles, the adoption of only one methodology is investigated. In these studies, it is unknown whether the identified factors are methodology specific or can be generalized to other methodologies as well. As a

[11] *TAM investigates the influence of different factors on the adoption of new and innovative technologies (rather than methodologies). This method is mostly used to see the adoption of different software programs.*

result, it is not possible to use the reported adoption factors of one methodology as adoption factors for another methodology. To explain this problem, the study that was conducted by Riemenschneider et al. [27] can be used as an example. This study was conducted among the employees of one organization to measure the factors influencing the adoption of one SDM. Since the identified factors are not tested on other methodologies, the explanations that these factors provide for the adoption of the SDM under study may only be appropriate for that specific methodology. So although the study found significant relation between some of the factors and adoption, the influence of these factors on other methodologies should be investigated before we generalize the results to the adoption of other methodologies.

Another shortcoming of the study by Riemenschneider et al. [27] is its concentration on one organization. Focusing on one organization increases the risk of including the organization specific factors as general adoption factors. Certain characteristics of an organization (like culture of the organization or the cultural background of people within the organization) can influence the adoption factors. For example, in the research conducted by Straub et al. [30], the factors that were identified by TAM hold in U.S.A and Switzerland while these factors do not explain the adoption behavior in Japan due to the difference in the culture.

It is important to notice that these problems do not reduce the importance of the factors reported in these studies. Rather it indicates that the effect of these factors on the adoption of other methodologies need to be investigated.

3.2.5 Method of Investigation

In studies about the adoption of methodologies both *qualitative* and *quantitative* analysis methods have been used by scholars. But we have to notice that quantitative analysis (like survey research) have been more popular among the reviewed articles. Articles by Ajzen [1], Davis [4], Davis et al. [5], Gefen and Straub [15], Riemenschneider et al. [27], Straub et al. [30], Vavpotic and Bajec [35], Venkatesh and Bala [37] are examples of the studies which used quantitative analysis to explore relations between adoption as a dependent variable and several independent variables. Studies by Toleman et al. [32] and some of the articles investigated in Tornatzky and Klein [33] are the examples of studies which used qualitative analysis methods to find the factors that influence the adoption.

the method of analysis is an essential factor in investigating the adoption behavior of the individuals. Each of these two methods of analysis provides a different set of benefits to the study. Quantitative analysis can validate hypotheses with the help of measurements and statistics. Each hypothesis shows the dependency of the variable understudy to independent variables[20]. Being dependent to measurements, quantitative analysis can be disqualified by small problems in the design of the research. Measurement errors, non-random samples and small sample size can affect the validity of researches based on quantitative analysis as well. Moreover, there is always a risk of not including some important factors in the research. Qualitative analysis does not have the problems associated with quantitative analysis. The analysis is usually dynamic and based on semistructured interviews. During the analysis process, the interview questions may change or new hypotheses may emerge. Qual-

itative analysis seems to be more useful in exploration of the problem and getting grip of the situation. On the other hand, since the statistical methods are not used in this analysis, the results gathered from qualitative analysis do not prove the relations among different factors and these relations still need validation (using quantitative analysis methods) [20, chapter 24].

Qualitative and quantitative analysis methods can complement each other if they are used together. The research which includes both qualitative and quantitative analysis methods is called *multi-method research* [20, chapter 24]. Kerlinger and Lee [20, chapter 24] refer to three different approaches in multi-method research. The following briefly explains these three approaches.

Qualitative - Quantitative This approach starts with problem exploration. The factors, variables and hypotheses are identified using qualitative analysis. Then the hypotheses will be validated using quantitative analysis.

Quantitative - Qualitative First a quantitative analysis is performed to prove certain hypothesis. Based on the results in this phase a followup qualitative analysis is designed to explain the relations found in quantitative analysis. In qualitative analysis also aims at finding the answers that were not or could not be explained by the quantitative analysis. After the qualitative analysis new variables and hypotheses may emerge which should be validated using quantitative analysis.

parallel analysis In this approach, both analysis methods are conducted simultaneously in which one of the two analysis methods are used to complement the other.

In investigating the adoption of a methodology, the appropriate method of analysis should be used based on the problem specifications and the solution space.

3.3 Investigating the Adoption of DEMO

Previously in this chapter, we briefly surveyed research on the adoption of methodologies, their method of analysis and the influencing factors that they have identified. In this section, we are going to use the acquired knowledge to design our research on the adoption of DEMO.

As we mentioned before the adoption of every methodology is affected by the perception of individuals about that methodology. So, to be able to get a sense about the reasons behind the adoption we should find the individuals who have been in contact with the methodology and made a decision to adopt or ignore it.

It is important to notice that it is not easy to discuss DEMO with people who do not have any knowledge about it. DEMO has a strong theoretical background and individuals with no knowledge about this theory may misinterpret the models presented by DEMO [10]. Introducing DEMO to these individuals needs a lot of effort and time consuming sessions. At the same time, introducing DEMO to new people will increase the complexity of the problem. Furthermore, the way the methodology is introduced to the individuals will influence their perception about different aspects of DEMO. So, the individuals which are

selected for the study should have had a certain level of knowledge about DEMO before the beginning of this study.

The only official record about the people who have some knowledge about DEMO is the list of *DEMO Professionals* [12]. These people are the individuals who have passed an exam about DEMO and got a DEMO Professional degree. DEMO Professionals are mostly working in practical fields and participated in a course about DEMO because of their interest in the methodology. Since they have passed an exam, they have at least a primitive knowledge about DEMO and it will be much easier to discuss about different aspects of the methodology with them.

DEMO Professionals are our connection to the practice. They have enough knowledge about DEMO and are interested in the future of the methodology. They can act as boundary spanners in their organizations and introduce DEMO to the organization they are working in. They have some knowledge about the possibility of adopting DEMO in the their organization and they can broaden our view point about the adoption of DEMO in those organizations.

3.3.1 Defining the Method of Investigation

Our knowledge about DEMO Professionals is limited. In the DEMO Knowledge Center website [12], some information is provided about some of the DEMO Professionals. But for the rest of this population we only possess some limited information (like their email and sometimes their phone number). Moreover, there is not enough knowledge about the adoption behavior of these professionals. So, we need to acquire more information about DEMO Professionals and get an insight about the general trend of adoption among this group.

The factors provided in the literature can be a good basis for a preliminary investigation on the adoption of DEMO. These factors are proven to affect the adoption behavior of individuals regrading to other innovative methodologies. So, it is possible that the same factors influence the adoption of DEMO. We use these factors to form a hypothesis for the adoption of DEMO. Even though these factors are general, in our quantitative analysis we have made these factors more DEMO specific (see chapter 4). We visualized these hypotheses in figure 3.1. By using a quantitative analysis method we can prove if these factors are actually influencing the adoption of DEMO by DEMO Professionals. In other words, we want to see whether these factors are the reason that people make a certain decision regarding the adoption of DEMO. These factors were defined in table 3.2.

The quantitative analysis can validate the relations between several factors found in the literature and adoption of DEMO. But in a complex sociological problem like the adoption of a methodology, it is not enough to rely only on the literature. The problem situation should also be explored in a more qualitative manner to find the case specific factors that may be undermined in quantitative analysis. The flexible nature of qualitative analysis can give us huge amount of possibilities to capture the experience of DEMO Professionals as it is and prevent us from following wrong hypotheses.

[12] see http://www.demo.nl/knowledge-centre/certification/certified-demo-professional-2007010923/

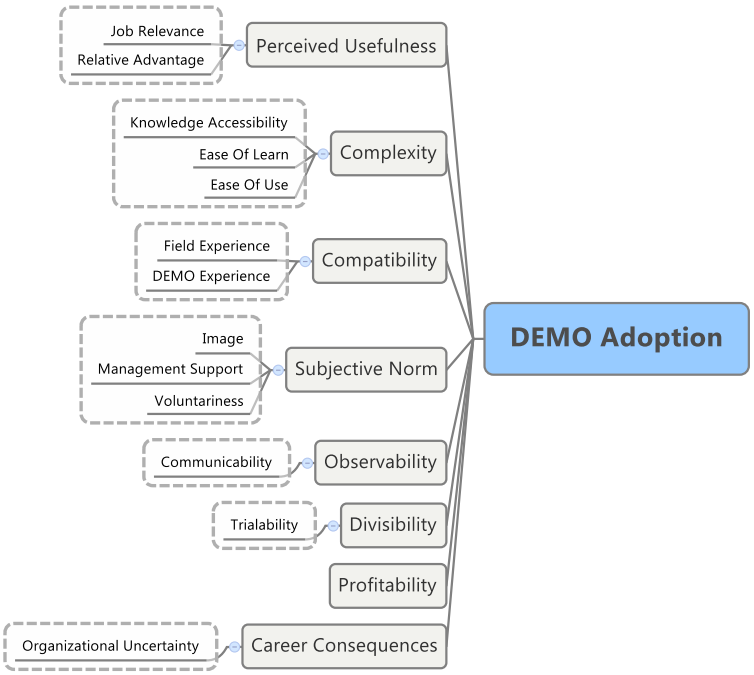


Figure 3.1: a preliminary model for the adoption of DEMO

Based on what we have argued so far we are going to design our research in two steps. First, we perform a quantitative analysis in which we analyze whether there is a relation between adoption of DEMO and the adoption factors found in the literature. This step can give us more understanding about the adoption behavior of DEMO Professionals and possible patterns between this adoption behavior and other aspects of the methodology. Second, a qualitative analysis has to be performed to give us more in depth insight about the adoption of DEMO by DEMO Professionals and possible problems they encounter while introducing DEMO to their organizations. This step will complement the quantitative analysis step by providing us with explanations of certain relations found in the quantitative analysis phase. This step can also lead to forming new hypotheses which could show the reasons behind a certain adoption behavior of DEMO Professionals regarding DEMO. To prove these hypotheses another quantitative analysis should be preformed. Due to time and resources available we leave this validation for future research. Notice that this approach is in line with the second approach of multi-method research which was discussed in section 3.2.

3.3.2 Related Work

at the moment we are only aware of two studies in which the adoption of DEMO in practice has been investigated.Dumay [10] uses a questionnaire and a group session to get more understating about the situation of DEMO in practice. He realized that DEMO is mostly used for information system development and business process redesign. Moreover, based

on his research DEMO is mostly used in combination with other methodologies. Although this study provides a good indication of the behavior of practitioners with respect to DEMO, it does not investigate the perceived reasons behind such behavior. In other words, the study fails to address practical reasons by not asking the respondents to explain why they have taken such a stance on DEMO.

Ven and Verelst [36] investigate the general trend of adoption in the literature. Based on what they found in the literature they have proposed several research agendas about the adoption of DEMO. They categorized their research agendas based on the type of adoption the research tackles (organizational or individual).

Due to specific characteristics of DEMO (having a strong theoretical background), we believe that the adoption of DEMO is possible through the boundary spanners (DEMO Professionals) within the organization. So, Based on the categorization in [37], our research on the adoption is more focused on the individual adoption. We will make an effort to explain adoption behavior of individuals based on the factors we have found in the literature. But we will also try to have more insight about the trend of adoption within organizations by conducting a qualitative research with the help of DEMO Professionals.

3.4 Summary

In this chapter, we explored the problem of adoption of methodologies and adoption of DEMO in specific. We found out that it is not possible to explain a certain adoption behavior without taking into account the perception of individuals who are performing that behavior. We identified and categorized several adoption factors that were reported to have an influence on the adoption of methodologies. We also explored the methods of analysis used in the literature to investigate the adoption of methodologies.

Based on what we have found in the literature, we presented the design for our research on the adoption of DEMO. We found out that the experience of DEMO Professionals are the most important resource in the investigation and the center piece in this research.

We designed our research in two phases. First a quantitative analysis which explores whether the identified factors in the literature can explain the adoption of DEMO. Then, a qualitative analysis to investigate the actual experience of professionals and to form case specific hypotheses. Clearly, the new hypotheses will still need validations but we will leave the validation of them for future work.

Part II

Quantitative Analysis

Chapter 4

The Adoption of DEMO in Quantitative Perspective

Our first step in analyzing the adoption of DEMO is performing a quantitative analysis in which we will investigate if the identified factors in the literature can explain the adoption of DEMO. Th factors shows the perception of DEMO Professionals about DEMO. This quantitative analysis is achieved by conducting a *survey research*.

The goal of this chapter is to explain the design of our survey research. In section 4.1, we will give the definition of survey research and the components which should be specified while designing a survey research. In section 4.2, we will identify these required components for our survey research on the adoption of DEMO.

4.1 Survey Research in Social Science

In sociological researches surveying is a common approach to measure certain aspects of a population. *Status survey* and *survey research* are two different types of surveying [20, chapter 25].

A status survey examines and reports the current characteristics of a population [20, chapter 25]. For example, the survey conducted by Dumay [10] is a status survey. This survey reports certain trends in the population, like the percentage of individuals who have applied DEMO in a certain level or the percentage of individuals who were working in an organization with a specific size, without analyzing this data to find possible relations.

A survey research is another type of sociological research in which a *sample* is selected from the population to study and measure the interrelations among several *sociological and psychological variables* [20, chapter 25]. These sociological and psychological variables are collected from the sample by questioning individuals about them [13]. Each individual belongs to different sociological groups known as sociological variables like gender, income level, etc. On the other hand, psychological variables provide a way to measure attitudes, opinions and behaviors of individuals. Finding relations between these two types of variables is the main goal of a survey research. The relations that are found in the sample

will be generalized as the characteristics of the whole population (taking a certain sampling error into account)[20, chapter 25].

4.1.1 Design Aspects of a Survey Research

For designing a survey research we must make sure that all the important components of the survey are taken into account. The important components in designing a survey research can be derived from its definition. These components are the *sample*, *population*, *variables* and the *questions* that we have to ask to measure these variables. Therefore, the way we derive the sample from the population, the questions we ask from individuals in the sample and the way we approach individuals (data collection method) should be specified in the design of every survey research [13]. What follows will explain each of these three aspects of the design of a survey research in detail.

Population and Sample

Most of the times a goal of the survey research is to generate statistics about the whole population by looking at the a small fraction of that population called *sample*. To be able to explain the behavior of the population accurately, we have to draw a *random sample* from the population. A random sample is a type of sample in which *"all individuals in the population have the same chance of being selected as a member of that sample"* [13].

In practice it is not easy to collect information from a random sample of the population. Most of the times we are faced with a certain number of individuals who are not willing to participate in the research and it is not possible to force them to do so. *Non-response* can have a big influence on the accuracy and validity of the results of a survey when we generalize them for the whole population. People who do not participate in the surveys mostly are not interested to the subject or do not hold a strong opinion about it. When they are excluded from the research, the effect of people who have strong (negative or positive) opinion about the research will increase which will make the survey biased towards their points of view[13].

There are some solutions to reduce non-response to a certain extent but it is hard to eliminate it completely. In such situations the results of the survey can still be used to *give us a general idea about the behavior and beliefs of the general population* [13]. nevertheless, the results of the survey can always indicate the actual behavior and relations in the sample.

Data Collection Methods

Survey researches can differ in the method they are using to collect information from the individuals within the sample. The information can be collected using *interviews, Telephone calls and mails*[13, 20]. Each of these methods are useful in a specific situation. Based on the problem specification and the resources available, a method of analysis should be chosen for each survey. The surveys are named after the data collection method they use. Table 4.1 provides a summary of the situations in which each type of survey research can be used. Moreover, for each type of the survey research several risks are assigned that may occur

Survey	Applicability	Risks
Personal Interview Survey	• Sample with available addresses • Inability of the sample to read, understand and write in the language of preference • Sample with lack of interest in the subject of research • Tackling complex problems using complex questions	• Unavailability of the individuals within sample • Inaccessibility of the respondents for the interviewers • Long duration of interview process • High cost of training interviewers, traveling, etc.
Telephone Survey	• Sample with available phone numbers • Fast conduction (in few days [13])	• Unavailability of the respondents at the time of the phone calls • Only accessible to respondents with phones • Low cooperation rate due to unknown interviewer (5-10% lower than interviews [13]) • Inability to obtain detailed information and using visual aids • Cost of training interviewers
Mail Survey	• Sample with available addresses • Ability of the sample to read, understand and write in the language of preference • Sample with high interest in the subject of research • Difficult to reach samples • Unavailability of trained staff (no training cost) • Low budget	• Low number of respondents (less than 40% [20] to 50% [13]) • Biased towards people with extreme points of view • High risk of misinterpreting the questions (accuracy)

Table 4.1: Different types of survey research derived from [13, 20]

while performing that type of survey. One should think of the ways to avoid or treat certain risks before performing a survey research.

Variable Types	Description	Examples	Measurement
Nominal Variable	A type of categorical variable in which there is no order between the values (categories).	Gender (male/female), Marital status (single/married/divorced)	Factual, Subjective
Ordinal Variable	A type of categorical variable in which the categories of variables are ordered along one dimension.	Wealth (rich/middle class/ poor)	Factual, Subjective
Interval Variable	A type of continuous variable in which there is equal distances between ordered values but there is not natural zero. So, the multiplication or division of these values does not have any meaning.	Centigrade, Fahrenheit	Not common
Ratio Variable	A type of continuous variable in which there are equal distances between ordered values and a natural zero.	age, pressure	Factual

Table 4.2: Types of variables derived from [13, 20]

Nature of the Variable and Questions

In designing a survey research, the importance of defining the questions which will be asked from the sample population is apparent. These questions are our tool of measurement. They provide information about the sample population based on the variables we want to investigate.

Variables are different from each other in the way they measure each phenomena. In that sense, variables are either *categorical* or *continuous* [20]. A categorical variable has a finite set of values each of which represents a category [20]. Continuous variables on the other hand can have an infinitive set of values. These values should be ordered and have equal distances from each other [20].

Each type of variable, can be divided into two subtypes. A categorical variable can be a *nominal* or an *ordinal* variable and a continuous variable can be an *interval* or a *ratio* variable. These four types of variables are defined in table 4.2. To make the definitions more understandable several examples are provided along with the definition of the variable types.

Each of these variables are suitable for some type of measurement. For measuring factual data of the individuals, categorical (ordinal or nominal) or ratio variables can be used. The decision to use one of these variable types is dependent on the nature of the phenomena and the amount of precision needed in the measurement. On the other hand, Subjective data which is involved with attitudes and opinions of the individuals can only be measured using categorical variables (nominal or ordinal) [13].

The variables are the basis of the questions we ask from the individuals. These questions should be designed in a way that enables correct measurement of these variables. *"Good questions should be reliable and valid"* [13]. Reliable questions are perceived the same by different respondents and the answers provided to the valid questions show the intended

measurement for the variable [13].

Fowler [13, 14] presented several techniques to ensure that our questions are reliable and valid. It is important to spend time on designing a good set of questions. These questions should be clear and simple at the same time each question should only measure one variable. Moreover, control questions should be designed to investigate the accuracy of answers [13, 14].

When designing a survey research all of the afore mentioned components should be developed with extreme caution. Since we have chosen a survey research for the quantitative analysis, overlooking the importance and design of any of these components will have a great effect on the validity and correctness of the final results of the quantitative analysis.

4.2 A Survey Research for the Adoption of DEMO

The important components (Sample, population, method of data collection, variables and questions) of the survey research should be taken into account in designing a survey research for the adoption of DEMO in practice. In this part, we will define these components for the adoption of DEMO. Moreover, We will provide a detailed explanation about the techniques we use to acquire data from the population.

4.2.1 Sample and Population

We are investigating the adoption of DEMO by DEMO Professionals in practice. Therefore, they form our population. Not all DEMO Professionals have practical experiences. Since DEMO has been taught in some academic courses, there are students who have passed the exam and became DEMO Professionals. Some of these students have joined the work force while others are still studying. These people should be excluded from the population before we select a random sample.

Based on the list provided for this research[1], the DEMO Professionals population consists of 211 individuals. The only available information about this population is their email addresses and (for several individuals) their phone numbers.

Obtaining more information about DEMO Professionals can be achieved by further questioning DEMO Professionals themselves. Using this method, we can inquire information about individuals' occupation, type of education and other factual information. These questions can be combined with other survey questions.

4.2.2 Data Collection Method

In order to choose the best data collection method we have to compare our situation to the ones provided in table 4.1 and choose the most appropriate method of investigation. In our situation several facts should be taken into account:

[1]This list is made accessible to us by Prof. Dr. ir. Jan L.G. Dietz (http://www.st.ewi.tudelft.nl/ dietz/) the founder of DEMO methodology.

Reaching DEMO Professionals : We only have access to the e-mail addresses of DEMO Professionals. So, we can either perform an e-mail based survey (which can be categorized as a mail survey) or send e-mails to the individuals and request their phone number or their addresses to perform a telephone or personal interview survey.

Unavailability of trained staff : Since there is only one person available to perform the survey research, it is more appropriate to perform a research similar to a mail survey. It is also possible to perform other methods with one staff but the time which will be required to perform the research will increase to a great extent.

Time Constraints : The survey research should be performed in a certain and predictable amount of time.

Based on the specific situation of this investigation it seems more reasonable to use mail survey data collection method. Having access to e-mail addresses, we make the questionnaire online. This way there would be less inconsistencies between the structure of answers provided by different individuals and the records of data can be produced automatically [2].

To increase the response rate we sent a reminder to the individuals who did not participate in the questionnaire. Moreover, we made it possible for the respondents to answer the questions in several sessions. This way, the respondents were able to leave the questionnaire whenever they wanted and get back to it later on.

4.2.3 Designing the Questions

The questions provided in our online questionnaire should reflect the variables we want to measure. So, to design the questions we have to first define and identify the variables that should be measured by those questions. The basis of these variables are the factors represented in figure 3.1.

Measuring DEMO Adoption

We know that the adoption of DEMO is a behavior performed by individuals. This behavior can simply be measured by asking people if they have used DEMO in practice or not. We call this variable *General Adoption*. To take the frequency of use into account, we have to see if the individual chooses to use DEMO over using other methodologies (if DEMO is applicable to his work) in his day to day work. We call this variable *Recent Adoption* which is derived from the definition of frequency of use provided in table 3.1. Recent Adoption shows the number of projects in which the individuals have applied DEMO in the last 6 months. Being measurements for behavior, General Adoption and Recent Adoption are categorical variables.

We have argued that it is not enough to only measure the adoption itself rather we have to take the implementation into account as well (see chapter 3). The individuals may apply DEMO in several layers. An individual may only apply the concepts of DEMO (the way of thinking). Some other individuals may adopt the concepts as well as some of the models

[2] To perform online questionnaire, we have used the NETQ tool (http://netq.co.uk/lang/EN/).

(the way of modeling). All the models and the way of working identified by DEMO (or DEMOIII) can also be adopted by individuals. In investigating the consistency of use these layers of adoption should be taken into account.

Independent Variables and the Questions

In the previous chapter we identified the factors that may explain the adoption of DEMO(see table 3.2). But not all of these factors are specific enough to be used as measurements (like social compatibility). Sometimes these factors represent a combination of several other factors (like complexity) and sometimes generic concepts have been used to define a factor (like the concept of other people in the definition of Subjective Norm) which should become specific for a methodology.

To be able to use these factors, we have to derive measurable variables out of them which are based on the specific situation of our problem. Some the factors which we made specific for our investigation are as follows:

Ease Of Learn One of the critics to DEMO is the fact that it is too theoretical and hard to understand. So, we expect to see individuals who have done their thesis or studied about DEMO apply the methodology (or parts of the methodology) more than the others. Moreover, we have to see whether special trainings are needed to apply DEMO in projects.

Knowledge Accessibility From the first time that DEMO was introduced up to now, the concepts and models of DEMO have been changed and improved. Every now and then new research is conducted on DEMO. So, it is important that DEMO Professionals stay up to date about these new advancements. Most of the information about DEMO and related researches are accessible on the DEMO Knowledge Center website. Individuals can also stay up to date by reading new articles or books about DEMO. Staying up to date is related to accessibility of knowledge. Without having access to new information, people cannot stay updated about new advancements and changes in DEMO. On the other hand, if the person does not want to be up to date about DEMO, the information provided by different sources will not be useful.

Subjective Norm Subjective norm shows the opinion of the people who are "important" for the individual about DEMO. But, These people are not explicitly identified in the definition. We believe that the opinion of coworkers of a DEMO Professional about DEMO will be important for him and have an effect on his adoption. So, if an individual has DEMO Professionals around him which are applying DEMO or coworkers with positive point of view about DEMO, we expect to see that he is more interested in applying DEMO.

Career Consequences Career consequences has a very broad definition. Any thing that can have long term consequences for the career of a person can fit within this definition. If a person becomes stable in a specific position, there would be less uncertainty regarding to the future of his job. So, he will be more flexible in adopting a new innovation. But this relation should be investigated and proven.

Having to prove and measure many hypotheses, will make the online questionnaire too large. As a result, many respondents may leave the questionnaire and never get back to it. So, many complex factors cannot be assessed by an online questionnaire. For example, compatibility is a complex factor. To investigate the compatibility of a methodology, we need to have a complete understanding about each individual's past experience and values. Since we have no knowledge about the past experience of individuals, we have to ask a lot of questions from each individual to be able to measure such factors. As a result, the questionnaire will become too big and the respondent will have to spend a huge amount of time only to answer the questions about one factor. We should also be careful about the factors that are investigating the concepts that the respondent may not have any knowledge of. For example, if we ask a question about profitability of DEMO, many DEMO professionals may not be able to answer that question. Because, this type of information might only be available to limited number of individuals in an organization. So, it is important to remove these factors from our investigation.

Based on all we have said so far we made a selection of the factors that can influence adoption while at the same time making the questionnaire not too complex. We assessed the relation of these factors with the adoption by our online questionnaire. These factors are colored yellow in figure 4.1.

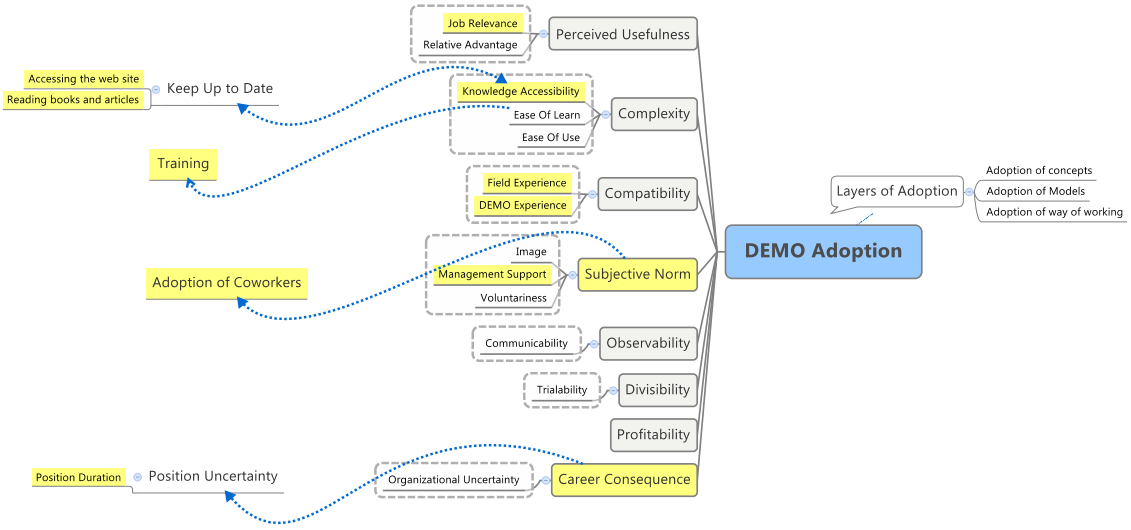


Figure 4.1: Variables that will be investigated

These variables became the basis for the questions we have asked from the individuals using the online questionnaire. The important variables, their definition and the type of variables are provided in table 4.3. The questions in the online questionnaire is presented in appendix A. In designing the questions we have tried to take the characteristics of good questions and different techniques to make good questions (which was explained by Floyd in [13, 14]) into account.

After performing our survey research, the collected data from this questionnaire should

be analyzed. We will use this data to asses and prove the relations between the identified variables and the adoption of DEMO. We will elaborate on this in our next chapter.

4.3 Summary

In this chapter we explained our approach to perform quantitative analysis to measure the variables that will be used to investigate the adoption of DEMO.

We explained that we need to perform a survey research for the purpose of this investigation. First we explained the definition and important components in the design of a survey research. These components are the population, sample of that population, the method of data gathering, the questions and variables behind these questions.

After that, we identified these important concepts in the design of our survey research on the adoption of DEMO. We defined the list of DEMO Professionals as the basis of our population. Based on our problem situation, we found out that the best method of data collection for our problem is an online questionnaire. The questions that are asked in this online questionnaire are based on several variables that we have selected in figure 4.1. These variables are derived from the factors that were identified in the previous chapter and made specific for DEMO and its adoption.

After the online questionnaire is performed. The data gathered from this questionnaire will be used to prove the relation between the identified variables and the adoption of DEMO.

Variable Name	Description	Type
Degree	What was your last educational degree?	Nominal
DegreeTime	How long ago did you get your last educational Degree?	Ordinal
CompanySize	How large is the company that you are/were working in?	Ordinal
Consultant	Which of the following describes your job well?(Consultant?)	Nominal
PositionDu	How long have you been in your current position?	Ordinal
DEMOProfDUCat	In what year did you participate in the DEMO Professional exam?	Ordinal
Training	Have you had training in DEMO?	Nominal
NoExcercise	Approximately how many exercises have you solved with DEMO before applying it in practice (e.g. cases in your work)?	Ordinal
Subjective Norm	How many of your coworkers are DEMO Professionals who are applying DEMO?	Ordinal
Management Familiarity	How familiar is the Management with DEMO?	Ordinal
ManagementSupport	In how many of the projects does management supports applying DEMO on projects?	Ordinal
GeneralAdoptionThesis	Did you apply DEMO (or part of DEMO or concepts of DEMO) in the thesis project of any of your previous educational studies?	Nominal
MethodologyExperience	Do you have experience with other methodologies?	Nominal
ReadingNewBooks Articles	Have you read any new books or articles about DEMO in the last 6 months?	Nominal
NoNewArticles	How many articles have you read about DEMO in the last 6 months?	Ordinal
VisitWebsite	How many times have you visited the DEMO knowledge Center website in the last 6 months?	Ordinal
StateModelAdoption	How frequently is the State Model used in the previously considered projects?	Ordinal
ConstructionModel Adoption	How frequently is the Construction Model used in the previously considered projects?	Ordinal
ProcessModelAdoption	How frequently is the Process model used in the previously considered projects?	Ordinal
ActionModelAdoption	How frequently is the Action Model used in the previously considered projects?	Ordinal
RecentpossibilityPortion	In how many of the projects that you have been working on in the last 6 months could DEMO (or part of DEMO or concepts of DEMO) have been applicable as a solution?	Ordinal
RecentAdoptionPortion	In how many of the projects that you have been working on in the last 6 months DEMO (or part of DEMO or concepts of DEMO) has been applied (or is planned to be applied) as a solution?	Ordinal
GeneralAdoption	Have you applied DEMO in your professional career?(The Adoption)	Ordinal

Table 4.3: Variables that are going to be investigated in the questionnaire

Chapter 5

Analyzing the Data

After performing the online questionnaire, the gathered data needs to be studied in order to find possible relations among variables. This process is called *data analysis*.

In this chapter we explain the data analysis process which was used in this research. This process starts form section 5.1, in which the validity of the sample for the whole population is investigated. Then in section 5.2, we will show the distribution of the adoption of DEMO among the individuals within the sample. After these two preliminary steps, our search to find relations among variables will start in section 5.2. In this section we try to find unexpected relations and hypotheses which were not identified in the model we provided in section 4.2. In section 5.4 we try to confirm the relations by using *Statistical data analysis methods*[11]. At the end of this chapter we will be able to specify the variables that can explain the adoption of DEMO.

5.1 Overview of the Sample

After inviting DEMO Professionals to participate in our online questionnaire (see chapter 4), we got 69 complete responses back (out of 211 DEMO Professionals). The distribution of the respondents with different occupation status can be found in figure 5.1.

The diagram shows that about 25% of the participants in the online questionnaire are students. These people do not have a full-time or part-time job and should be excluded from our research. As a result, the sample size will be reduced to 52 individual records.

5.1.1 Representing the Population

Most of the times the researchers are interested in discovering the characteristics of the whole population accurately by generalizing the characteristics of a sample of that population to the whole population[20]. Although we can never be sure that a sample is a representative of this population, *'the random samples are more likely to represent the population'* [20].

As opposed to random sampling, the sample of DEMO Professional ,which is provided here, is a voluntary sample (the participants volunteered to answer our questions) [13]. This type of sampling can be biased towards the individuals who have strong positive or

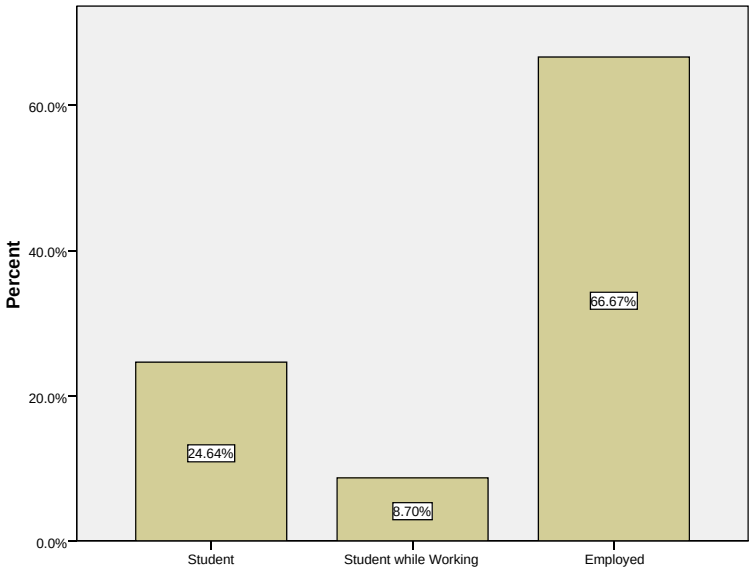


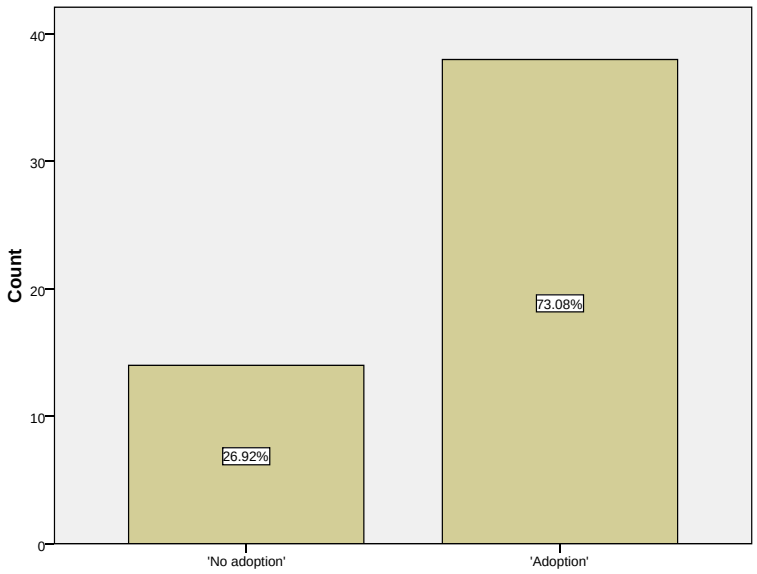
Figure 5.1: Sample's Occupation Status

negative opinion about a phenomena. Compared to random samples, there is less chance that voluntary sample represent the population. But, our sample represents 32% of the DEMO Professional population (more than one quarter of the whole population), Which is still a noticeable amount. Moreover, the conclusions made for this sample can still explain the behavior of a large number of individuals within the population. So, even though this type of sample can not represent the population, this research can still be useful as a pilot study that indicates the way variables are connected and related to each other [13].

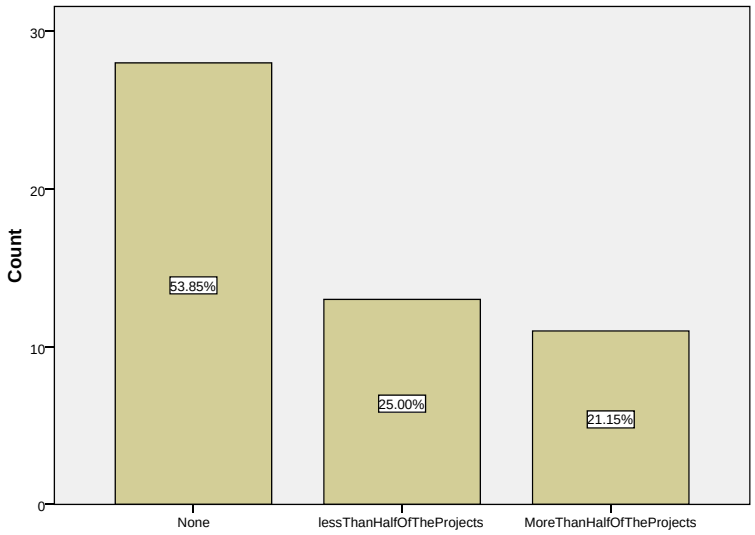
5.2 Preliminary Exploration

The sample dataset indicates that a large number of participants in the questionnaire applied DEMO in practice at least once. Figure 5.2a shows that about 73% of 52 records of the sample dataset applied DEMO in at least one real life project (General Adoption). The remaining 27% of these participants have never applied DEMO in their professional career. Non adoption increases when we ask the participants about their adoption behavior in the last 6 months (Recent Adoption). Around 54% of the participants have not used DEMO in the last 6 months (see figure 5.2b). This means that around 27% of people who have applied DEMO in practice before, did not used this methodology in the last 6 months.

Figure 5.3 shows the number of DEMO Professionals who applied certain models in practice in the past 6 months. The green bars show the number of individuals who applied a certain model. Based on this figure the popularity of the Construction Model(see figure 5.3a) and the Process Model (see figure 5.3b) is more than twice as much as the popularity of the Action Model(see figure 5.3c) and the State Model (see figure 5.3d). The motivation of people behind applying a certain model more than the others will be investigated in chapter



(a) General Adoption among DEMO Professionals



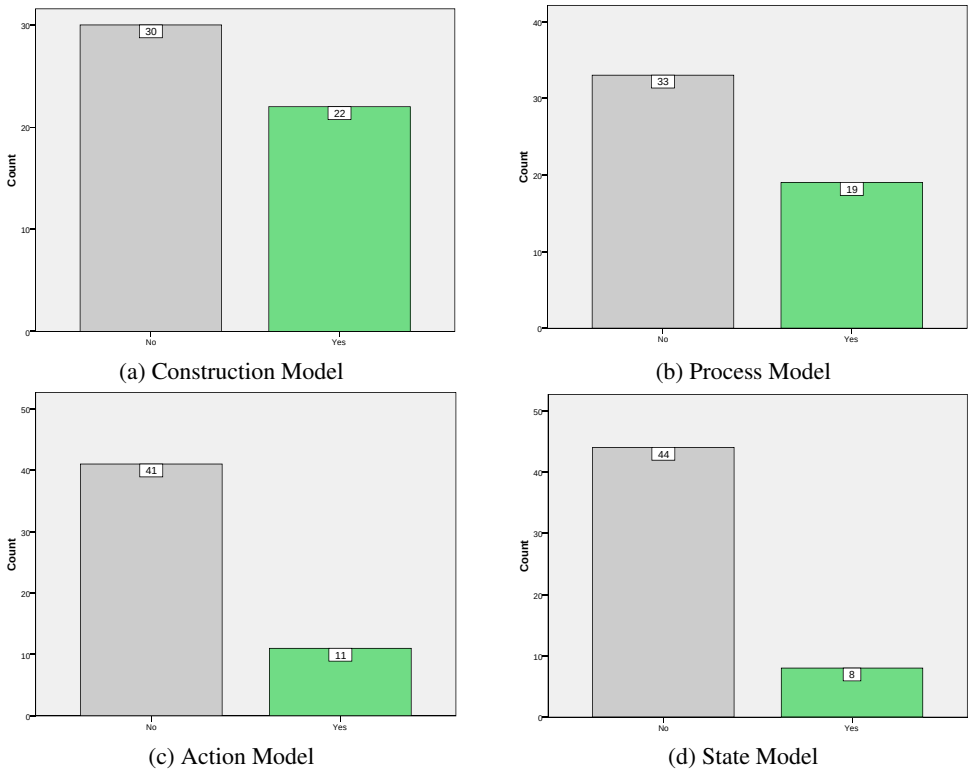
(b) Recent Adoption among DEMO Professionals

Figure 5.2: Adoption Among DEMO Professionals

6 through qualitative analysis.

5.3 Pattern Recognition

Before proving the relations among the variables that were identified in chapter 4, we have to check the data for any *unanticipated relations* or *patterns* among the variables. Exploring the data may show the emergence of non-random patterns and structures in dataset which



(a) Construction Model

(b) Process Model

(c) Action Model

(d) State Model

Figure 5.3: Adoption of different Models of DEMO among DEMO Professionals

we have not taken into account. These patterns are discovered by using *data mining methods* [11].

Data mining methods are categorized based on the type of patterns they discover in the dataset. Some methods represent patterns as black-boxes (e.g. neural networks). These methods do not represent the structure of the patterns instead for every new record of data (individual), they can predict the value of the dependent variable of that record based on the values of its independent variables. In contrast, other data mining methods show the construction and the structure of patterns and relation among different variables (white-box) [42, Chapter 1]. The patterns that are produced by the latter type of data mining methods are called *structural* patterns.

In our investigation we are interested to see the actual relation between independent variables and the adoption of DEMO. Therefore, we have to use a data mining method that provides structural patterns. The structural patterns are typically expressed by decision trees or as a set of classification or association rules [42, Chapter 1]. Decision trees have the ability to simplify the relation between different variables with a good graphical representation in a concise manner. This graphical representation of the patterns and the simplicity of the relations makes the decision tree a good candidate for our situation.

5.3.1 Setting up the Decision Tree

The decision tree is valid if it can be used to predict the results of new records of data. To perform this validation, the dataset should be divided into a *training set* (based on which the tree is produced) and a *test set* (which will be used for evaluating the results). While it is possible to use only one dataset as both test and training set, the results of the evaluation of tree will become highly optimistic [42].

Cross-validation is a statistical technique commonly used for evaluating decision trees. This technique divides the dataset into equal parts. Then an iterative process, that reserves one part for validation and uses the rest for training and constructing the tree is used. An *n-fold cross-validation* is a cross-validation that divides the dataset into *n* parts. This method makes sure that the samples of dataset which are taken as training and test set are representatives of the dataset [42, see Chapter 5]. Because of its special technique in training and evaluating the decision trees, cross-validation is very useful for validating small datasets (like our dataset).

For every dependent variable, we have to construct a decision tree. *Weka machine learning* workbench[1] is one the tools that has the ability to build decision trees automatically. Taking specified cross validation into account, WEKA reports statistics which can show the ability of the tree to explain the test set correctly[42].

What follows shows the decision trees produced for our two dependent variables General Adoption and Recent Adoption with 10-fold cross-validation using WEKA.

A Decision Tree for General Adoption

Figure 5.4 shows the decision tree which was produced for General Adoption. The top node of the tree is the *PositionDu* variable. PositionDu is an ordinal variable with five categories which shows the amount of time an individual stayed in his current position.

The selection of PositionDu as the highest node of the tree shows that at least one of the categories of this variable could classify the records of the training set most appropriately. This means that the most number of the records with the same PositionDu value as the aforementioned categories have the same adoption behavior. A category that only includes the records with the same value as the dependent variable is called a pure or leaf node [42, chapter 4]. If a node is not pure other independent variables should be included in the tree in a recursive process until we reach pure nodes.

A tree can be interpreted as a set of rules. These rules can be a single rule or a combination of multiple rules. For example, the first line of our tree shows that *if the PositionDu of a record equals to 'Less than 6 months' then the General Adoption of that record will be 'No Adoption'*. The number in the parenthesis shows the number of records in the dataset which have the specifications of the rule ($PositionDu =$ *'less Than 6 months'*) to the number of records in the dataset which have the specifications of this rule but result in an incorrect outcome ($GeneralAdoption =$ *'Adoption'*). The number $(5.0/1.0)$ in the first line of the tree means that 5 records belong to this category out of which one is predicted incorrectly. In other word, there is one record which belongs to this category but the individual represented

[1] http://www.cs.waikato.ac.nz/ ml/weka/index.html

```
PositionDu = Less than 6 months: No adoption (5.0/1.0)
PositionDu = Between 6 months and 1 year: Adoption (4.0/1.0)
PositionDu = Between 1 year and 2 years
|   CompanySize = Less than 10 employees: Adoption (2.0)
|   CompanySize = 10 - 99 employees: No adoption (0.0)
|   CompanySize = 100 - 500 employees: No adoption (0.0)
|   CompanySize = 500 or more employees: No adoption (4.0/1.0)
PositionDu = Between 2 years and 3 years
|   NoExcercise = Less than 5 exercises: No adoption (5.0/1.0)
|   NoExcercise = Between 5-10 exercises: Adoption (4.0)
|   NoExcercise = More than 10 exercises: Adoption (3.0)
PositionDu = More than 3 years: Adoption (25.0/2.0)

Number of Leaves  :     10

Size of the tree :      13


Time taken to build model: 0.02 seconds
```

Figure 5.4: Produced Decision Tree for General Adoption

by this record has (at least once) adopted DEMO. The third and forth line in figure 5.4 can be interpreted with a complex rule. This rule is perceived as: *If the PositionDu of a record equals to 'Between 1 year and 2 years' and the CompanySize the individual works in has 'Less than 10 employees' then the individual has adopted DEMO [42, see chapter 10].*

The decsion tree of General Adoption does not provide a structured pattern for the adoption behavior. It shows that if the positionDu is more than 3 years we have adoption and if it is less than 6 months, individuals will not adopt DEMO. When the individual has position duration between 2 to 3 years, his adoption is related to the number of exercises he solved using DEMO. The more exercises means the more adoption. This tree also shows a relation between General Adoption and Company Size if a person is in his current position between 1 to 2 years period. This data can provide information about our target groups. But it seems that many factors were left out of the equation. Moreover, although the factor PositionDu is an ordinal variables, we do not see the effect of this order on the adoption behavior (More time on one position is not always equal to 'Adoption' or vise versa).

This pattern may be the result of the actual representation of the dataset or may show a problem. Figure 5.5 is the report produced by Weka about the accuracy and the correctness of the predictions of this classification.

Based on this report decision tree can only classify 67% of the records in the cross-validation correctly (see 5.3.1). To see if the model is valid we have to check whether this model predicts patterns in the dataset better than a random predictor. *Kappa statistics* measures the extra success a model has in comparison with a random model [42, chapter 5]. Kappa statistics of the decision tree for General Adoption is 6% which shows that decision tree is not very different from a random predictor. So, the model can not be perceived as valid.

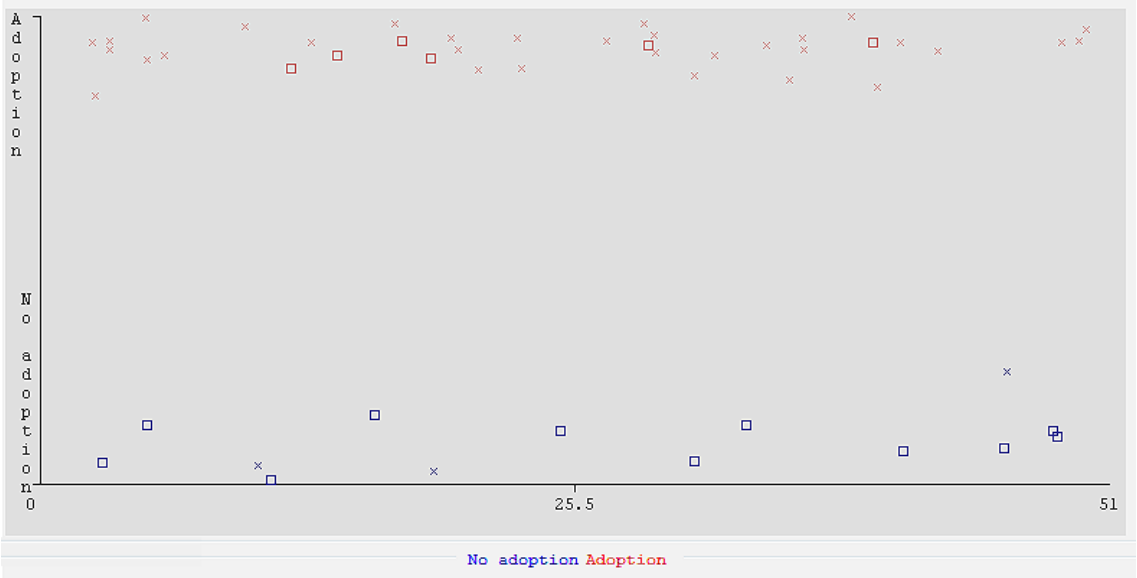
For more clarification the distribution of General Adoption of DEMO (taking the cross-

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances          35               67.3077 %
Incorrectly Classified Instances        17               32.6923 %
Kappa statistic                          0.0636
Mean absolute error                      0.4138
Root mean squared error                  0.5367
Relative absolute error                103.6606 %
Root relative squared error            120.5047 %
Total Number of Instances               52

=== Detailed Accuracy By Class ===

TP Rate   FP Rate   Precision   Recall  F-Measure   Class
  0.214     0.158      0.333     0.214     0.261    No adoption
  0.842     0.786      0.744     0.842     0.79     Adoption

=== Confusion Matrix ===

  a  b   <-- classified as
  3 11 |  a = No adoption
  6 32 |  b = Adoption
```

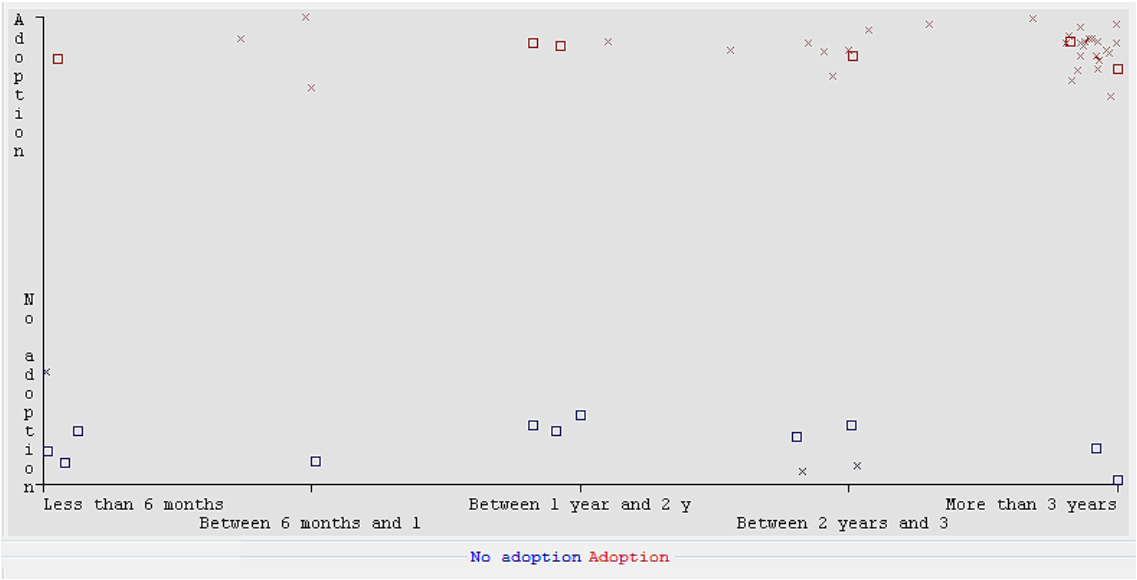
Figure 5.5: The accuracy of produced Decision Tree for General Adoption

validation into account) is shown in figure5.6. The Red points shows the records with value Adoption for the General Adoption variable and the blue points show the records with no adoption. Points with 'X' marks are the records of cross-validation which can be explained by the decision tree and the square points are the ones that are not explained by the decision tree. Figure 5.6a shows the distribution of General Adoption of DEMO. This figure is the visualization of the *confusion matrix* in figure 5.5 which shows how the incorrect classifications are distributed. Based on this distribution, it is apparent that most of the 'No Adoption' records are not taken into account by the decision tree. Figure 5.6b shows the distribution of General Adoption records based on the categories of PositionDu they have. Position Du is the highest node in the produced decision tree and the first category based on which the data is split. As we can see in the figure the number of records in the first four categories of positionDu variable is very low in comparison to the last category. This low number can influence the selection procedure in a decision tree. For example the first category of positionDu is 'less than 6 months' which has 4 records of no adoption and one record of adoption. Based on the decision tree algorithm this category is providing a good split because only one of the records will not be predicted correctly. But actually nothing can be concluded in this category since the number of records in the category is so small that a change in one or two records can reverse the outcome completely.

The strange representation of the decision tree (only two variables were involved and some categories are empty) and its very low Kappa statistics measure raise the question of whether the decision tree was a good method for exploring our dataset. Figure 5.2a shows that the Adoption rate of General Adoption is twice as high as No Adoption rate. Having a dataset of 52 records, the number of individuals who did not adopt DEMO is very small and it is very hard to find any pattern that can take 'No Adoption' into account. Moreover,



(a) General Adoption Distribution within the population



(b) General Adoption distribution based on PositionDu

Figure 5.6: General Adoption distribution

the low number of records in the dataset also increases the chance of having categories with very small or empty records which can increase the chance of misclassification as the effect of outliers increases. Later in this chapter we will try to find and explain the patterns with statistical methods.

A Decision Tree for Recent Adoption

Figure 5.7 shows the decision tree which was produced for the Recent Adoption of DEMO. Based on this decision tree, if DEMO is not applicable to the projects of an individual (*RecentpossibilityPortion*), he will not adopt this methodology. But if DEMO is applicable in less than half of the projects, its adoption is dependent on the Management Support. If the Management Supports DEMO it will be adopted but if the management does not support DEMO the methodology will not be adopted. When DEMO is applicable in more than half of the projects, the application is dependent on several factors. In this situation if the DEMO professional is up to date about the latest information or changes in DEMO (*ReadingNewBooksArticles*) and the Management Supports its application, the individual will apply DEMO. If the Professional is not up to date and he has some knowledge about other methodologies he will not apply DEMO (and apply the other methodologies instead).

```
RecentpossibilityPortion = None: None (5.0)
RecentpossibilityPortion = lessThanHalfOfTheProjects
|   ManagementSupport = noSupport: None (4.0)
|   ManagementSupport = supportLessThanHalf: lessThanHalfOfTheProjects
(6.0)
|   ManagementSupport = supportMoreThanHalf: lessThanHalfOfTheProjects
(1.0)
RecentpossibilityPortion = MoreThanHalfOfTheProjects
|   ReadingNewBooksArticles = Yes
|   |   ManagementSupport = noSupport: None (6.0/1.0)
|   |   ManagementSupport = supportLessThanHalf
|   |   |   Training = Yes(aTrainingWorkshop): None (5.0/2.0)
|   |   |   Training = Yes(aStudyCourse): lessThanHalfOfTheProjects
(3.0/1.0)
|   |   |   Training = No(accessToProfessionals): None (1.0)
|   |   |   Training = No(NoTrainingNOConsultancy): None (0.0)
|   |   ManagementSupport = supportMoreThanHalf:
MoreThanHalfOfTheProjects (6.0)
|   ReadingNewBooksArticles = No
|   |   MethodologyExperience = Yes: None (13.0/3.0)
|   |   MethodologyExperience = No: lessThanHalfOfTheProjects (2.0/1.0)

Number of Leaves  :     12

Size of the tree :      18
```

Figure 5.7: Produced Decision Tree for Recent Adoption

The decision tree provided for Recent Adoption predicts 73% of the records in cross-validation correctly (see figure 5.8). Kappa statistics of this decision tree is 51% higher than a tree made from a random predictor.

This result is much higher than the results produced for General Adoption. But still some issues need more attention. First, like the tree produced for General Adoption some of the leaf nodes represent small (or zero) records of data. So, the predictions the tree makes for that categories are not supported by any records of the dataset. Second, the wrong predictions in the confusion matrix are much higher for categories which represent 'Adoption' in comparison to the 'No Adoption' category. In other words, The tree presents better predictions for 'No Adoption' in comparison to 'Adoption'.

Although decision trees have the ability to visualize and categorize the dataset based on the effects of independent variables on a dependent variable, they are highly affected by the

```
=== Stratified cross-validation ===
=== Summary ===

Correctly Classified Instances          38               73.0769 %
Incorrectly Classified Instances        14               26.9231 %
Kappa statistic                          0.5166
Mean absolute error                      0.2387
Root mean squared error                  0.3835
Relative absolute error                 58.8574 %
Root relative squared error             85.2942 %
Total Number of Instances               52

=== Detailed Accuracy By Class ===

TP Rate   FP Rate   Precision   Recall  F-Measure   Class
  0.929     0.417      0.722     0.929     0.813    None
  0.462     0.026      0.857     0.462     0.6
lessThanHalfOfTheProjects
  0.545     0.073      0.667     0.545     0.6
MoreThanHalfOfTheProjects

=== Confusion Matrix ===

  a  b  c   <-- classified as
 26  0  2 |  a = None
  6  6  1 |  b = lessThanHalfOfTheProjects
  4  1  6 |  c = MoreThanHalfOfTheProjects
```

Figure 5.8: The accuracy of produced Decision Tree for Recent Adoption

size of the dataset. Based on what have been seen in data mining sources the datasets used for decision trees contain a large number of records, while our dataset only has 52 records. Due to algorithm of the decision tree which classifies dataset into certain categories, a small dataset can magnify the effect of noises on the final results. It seems rather important to try out other methods and see if the outcome will improve.

5.4 Testing the Hypotheses with Statistical Methods

Statistical data analysis techniques are well-known branch of data analysis[19, 42]. The methods presented in this branch of data analysis are used to prove hypothesized relations between a dependent variable and independent variables. These methods are known to be mathematically sound and well-founded.

Many methods have been introduced under the name of statistical analysis. A few number of which are appropriate for categorical variables. We have used a number of these methods to analyze our dataset. To perform our analysis we have a process which is represented in figure 5.9. In this process we have used three statistical data analysis techniques to make sure that the results are reliable. These tests are the *Test of Dependency, Test of Magnitude of Relation* and *Linear regression* which will be explained respectively.

Test of Dependency This test can indicate the existence of a dependency between the (General or Recent) Adoption of DEMO and independent variables. One of the simplest and most well-known methods used for this purpose is *Cross-tabulation*. This

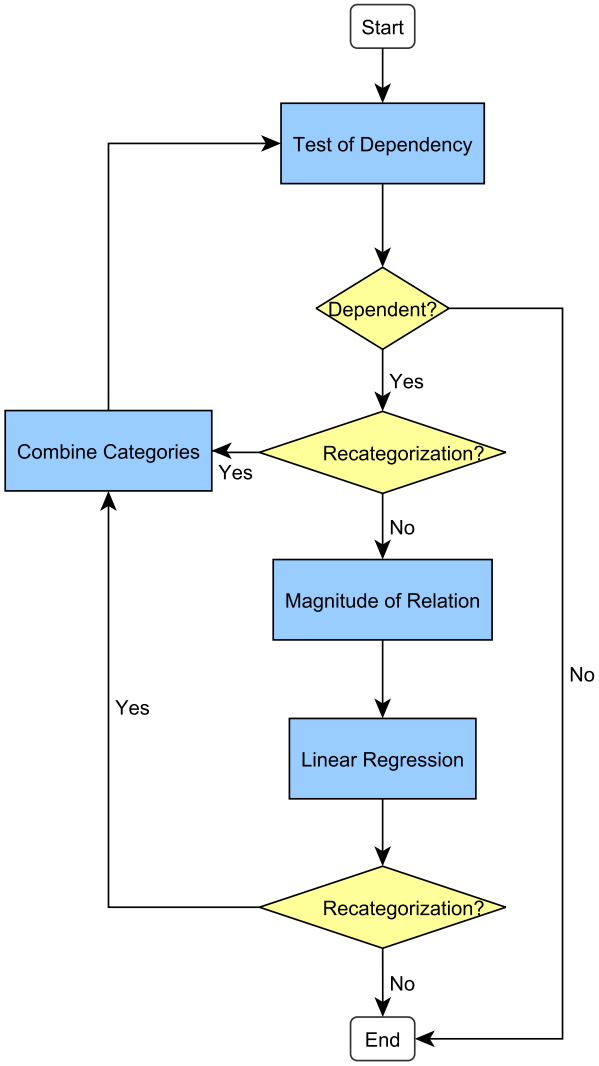


Figure 5.9: Statistical Data analysis Process

method represent the dataset as a table in which the rows represent the categories of the independent variable(s) and the columns represent the categories of the dependent variable. Each Record of the dataset belongs to one cell of this table based on its values for the dependent and the independent variables [20, chapter 10].

X^2*(chi-square)* is a measure mostly used with cross-tabs to uncover a certain correlation or association among the variables which did not happen by chance [16]. In other words, this measure which shows the departure of the frequencies obtained in the cross-tab from the frequency expected by chance[20, chapter 10].

Chi-square is sensitive to the number of cells that have expected values less than 5 records. If a lot of cells have expected value less than 5 then the categories of variables

should be combined in a way that it decreases the number of cells with low expected number of records [16]. This step in our process is called 'Combine Categories' (see figure 5.9).

Magnitude of Relation Chi-square only shows a correlation or association between different variables. We can calculate the degree of these associations with at least one of the three measures known as *Cramers V*, *lambda* λ *coefficient* and *Somer's d*. Each of these methods are appropriate for specific type of variables. Somer's d shows the magnitude of correlation between two ordinal variables while taking the direction of correlation into account. This measure is used in the examination of the Recent Adoption variable. The lambda λ coefficient does the same thing for nominal variables [16]. For nominal variables Cramers V is also a good index. This index ranges from 0 to 1 (0 for no association and 1 for perfect association)[20, chapter 10]. Since the General Adoption variable is by nature a nominal variable, we calculate both of these indexes and then choose the appropriate one.

Linear Regression Statistical data analysis methods also provide methods to predict (and explain) the value of a dependent variable based on other variables. One of the most well-known methods for this purpose is *linear regression*. In linear regression *"the expected value of the outcome is modeled as a linear function of the predictor"* [39].*Logistic regression* is an abbreviation of linear regression which is used for dependent categorical variables.

Binary logistic regression is used for dichotomous variables (like General Adoption) and can be described by the following equation [21, chapter 1].

$$\begin{aligned} &logitP(D=1|X) = \ln\left[\frac{P(D=1|X)}{1-P(D=1|X)}\right] = \alpha + \sum \beta_i X_i \\ &where \\ &P(X) = \frac{1}{1+e^{-(\alpha+\sum \beta_i X_i)}} and D = 0,1. \end{aligned} \tag{5.1}$$

The $logitP(X)$ described by equation 5.1 shows the log of the *odds* of occurrence for the dichotomous dependent variable (i.e $GeneralAdoption = $ *'Adoption'*), for a record taking a set (X) of independent variables in to account. These individual variables are specified by X_i in the equation. β_i shows the correlation of the X_ith independent variable with the log of odds that a dependent variable occurs. Alpha α which is known as the *baseline odds* shows the log of odds for the occurrence of dependent variable without taking any of independent variables into account. Notice that *Odds is the ration of probability of occurrence of an event (*$P(X)$*) over the probability that the event will not occur (*$1-P(X)$*)* [21].

The Logistic Model is not appropriate for ordinal dependent variables (like Recent Adoption). Logistic regression ignores the order of values of a variable and look at them as nominal categorical variables. *Ordinal regression* is an extension of logistic model which takes the order of ordinal variables into account by calculating the probabilities differently. In this model the probability of an event is calculated based on

	General Adoption	Recent Adoption
Test of Dependency	Cross tabulation and Chi-Square	Cross tabulation and Chi-Square
Magnitude of Relation	Lambda (λ) coefficient and Cramer's V	Somer's d
Linear Regression	Logistic Regression	Ordinal Linear Regression

Table 5.1: General Adoption and Recent Adoption methods in data analysis process

the probability of the event and all the events that are ordered before that event [25, chapter 4]. This models is represented in equation 5.2.

$$\begin{aligned} &\textit{Cumulative logit } P(D \leq g|X) = \ln\left[\frac{P(D \leq g|X)}{1-P(D \leq g|X)}\right] = \alpha_g - \sum \beta_i X_i \\ &\textit{where} \\ &g = 1,2,3,...,G-1 \\ &D = 1,2,...,G. \end{aligned} \tag{5.2}$$

Equation 5.2 represents the odds that the value of the dependent variable D (with 1 to G categories) becomes a category which is equal to g or has lower values than g, based on the independent variables in X. The value of α is dependent on the category (g) we are investigating which means the odds of occurrence for a category (without taking into account the dependent variables) is different for each category [21].

As mentioned before we have used the process depicted in figure 5.9 and applied the most appropriate technique to each dependent variable. The appropriate techniques for each type of independent variable are summarized in table 5.1. We have performed these tests with SPSS software (version 16.0) [2] and using the instructions provided by Kleinbaum et al. [21]. The tests and the results of our data analysis are provided in appendix B.

5.4.1 Recent Adoption Dependencies

Recent Adoption represents the number of projects in which the individual applied DEMO in comparison to the total projects an individual worked on in the last 6 months. In this section we show how we calculate the dependency of Recent Adoption to other variables. We chose the relation between *Recent Adoption* as a dependent variable and *Management Support* as an independent variable as an example. Notice that since 'Recent Adoption' is an ordinal variable, in each step we use the techniques that are useful for ordinal variables.

Test of Dependency

As the first step we need to see if the variables have any relation with each other. Figure 5.10 is the cross-tab between Recent Adoption and Management Support.

[2] http://www.spss.com/statistics/

			Recent Adoption			
			None	lessThanHalfOfTheProjects	MoreThanHalfOfTheProjects	Total
Management Support	noSupport	Count	20	3	2	25
		% within Support of management in applying DEMO on projects	80.0%	12.0%	8.0%	100.0%
	supportLessThanHalf	Count	6	9	3	18
		% within Support of management in applying DEMO on projects	33.3%	50.0%	16.7%	100.0%
	supportMoreThanHalf	Count	2	1	6	9
		% within Support of management in applying DEMO on projects	22.2%	11.1%	66.7%	100.0%
	Total	Count	28	13	11	52
		% within Support of management in applying DEMO on projects	53.8%	25.0%	21.2%	100.0%

Figure 5.10: Cross tabulation for Recent Adoption and Management Support

Each cell in this table shows the number of records in the data set which has a certain value for dependent and independent variable under study. For example, Based on this cross-tab 20 records of our dataset were individuals who did not adopt DEMO and the management in their company did not support applying DEMO ('None' versus 'No Support'). The ratio in this cell shows that about 80% of people whom their managers did not support applying DEMO, did not adopt DEMO in the last 6 months. Compared to the ratio of other records which did not adopt DEMO recently but their Management Supported applying DEMO (33% and 22%), this cell has the highest ratio which shows a direct relation between not adopting DEMO and no Support from the management. This trend continues in other values of Management Support as well. This shows an incremental relation between DEMO's Recent Adoption and Management Support. But is this relation random?

Chi-Square determines how probable it is that the results of this observation were occurred by chance by calculating the *level of significance*[20, chapter 10]. For example, significant level of .05 shows that at least in 95% of the observations, the results did not occur by chance [20]. The chi-square measure for the relation between Recent Adoption and Management Support can be found in figure 5.11. The significance level of this relation is .000. Meaning that it is highly improbable that the relation is between two variables has happened by chance.

Among different scholars, an acceptable significant level has a range between 0.1 ($\leq$ 0.1) to 0.05 ($\leq$ 0.05) [20]. To be able to comply with all different ranges of significance level in the literature in this research we report all the independent variables which had a relation with one of the dependent variables with significant level of 0.1 ($\leq$ 0.1).

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	24.168[a]	4	.000
Likelihood Ratio	21.446	4	.000
Linear-by-Linear Association	14.749	1	.000
N of Valid Cases	52		

a. 5 cells (55.6%) have expected count less than 5. The minimum expected count is 1.90.

Figure 5.11: Chi-square and phi coefficient for Recent Adoption and Management Support relation

Magnitude of Relation

When investigating the magnitude of a relation among two ordinal variables Somer's d measurement can be used. In Somer's d both the order of the variables and the direction of dependency is taken into account. Somer's d simply calculates and reports the magnitude of the relation among variables with the assumption that any of the variables in the relation can be the dependent variable. As you can see in figure 5.12 somer's d reports two records one for the hypothesis that Management Support is dependent on Recent Adoption and the other one for the hypothesis that Recent Adoption is dependent on Management Support. We are interested in the later hypothesis which is highlighted yellow in figure 5.12. the Somer's d measure for the relation between Recent Adoption and Management Support when Recent Adoption is the dependent variable is .497 with the standard error of .115 and significant level of .000. This shows that two variables have a moderate positive significant relation with each other.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.504	.115	4.198	.000
		Management Support Dependent	.510	.117	4.198	.000
		Recent Adoption Dependent	.497	.115	4.198	.000

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Figure 5.12: somer's d for Recent Adoption and Management Support relation

Linear Regression

Since our dependent variable (Recent Adoption) is an ordinal variable, an ordinal regression model is the most appropriate model to calculate its correlation with other variables.

Before we start calculating the regression coefficients, we try to visualize this relation with a cumulative percentage plot. What you see in plot 5.13 is the cumulative percentages for Recent Adoption with different curves for different Management Support categories.

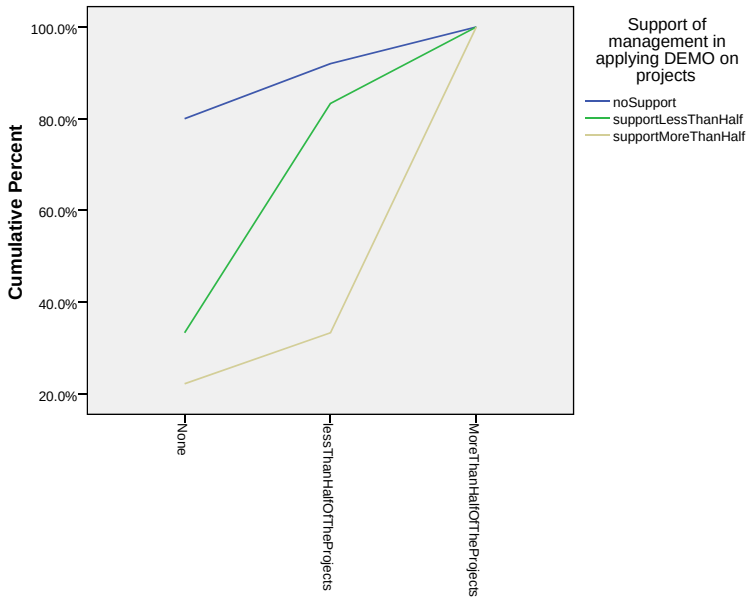


Figure 5.13: Plot of cumulative percentages for Recent Adoption

The plot clearly shows an incremental relation between Recent Adoption and Management Support. Based on this plot the number of records with 'No Management Support' which have a 'No Adoption' value is higher than the ones which have some sort of support from management. As the Recent Adoption increases the difference between the curves decreases. This phenomenon shows that records with higher Management Support posses higher values for Recent Adoption. Since the percentage of records with 'No Adoption' and 'No Management Support' is much higher than the other categories of Management Support (see figure 5.10), the cumulative percentage of other Management Support categories never gets higher than the cumulative percentage of 'No Support'. Based on this plot we expect to see a positive coefficient for Management Support.

Now we will start calculating the ordinal regression model[3]. To perform an ordinal regression we have to find the α and β parameters in equation 5.2. In this example, set X only has one independent variable (Management Support) and consequently one β. The calculated α and β can be found in figure 5.14.

In the table presented in figure 5.14 the *'thresholds'* are α values and *'Location'* shows the β coefficient which is 1.71 (Location is highlighted yellow). Based on this table the correlation between Recent Adoption and Management Support is highly significant (with

[3]SPSS software uses equation 5.2 to calculate the ordinal regression. So, We used this software for our calculations.

Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	[RecentAdoptionPortion = 1.00]	3.036	.812	13.982	1	.000	1.445	4.627
	[RecentAdoptionPortion = 2.00]	4.596	.969	22.485	1	.000	2.696	6.495
Location	ManagementSupport	1.713	.436	15.462	1	.000	.859	2.567

Link function: Logit.

Figure 5.14: estimates of parameters for relation between Recent Adoption and Management Support

.000). So, we can interpret that by increasing the support of management the odds that a person adopts DEMO more will increase.

Cell Information

Frequency

		Recent Adoption		
Support of management in applying DEMO on projects		None	lessThanHalfOfTheProjects	MoreThanHalfOfTheProjects
noSupport	Observed	20	3	2
	Expected	19.740	3.934	1.326
	Pearson Residual	.127	-.513	.602
supportLessThanHalf	Observed	6	9	3
	Expected	7.263	6.470	4.267
	Pearson Residual	-.607	1.243	-.702
supportMoreThanHalf	Observed	2	1	6
	Expected	.978	2.326	5.696
	Pearson Residual	1.094	-1.010	.210

Link function: Logit.

Figure 5.15: expected and observed relation between Recent Adoption and Management Support

In figure 5.15, we can see how well our model can explain the behavior depicted by our records of data. The observed value is the same as what we have seen in figure 5.10 but the expected value is calculated based on cumulative probabilities of each cell and the coefficients in figure 5.14. The *Pearson Residual* shows the difference between the observed and expected values. Based on observed and expected frequencies, the *Goodness-of-Fit Measure* (figure 5.16) calculates a significant level. If the observed and expected counts are similar then the significant level will be high showing that the model fits well with the dataset.

In conclusion, our different tests shows that there is a significant positive relation between Recent Adoption and Management Support. This means that in a hypothetical situation in which all the influencing factors stay unchanged, an increase in the support of

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	3.993	3	.262
Deviance	3.873	3	.275

Link function: Logit.

Figure 5.16: goodness of fit of the model

Explanatory variable	**Chi-square** (Significant level)	**Somer's d**	**Ordinal Regression** (β)	**Problems**
CompanySize	0.065	Not Sig.	Not sig.	empty cells
DegreeTime	0.01	Not Sig.	Not sig.	empty cells
ReadingNewBooksArticles	0.057	0.296 (0.02 Sig.)	1.118 (0.05 Sig.)	
NoNewArticles	0.045	Not Sig.	Not sig.	empty cells
RecentpossibilityPortion	0.003	Not Sig.	Not sig.	empty cells
Subjective Norm	0.09	0.258 (0.08 Sig.)	0.797 (0.05 Sig.)	empty cells
Consultant	0.097	Not Sig.	Not sig.	empty cells
ManagementSupport	0.0005	0.497 (0.0005 Sig.)	1.713 (0.0005 Sig.)	

Table 5.2: The factors explaining Recent Adoption

the management will lead to an increase in the adoption rate of the individuals within the organization.

Other Related Variables

As mentioned before we have only provided an example of our analysis for the Recent Adoption and Management Support in the previous subsection. The Chi-square test, somer's d and regression analysis of the variables which had significant relation with Recent Adoption can be found in appendix B. Apart from Management Support, six other variables were found to have a significant chi-square relation with Recent Adoption. Out of which only ReadingNewBooksArticles and ManagementSupport were found to influence the Recent Adoption variable. The relation of other four variables (RecentPossibilityPortion , No.Newbooks, DegreeTime and CompanySize) with Recent Adoption is inconclusive due to non significance (see the results in table 5.2) or other problems with the sample.

After calculating a one to one regression, we should see if it is possible to put all the explanatory independent variables together in one formula. This approach can also show if the relation detected in the one to one regression models was correct or if it was caused by other variables [39]. But this calculation did not reveal any significant association. This problem was caused due to an increase in the number of empty cells in the calculation. This problem will be addressed later in section 5.4.3.

5.4.2 General Adoption Dependencies

General Adoption is a dichotomous variable and many of the methods used for Recent Adoption are not applicable for this variable. Recall that general adoption shows if the individual at least once applied DEMO in the projects he worked on. In this part we will shortly explain the data analysis process which was used to find the dependencies between General Adoption and the independent variables. We use the relation between General Adoption and ReadingNewBooksArticles as an example.

Test of Dependency

Figure 5.17 which shows the cross-tab and chi-square test between General Adoption and ReadingNewBooksArticles. Itshows a significant relation (0.033) between General Adoption and ReadingNewBooksArticles. The cross-tabular also shows a relation between these two variables. We can clearly see that about 83% of individuals who have been reading new books and articles about DEMO recently have adopted DEMO and although the percentage of individual records who are adopting DEMO is higher for both categories of ReadingNewBooksArticles, the gap between 'Adoption' and 'No Adoption' is decreased when ReadingNewBooksArticles was equal to 'No'. The cumulative percentage plot in figure 5.18 also confirms this reduction.

ReadingNewBooksArticles * General Adoption Crosstabulation

			General Adoption		
			'No adoption'	'Adoption'	Total
ReadingNewBooks Articles	Yes	Count	5	26	31
		% within ReadingNewBooks Articles	16.1%	83.9%	100.0%
	No	Count	9	12	21
		% within ReadingNewBooks Articles	42.9%	57.1%	100.0%
	Total	Count	14	38	52
		% within ReadingNewBooks Articles	26.9%	73.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.546[a]	1	.033		
Continuity Correction[b]	3.289	1	.070		
Likelihood Ratio	4.505	1	.034		
Fisher's Exact Test				.055	.035
Linear-by-Linear Association	4.458	1	.035		
N of Valid Cases	52				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.65.

b. Computed only for a 2x2 table

Figure 5.17: Cross tabulation and chi-square test for General Adoption and ReadingNewBooksArticles

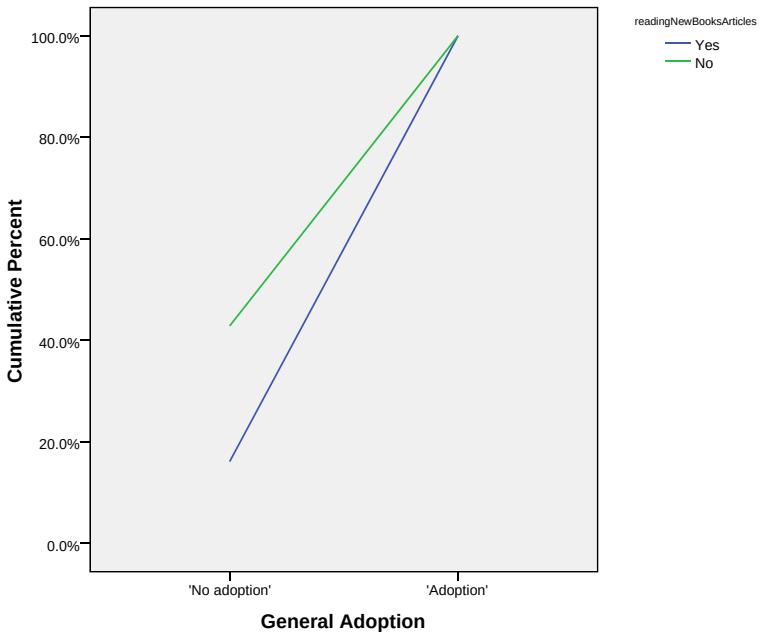


Figure 5.18: Plot of cumulative percentages for General Adoption

Magnitude of Relation

To calculate the magnitude of relation between General Adoption and ReadingNewBooksArticles, lambda (λ) is our first choice. Apart from the ability to distinguish between dependent and independent variables, this measure is well suited for nominal variables. But this measure has the problem of understating the relation among variables. For example, the lambda coefficient presented in figure 5.19 is zero while based on the data in cross-tabulation there is a relation between the variables under study. Since the majority of individuals in both categories of ReadingNewBooksArticles have adopted DEMO, the lambda coefficient perceives that this variable cannot explain General Adoption. While as we saw in the previous section even though the majority in both categories are adopting DEMO, the gap between adoption and non adoption is much smaller for the group of individuals who did not read books or articles about DEMO recently.

An alternative to the lambda coefficient is *cramer's V*. This measure does not specify the dependent variable and only shows a coefficient between 0 to 1. Based on this measure General Adoption and ReadingNewBooksArticles have a significant relation with each other with the value of .296. This value shows a relation of low strength between these two variables.

Linear Regression

Logistic Regression is the best candidate to measure the dependency of General Adoption to the independent variables. Based on equation 5.1, logistic regression calculates the log of odds that an individual adopts DEMO. For doing so the logistic regression function of SPSS

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.114	.098	1.081	.280
		ReadingNewBooksArticles Dependent	.190	.160	1.081	.280
		General Adoption Dependent	.000	.000	.[c]	.[c]
	Goodman and Kruskal tau	ReadingNewBooksArticles Dependent	.087	.079		.035[d]
		General Adoption Dependent	.087	.080		.035[d]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	-.296	.033
	Cramer's V	.296	.033
	N of Valid Cases	52	

Figure 5.19: Magnitude of relation between General Adoption and ReadingNewBooksArticle

first calculates how well the model can predict data without taking the independent variable into account (block 0). Then this function calculates the effect of including the independent variable into the equation (block 1) and measures if this inclusion can improve the model any further.

Block 0 of logistic regression for General Adoption (see figure 5.20) shows that if we predict that an individual will adopt DEMO, we are right 73% of the times. This result is shown in *Classification Table* in figure 5.20. This high percentage comes from the fact that 73% of DEMO professionals (at least once) applied DEMO in their work (see figure 5.2a). Due to this high number of adoption finding relations that can improve this prediction is highly unlikely and ReadingNewBooksArticles is no exception. Based on the classification table, this independent variable did not improve the prediction of the model and the individuals who did not adopt DEMO are categorized as if they have adopted DEMO. The *Cox & Snell R Square* test in table *Model Summary* from figure 5.21 shows the improvement of the new model (with adding ReadingNewBooksArticles variable) to the previous model (without including any independent). This measure does not show a significant improvement as well.

Nevertheless, the calculated regression which is depicted in figure 5.21 shows a significant relation between General Adoption and readingNewBooksArticles with β coefficient equal to 1.36. In other words, the log of odds that a DEMO Professional (at least once) applied DEMO in his work is equal to $3.01 + 1.36$ *ReadingNewBooksArticles*.

Logistic Regression

Dependent Variable Encoding

Original Value	Internal Value
'No adoption'	0
'Adoption'	1

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 0	General Adoption	'No adoption'	0	14	.0
		'Adoption'	0	38	100.0
		Overall Percentage			73.1

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.999	.313	10.201	1	.001	2.714

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	ReadingNewBooksArticles	4.546	1	.033
		Overall Statistics	4.546	1	.033

Figure 5.20: Logistic regression for the relation between General Adoption and ReadngNewBooksArticles (Block 0)

Other Related Variables

Apart from ReadingNewBooksArticles there are other factors which are identified to have a significant relation with General Adoption. These factors are shown in table 5.3. Based on this table Management Support, DegreeTime, ReadingNewBooksArticles, NoExercises and PositionDu are the factors that can explain General Adoption of a DEMO Professional.

Table 5.3 shows the influence of the independent variables on General Adoption. The results in this table were calculated separately for each variable (without taking other variables into account). This table only shows the one to one relations between General Adoption and other independent variables which is different from the equation 5.1 that we gave before.

According to the equation 5.1 odds of adoption are calculated by the sum of all independent variables. The results of this approach can be seen in figure 5.22. As you can see the β coefficient of only two of the independent variables (positionDu and NoExercises) is significant and this regression model can predict 82% of the cases (see figure 5.23).

Although this model clearly shows some correlations between the dependent variable

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	4.505	1	.034
	Block	4.505	1	.034
	Model	4.505	1	.034

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	56.074[a]	.083	.121

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 1	General Adoption	'No adoption'	0	14	.0
		'Adoption'	0	38	100.0
		Overall Percentage			73.1

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	ReadingNewBooksArticles	1.361	.658	4.279	1	.039	.256
	Constant	3.010	1.072	7.888	1	.005	20.280

Figure 5.21: Logistic regression for the relation between General Adoption and ReadngNewBooksArticles (Block 1)

and two independent variables, we cannot exclude the possibility that the other independent variables might also have a relation with General Adoption. Because The cross-tabulation between General Adoption and variables like Management Support, DegreeTime, Subjective Norm and NoNewArticles has empty cells. The existence of these empty cells will render the results inconclusive. We will elaborate on this issue in the following section.

5.4.3 Problems in the Results

Most of the methods that we have used in our data analysis process are sensitive to the sample distribution. Chi-square (and all the methods that use chi-square as basis of their calculations) need at least 5 records of the dataset in each cell of the cross-tabulation to give

Explanatory variable	**Chi-square** (Significant level)	**lambda coefficient**	**Crammer's V**	**Logistic Regression (β)**	**Problems and status**
Management Support	0.018	Not Sig.	0.392 (0.18 Sig.)	1.643 (0.012 Sig.)	no improvement in model, empty cells
Subjective Norm	0.024	Not Sig.	0.339 (0.050 Sig.)	Not Sig.	missing values, no improvement in model, empty cells
DegreeTime	0.011	0.286 (0.037 Sig.)	500 (0.011 Sig.)	0.66 (0.027 Sig.)	improvement in model, empty cells
ReadingNewBooksArticles	0.033	Not sig.	0.296 (0.033 Sig.)	1.361 (0.039 Sig.)	no improvement in model
NoNewArticles	0.05	Not Sig.	Not sig.	empty cells	no improvement in model
NoExercises	0.027	Not Sig.	0.373 (0.027 Sig.)	1.256 (0.020 Sig)	no improvement in model
PositionDu	0.009	Not Sig.	0.511 (0.009 Sig.)	0.761 (0.003 Sig.)	improvement in the model

Table 5.3: The factors explaining General Adoption

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	PositionDu	1.041	.435	5.742	1	.017	2.833
	DegreeTime	.438	.389	1.265	1	.261	1.549
	NoExcercise	2.238	.988	5.130	1	.024	9.379
	ManagementSupport	1.534	.967	2.516	1	.113	4.635
	ReadingNewBooks Articles	-.637	.944	.455	1	.500	.529
	Constant	-9.325	3.915	5.674	1	.017	.000

Figure 5.22: Logistic regression for General Adoption

the right estimate on the significant level. If the percentage of cells with low number of records exceeds 20%, it is advised to re-categorize the variables [16].

Due to the small sample size and specific distribution of our sample data, in many cases we have cross-tabs with empty cells and in many of these cases re-categorization can cause information loss. For example, we categorized the number of new books a person has read about DEMO in three categories (Non,Some,Many) based on the answers provided to a question in the questionnaire. This re-categorization was done to decrease the number of empty cells. But as you can see in figure 5.24 still 44% of the cells have values less than 5. If we re-categorize this variable again to 2 categories we would have a variable which is equal to the ReadingNewBooksArticles variable. This way the NoNewBooks variable will become useless and just a redundancy in our data. In order to prevent this situation we report such variables as the way they are and hope to find an association using the regression models.

On the other hand, logit Models are also sensitive to the number of records in each

Classification Table[a]

Observed			Predicted: General Adoption		
			'No adoption'	'Adoption'	Percentage Correct
Step 1	General Adoption	'No adoption'	9	5	64.3
		'Adoption'	4	34	89.5
		Overall Percentage			82.7

a. The cut value is .500

Figure 5.23: predication of Logistic regression for General Adoption

NoNewArticles * RecentAdoptionPortion Crosstabulation

			RecentAdoptionPortion			
			None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects	Total
NoNewArticles	None	Count	14	6	1	21
		% within NoNewArticles	66.7%	28.6%	4.8%	100.0%
	Some	Count	8	7	6	21
		% within NoNewArticles	38.1%	33.3%	28.6%	100.0%
	Many	Count	6	0	4	10
		% within NoNewArticles	60.0%	.0%	40.0%	100.0%
	Total	Count	28	13	11	52
		% within NoNewArticles	53.8%	25.0%	21.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.762[a]	4	.045
Likelihood Ratio	13.093	4	.011
Linear-by-Linear Association	2.916	1	.088
N of Valid Cases	52		

a. 4 cells (44.4%) have expected count less than 5. The minimum expected count is 2.12.

Figure 5.24: partitions with low numbers Recent Adoption and NoNewBooks association

partition of data. More specifically they will have inconclusive results when there is a cell in cross-tabulation with zero records. These models are based on the calculation of the log of expected value for each cell. So, if a cell's value is equal to zero the log will become undefined [3].

Christensen [3] identified two types of zero's in cross-tabs. The first type is called a *fixed zero*. It is logically impossible for the cells with fixed zero values to hold a record. For example, it is highly unlikely that a person applies the DEMO methodology when this model is not applicable to his work. Specifically in organizations, the applicability of a methodology should be proven to the individuals working on the project before adopting that methodology. So if DEMO is applicable to a certain number of projects, the adoption of DEMO will not be more than that number (see the cross-tab in figure 5.25). Apart from the cross-tabulation of RecentAdoptionPosibilityProtion and Recent Adoption, all the zeros occurred in the analysis where the result of "lack of information". These zero cells are called *random zeros* and they happen due to a small sample size.

the existence of empty cells increases the doubt about the results reported for the association of variables. Since most of the empty cells are random empty cells, we can not

RecentpossibilityPortion * RecentAdoptionPortion Crosstabulation

			RecentAdoptionPortion			
			None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects	Total
RecentpossibilityPortion	None	Count	5	0	0	5
		% within RecentpossibilityPortion	100.0%	.0%	.0%	100.0%
	lessThanHalfOfThe Projects	Count	4	7	0	11
		% within RecentpossibilityPortion	36.4%	63.6%	.0%	100.0%
	MoreThanHalfOfThe Projects	Count	19	6	11	36
		% within RecentpossibilityPortion	52.8%	16.7%	30.6%	100.0%
	Total	Count	28	13	11	52
		% within RecentpossibilityPortion	53.8%	25.0%	21.2%	100.0%

Figure 5.25: Fixed Zeros Recent Adoption and RecentAdoptionPosibilityProtion association

interpret what would have happened if the sample size was bigger. Looking at factors that influence Recent Adoption (table 5.2), we can see that all these factors (which did not report significant association through regression) had empty cells. Due to existence of empty cells, some relations may not be detected. So we have to say that with the sample size at hand the relation of factors with empty cells in their analysis and adoption is inconclusive. Subjective Norm which was reported significant also had empty cells. So, the reported significance is also inconclusive. In table 5.3 three variables (Subjective Norm, Management Support and Degree time) had zero cells in relation with General Adoption. As a results, their association with General Adoption is again inconclusive.

In a small sample size like ours, the problem of empty cells increases as we include more independent variables in the equation. So, it is going to be harder to find associations as we increase the number of independent variables in the regression analysis. That is why we did not find any significant relation for Recent Adoption when we conducted an ordinal regression when we combined all the influencing in dependent variables.

5.5 Conclusions

In this chapter we have provided the methods that we have used to analyze the data gathered from our online questionnaire. We have used decision trees and statistical data analysis methods to identify patterns in the data and prove our hypothesis. In this chapter we have also represented the results of our data analysis and the problems we encountered during and after producing these results. The results of the data analysis methods for each of our two dependent variables (General Adoption and Recent Adoption) is provided in the following:

General Adoption: We did not manage to construct a valid decision tree for General Adoption. Therefore, we had to validate the relations using statistical data analysis methods. The multivariate logistic regression model showed That General Adoption can be significantly explained by PositionDu and No.Excersizes in which No.Excersizes has twice as much influence on the General Adoption as the PositionDE has. This relation was also captured by the decision tree of General Adoption. We were not

able to prove the relation between other independent variables and General Adoption using this regression but we could not exclude these variables either. The existence of empty cells and the increase in the number of these empty cells when we include all the variables in the equation was the reason behind this situation.

To decrease the number of empty cells, we performed one to one regressions to see the relation of other variables with General Adoption. Based on these regressions, General Adoption has significant relation with position duration, Number of exercises, reading new books and articles. Degree time and Management Support show significant relation to the General Adoption, but since they have empty cells we cannot confirm the relation. Subjective norm does not show a significant correlation with General Adoption but due to existence of empty cells this relation is inconclusive as well.

Recent Adoption: The decision tree which predicts the Recent Adoption of individuals shows an acceptable kappa statistics (the model can be valid). Based on this decision tree, individuals make adoption decisions based on the possibility of adoption. If there is no adoption possibility, there will be no adoption either. If there is a possibility of adoption for 'less than half of the projects', then the extent to which one adopts DEMO is dependent on the amount of support the adoption gets from the management. If the adoption is possible for 'more than half of the projects' then the adoption is related to the Management Support and the fact that the DEMO professional is up to date (ReadingNewBooksArticles variable) about the Recent Adoption of DEMO.

Due to existence of empty cells, a multivariate regression of the individual variables for explaining the Recent Adoption did not reveal any significant relation. Using one to one ordinal regression we were able to get some results. Based on these regressions, Recent Adoption has significant relation with Management Support and ReadingNewBooksArticles variables. There is also a significant correlation between Recent Adoption and Subjective Norm but due to the existence of empty cells the results of this regression is inconclusive. Company size, Degree Time, Number of New Articles, Recent possibility Portion and being a consultant were not significant with regression analysis and have empty cells which means that we can not make any conclusions about the relations among these variables as well.

Some of the relations represented in the decision tree of Recent Adoption is also compatible with what we have calculated based on statistical data analysis methods. The significant dependence of Recent Adoption to the Management Support and ReadingNewBooksArticles variables was proven using statistical data analysis methods. These relations have been represented in the decision tree as well. After the Recent Possibility Portion which shows the possibility of adoption, management support were found to predict Recent Adoption well. Moreover, in statistical data analysis we found out that the cross-tabulation between Recent Adoption possibility and Recent Adoption has fixed zero cells and the value of Recent Adoption is always less than or equal to the value of Recent Adoption possibility. This trend is also captured in the decision tree made for Recent Adoption.

Through out our analysis we have seen that our sample size is small for many different data analysis methods. Because of the small sample size, it is not possible to calculate a correct multivariate regression and find an appropriate logit function for the dependent variables. Therefore, the regression between different variables was calculated separately. We have seen that the same problem can influence our resulting decision trees. The nature of decision trees make it hard to get correct predictions for a small sample size. As we delve further into the categories and their sub categories, the number of records belonging to each category decreases which will increase the influence of noisy data. This is no problem for a large sample as the effect of the noise in data will be canceled out by the effect of the large number of correct data. Using a bigger sample data or different methods of data analysis may decrease the problems encountered in this analysis.

Part III

Qualitative Analysis

Chapter 6

Experiences in Practice

In our investigation, a qualitative analysis was conducted to confirm the hypotheses that we have proven in the quantitative analysis phase. Furthermore, a qualitative analysis will also provide explanations about specific patterns in the data. In other words, this can clarify the actual experiences and obstacles of DEMO Professionals in applying DEMO in their day to day work. As a result, this process may lead to new hypotheses that may have not been taken into account in our quantitative analysis process regarding the adoption of DEMO.

In this chapter we will provide our findings of the qualitative analysis phase. In section 6.1, we will first start by explaining the way we performed this step of the research. Then in section 6.2 we will provide our findings regarding the adoption of DEMO by DEMO Professionals. In section 6.3 we will provide a confirmation about certain trends which we have found in our quantitative analysis. We will also explain the weaknesses in our measurement and the new hypotheses which were found as a result of qualitative analysis.

6.1 Performing a Qualitative Research

The qualitative research is performed by observing individuals within a certain group. If the individuals become aware of the observation they may behave differently. So, sometimes researchers perform the observations without acknowledging the individuals about it. But many times this type of observation is not possible or very time consuming. For example, to observe the actual performance of individuals in practice one should join their organizations and observe their behavior which has both ethical and privacy problems. Moreover, the observer should have a certain level of knowledge about the type of work these people do. Therefore in many cases the individuals are informed about the research and the research is conducted on volunteers [20]. This type of research can be much easier to perform and in our case seems more appropriate.

One of the most easy and common methods of qualitative research when the individuals are participating in the study willingly is interviewing these participants. These interviews are conducted in semi-structured sessions [20] based on a plan in which a sequence of topics and the questions that should be covered in each interview are provided. This plan is flexible, therefor, the interviewer does not have to follow it strictly. In this sense there is an

openness attached to this type of research which can not be found in quantitative research [22].

6.1.1 Interviews with DEMO Professionals

In our online questionnaire, we asked the respondents if they are interested to participate in one to one interview sessions. Out of 52 respondents of the online questionnaire who were working in practical fields, 30 DEMO Professionals were interested in the qualitative research.

The interviews were conducted based on an interview plan that is presented in appendix C. During the interviews we tried to let the interviewees talk about their experiences freely and changed the order of the questions accordingly. The questions were most helpful when the individuals were not expressive and preferred to give short answers to the questions. The interviews were scheduled based on the availability of the individuals and the interviewer. Based on the preference of the interviewee, the interviews were conducted either at the TUDelft campus or the home organization of the interviewee.

6.2 DEMO Professionals within their Organizations

During the qualitative analysis phase, we have managed to conduct interviews with 19 DEMO Professionals. To keep the anonymity of these individuals we will address them with N_1 to N_{19} throughout this text. About half of the interviewed DEMO Professionals were consultants who were working with the clients outside of their company (10 individuals) and the rest were working inside their home organizations. Apart from 3 individuals, the interviewees have at least once applied DEMO (and probably that was the reason behind their interest in the research). We have asked the individuals to talk about one of the projects in which they have applied DEMO. These projects along with the organization the individual works in are provided in Table 6.1. The role of DEMO in these projects is also presented in this table.

As you can see in the table there are individuals who are working in a same company or on a same project. Interviewing the individuals who are working in a same company revealed the trend of adoption in that organization. Moreover, different people who are working on a same project can provide us with different view points over the same problem.

6.2.1 The Trend of Adoption

In the interviews, two organizations (O_1 and O_2) were identified in which the adoption of DEMO is growing. Mostly DEMO was adopted by one sector of the organization and then individuals in other sectors of the organization became interested in the methodology.

In O_1 DEMO was introduced to the organization by one DEMO Professional. He conducted a research about DEMO in this organization (free of charge). The results was interesting for the organization. So, they had decided to use DEMO in higher layers.

This event was best explained by N_2*: "At first DEMO was only used to consolidate the IT environment. Looking at IT they saw it had much more potential. They said if it is useful*

Individual	Organization	Project	Purpose of DEMO
N_1	O_3	P_1	Recognizing whether the software systems are fulfilling their purpose
N_2	O_1	P_2	Aligning the requirements of field workers[1] and management
N_3	O_2	P_3	To find the essential transactions for a sector of the organization
N_4	O_2	P_4	To connect the information system of different collaborating organizations
N_5	O_4	P_5	To make efficient and standard communication between different organizations
N_6	O_5		Using DEMO at personal level
N_7	O_1	P_6	Making a distinction between B-I-D layers
N_8	O_6	P_7	Making a distinction between B-I-D layers, finding the essence
N_9	O_1	P_8	Centralizing a processes and informations related to a certain task from different departments
N_{10}	None	P_5	To make efficient and standard communication between different organizations
N_{11}	O_7		Not adopting DEMO
N_{12}	O_8	P_9	Quality management of the processes
N_{13}	O_7		Not adopting DEMO
N_{14}	O_9	P_{10}	Designing information systems out of construction model
N_{15}	O_8	P_9	Quality management of the processes
N_{16}	O_8	P_9	Quality management of the processes
N_{17}	O_{10}	P_{11}	Centralizing different processes of different organizations to make an application for all the organizations
N_{18}	O_{10}, O_2		Not adopting DEMO
N_{19}	O_{11}	P_{12}	Designing information systems

Table 6.1: The interviewed individuals and their respective organization and projects

for information it is also useful for business. If we use it for business we can make the scope more clear and maybe we can make processes with it."

In this organization the individuals within other sectors are becoming interested in DEMO. On of those individuals (N_7) is analyzing and researching if he can use DEMO in one project. The fact that DEMO is being used as one of the viable candidates shows that there is a chance that the application of DEMO increases overtime.

Based on our interviews, O_2 has the highest adoption rate in comparison with other organizations. Three different sectors of the organization were identified that were actively applying DEMO in their day to day work. Individuals are enthusiastic about DEMO and are eager to learn the methodology. Moreover, it seems that one of the sectors is actively promoting applying DEMO (N_4). Apart from these advancements, the organization is inte-

grating with another organization and there are some conflicts in accepting DEMO between two organizations.

Based on what we have seen in these two organizations we are able to identify a general trend of adoption for DEMO in the organizations. Usually DEMO is introduced to the organization in a small scale (N_1 *and* N_2). If the sector in which DEMO is introduced is happy with the results, they recommend the methodology to be applied in bigger scale (bottom up). In this step, the adoption of DEMO is very dependent on the support of the managers. If the managers support applying DEMO, they will provide more resources (like experts) and the methodology can be applied in bigger scale.

DEMO has a more chance of adoption if it is supported by the higher management (N_3). But in many organizations process managers are the group of individuals who will make the decision of applying DEMO in bigger scale. These individuals are mostly used to applying BPMs in design of processes for the organization. Since the concepts represented in these two types of methodologies are very different, convincing the process managers about advantages of DEMO can be a hard job.

N_4*: "The difficulty in our organization is to explain what DEMO is and what it is not in relationship to other methodologies that we use... It is very difficult to explain what is unique to DEMO and how it can be used together with other methodologies".*

since the process managers are the responsible party regarding the design and change the processes, any change in the method of process design means a huge amount of work for them. As the responsible party, they have to learn the introduced methodology and if its needed redesign many of the processes based on that methodology (N_1 *and* N_{12}).

N3: "I think the problem is when you have an organization who is there for a longtime and already have a process framework... Well people are working with those processes for a long time and now you tell them hey people we have a new way of doing things and this is a big change for them."

When there is a shift in the vision of the organization (like making the processes more customer oriented), the application of DEMO in a higher scale is accepted with less amount of resistance (N_2). But even in those cases DEMO is not fully adopted rather it is combined with other methodologies which are already applied in the organization.

6.2.2 The Adoption Measurements

In our quantitative analysis we identified two adoption factors (General Adoption and Recent Adoption) as dependent variables. We measured General Adoption to see whether an individual adopted DEMO in at least one project. The Recent Adoption was calculated based on the number of projects in which an individual applied DEMO in ratio to the number of the projects he has worked on in the last 6 months. We have also defined different levels of adoption for DEMO that show the models and concepts of DEMO that the individual is using when he applies DEMO.

Level of Adoption

A lot of interviewed individuals used only the concepts that were introduced in the way of thinking of DEMO in their work (N_2, N_4, N_6). The application of Construction Model is also very common among the professionals (N_1, N_3, N_8, N_{14} *(Not sure about the last 2)*). The Action Model and Process Model were applied in P_9. Among all the identified projects only one project was found in which all the models of DEMO have been used P_5.

Using the models of DEMO was related to the purpose of DEMO within the project. For example, Process Model is used for managing the quality of processes and the Construction Model was mostly used to capture the essence of the organization.

Apart from the purpose of DEMO in the project other factors can influence the level of adoption. Among the interviewed individuals the State Model has received the lowest amount of attention in comparison with other models. While the individuals acknowledged the importance of this model, they often had a low level of understanding about it. Therefore, the little amount of attention that this model gets from the individuals can be explained by their low level of understanding about this specific model.

The level of adoption is also related to the level of understanding of other individuals within the organization about the models of DEMO. This problem can be regarded as the ability of the models produced by DEMO to be communicated with the individuals who do not have any knowledge about the methodology (communicability).

N_2*: "When we make processes with a methodology we want to be sure that everybody in the organization understands it. So, the models of the methodology have to be organic and attractive... But in DEMO, you need to explain the models to the people before they can understand or interpret them and you can only explain the models to a small group of individuals (and not 9000 people)".*

In DEMO, communicating some models and concepts are much easier than the other models.

N_3*: "construction model is very easy to explain we use that to explain DEMO to people who do not have any training and it works. But if you explain the concepts in more detail (like cancellation patterns), the concepts will become too complex for the individuals to understand.*

Because DEMO is hard to understand and the results cannot be communicated with individuals other than DEMO Professionals, the individuals within the organization will become resistant to the methodology. Presenting the models to the others will bring up a lot of confusion and discussions about the concepts and models of DEMO. To avoid this situation, many DEMO Professionals prefer to use the models and concepts of DEMO for the analysis in an individual scale and communicate the results using other medium like power point slides or tables (N_6, N_{12}, N_{14}, N_8). In many other cases, individuals use the concepts of DEMO in order to make processes with other methodologies which have been used in the organization for a long time and therefore, the individuals within the organization are familiar with those methodologies and their representation. Methodologies like ARIS [2], SEAM[3]

[2] `http://www.ids-scheer.com/en/ARIS_Software_Software/3730.html`

[3] Seam is a development platform used for implementing online applications. It is possible to construct BPM related models(like work flows, Task management) in this framework (see

and IAF [4] (N_2, N_4) are some of methodologies which have been used in combination with DEMO. In some cases the organizations have done research to find good ways to combine DEMO with these methodologies [26, 31].

P_5 is one the examples of the projects which was able to overcome some of the aforementioned problems. In this project, the idea and added values of DEMO is promoted by visualizing the different concepts and models of DEMO (like the level of abstraction) in small video clips. This way they became capable of communicating the important concepts and advancements of DEMO to the parties involved in the project and encourage them to make their own transactions. Other techniques which were recommended by DEMO Professionals were short training sessions in which the important concepts of DEMO have been explained, short articles in the local famous management (or IT) magazines and one or two pages brochures about DEMO and its new advancements.

The aforementioned problems are mostly concerned with adoption of DEMO in high level of abstraction. But when we want to design the information systems we need to transform the models from high abstract levels to more detailed levels. This transformation is not yet provided by DEMO. This problem resulted in customized techniques for making detailed models out of DEMO models. The individuals came up with customized techniques to implement information systems from DEMO models by using UML or making detailed models from the construction model of DEMO (N_{19} *and* N_{14}) but these techniques are not yet supported by DEMO.

Other Ways to Measure the Adoption

All the measurements that are provided for the adoption of DEMO in quantitative analysis are investigating the adoption at individual scale. This is because at that moment we were more interested in findings about the individuals' level of adoption and the possibility of adoption through boundary spanners. Moreover, we did not have a clear picture about the trend of adoption within the organizations and we could not investigate the trend at that moment.

Through out the interviews it became clear that there are more stages of adoption in an organization. We know that an individual can adopt DEMO in personal scale with out telling others about it or combine the concepts of DEMO methodology with other methodologies. But he can also adopt DEMO in a bigger scale in the organization for designing the business processes. Moreover, he can use DEMO to make detailed models for implementation. In future investigations, other factors can be used for the adoption which reflect these findings.

6.3 Hypotheses In Qualitative Analysis

In quantitative analysis we found several relations between adoption and our independent variables. But some of the hypotheses could not be confirmed nor disqualified due to lack of data and the small sample size.

http://www.seamframework.org/).

[4] The Integrated Architecture Framework (IAF) is developed in Capgemini (http://www.capgemini.com/).

The interviews can help us in validating and analyzing the hypotheses we have investigated in quantitative analysis. Moreover, we can check the accuracy of our measurements based on the actual situation of DEMO and its adoption in the organizations. The qualitative analysis may reveal new relations and lead to new hypotheses as well. These hypotheses can be used as a basis for future research. What follows we have listed some of the hypotheses and relations which were investigated in qualitative analysis.

Support of Management and Adoption of DEMO

In previous section, we have seen that the management support influences the adoption of DEMO within organizations. A supportive management can increase the adoption of DEMO by providing experts and encouraging the individuals in the organization to get trainings about DEMO (i.e O_2). On the other hand, if the management rejects adopting DEMO the methodology will not be adopted in large scale and will only be used at personal level (i.e O_5). Even in some cases DEMO Professionals do not tell their colleagues that they have applied DEMO rather they use the concepts or make the models for themselves and present the results using other medium (N_{12}, N_4, N_6 *and* N_8).

Identifying the management: In our survey research and online questionnaire we have only asked about the support of management as a broad term and we did not identify in detail what we mean by the management. After conducting interviews we identified two types of managers in each organization that can influence the adoption of DEMO. These managers are the high level managers and the process managers. In many cases the high level managers do not care about the methodology and are more interested in the results. In this situation the process managers will play a significant role in the scale of adoption of DEMO (positive influence). Since some of these process managers are DEMO professionals themselves, it is important to distinguish the process managers from other types of managers.

Subjective Norm and Adoption of DEMO

We defined the Subjective Norm of an individual as a degree to which the coworkers of that individual are applying DEMO. Even though we have found a significant relation between Subjective Norm and Adoption, we were not able to confirm the hypothesis in the data analysis phase. This problem was caused due to lack of information and existence of empty cells.

Using qualitative analysis we found out that in the organizations in which number of DEMO Professionals are higher and more people are applying DEMO, the individuals are more interested in adopting DEMO in comparison to other organizations. For example, in O_2 people are more enthusiastic about adoption of DEMO because other people are enthusiastic about this methodology (N_4).

Being Up to Date and Adoption of DEMO

To investigate the extent to which the individuals are up to date we measured the number of times a person visited the DEMO Knowledge Center website and the books and articles they have read recently. But it seems that these two variables are not the only variables that can show how much a person is up to date. Many people keep themselves updated by participating in DEMO Platform meetings [5] or communicating with other DEMO Professionals (N_{12}). The influence of these two factors on the adoption of DEMO should also be investigated.

Network Size and Adoption of DEMO

Subjective Norm measures the amount encouragement a person receives from his coworkers if he adopts DEMO. The coworkers who encourage the adoption of DEMO are more likely to be DEMO Professional themselves. The community of DEMO Professionals consists of around 200 individuals. Many of these people are working in different organizations.

If an individual becomes connected to many other DEMO Professionals (who may not work in his organization) he can still become interested in adopting DEMO. Moreover, as we said before he can be updated about the new advancements of DEMO with the help of his network of DEMO Professionals.

In some cases we found out that individuals are trying to find answers to the questions which have been already solved by another DEMO Professional in another organization. This problem was the result of a lack of connection between these two individuals. With a network of experts, DEMO Professionals are able to share their latest works and advancements with each other and avoid redundant work which has been already done by others.

Organizational Uncertainty and Adoption

Because of the financial situation, some organizations like O_7 became very uncertain. The individuals working in these organizations are not sure how long they are going to stay in their current position and what will happen to the organization in near future. When the organization is at this stage, short term solutions and less changes in the processes of the organization are more of preference. Therefore, these organizations will not adopt new methodologies like DEMO. We did not investigate the influence of Organizational Uncertainty on the Adoption in the quantitative analysis phase. But we think that the effect of this factor should be investigated in the future.

Communicability and Adoption

[5] Several times in a year, DEMO Platform meetings are held by DEMO Knowledge Center to keep DEMO Professionals up to date about the latest advancements in DEMO.

Communicating the results produced by DEMO is one of the biggest problems DEMO Professionals have to tackle in their work. The models and concepts of DEMO are so different from other methodologies in the same area that DEMO Professionals have to explain the concepts and the way of thinking of DEMO before introducing the models. These people also see the problem in the symbols that are used by DEMO models (N_{17}, N_2, N_{11}). The symbols are too generic that the individuals in the organization will not understand the models without further explanation.

We believe that Communicability will have a big effect on the scale of the adoption of DEMO in an organization. But this relation should be investigated in future research.

Good tools and Adoption

The lack of good tools is another issue that DEMO professionals are facing when applying DEMO. Many of them use Microsoft Visio to make the models of DEMO. Having a good tool is very important specially when the other competing methodologies sophisticated tooling (like SEAM).

Probably the introduction of the new tool Xemod[6] can solve the tooling problem of DEMO. The effect of the introduction of this new tool on the adoption should also be investigated. If the tool is user friendly and easy to use we expect to see an increase in the adoption rate of individuals.

In short all of the aforementioned relations are based on the interviews we have conducted in our qualitative analysis phase. We have confirmed some the hypotheses which were found in quantitative analysis phase. Moreover, We have found new relations which we did not measure or anticipate before. The investigation on correctness of these hypotheses can be achieved by conducting another quantitative analysis research. This research is out of the scope of our investigation. As a result, we recommend the proof of these new hypotheses for future research.

6.4 Conclusions

In this chapter we provided the results of our qualitative analysis phase. We conducted interviews among 19 individuals to get a clear picture about the actual experience of DEMO Professionals in practice.

Based on the interviews, we were able to identify a certain trend of adoption of DEMO within the organizations. In investigating the adoption in organizational scale this trend of adoption can be used as a basis for recommendations and taking the correct steps towards increasing the adoption.

We were able to identify the factors that may influence the adoption of different models. We found out that the level of understanding of the DEMO Professionals and other individuals within an organization will affect the level of adoption of DEMO by those DEMO

[6]Developed by Xprise `http://www.xprise.com/`

Professionals. We realized that in many cases the time consuming communicability process and exhausting discussions may lead to a low level of adoption or only the adoption in personal scale.

Using the qualitative analysis research we were able to identify and prove several hypotheses which shows the dependency of adoption to our earlier identified factors. We validated the dependency of adoption to Management Support and Subjective Norm. We also provided some improvements in the measurements of being up to date and Management Support which can improve the accuracy of these factors in prediction and explaining the adoption. We have also identified new hypotheses for the adoption of DEMO. Based on the interviews factors like Network Size, Organizational Uncertainty, Communicability and Good tooling can also influence the adoption of DEMO. Since these new hypotheses were not investigated in our quantitative analysis, the actual relation between these factors should be validated by performing another quantitative analysis research. We recommend this as future work.

Chapter 7

Conclusions and Future Work

This study was dedicated to investigating the adoption of DEMO in practice. Several techniques and methods including a survey and a series of interviews were used to find how we can improve adoption. To achieve this goal we first approached the problem with the question: " what are the things that are affecting the adoption of DEMO by individuals?". The survey and our interviews helped us identify some of these influencing factors. By adjusting these influencing factors the right way we should be able to improve the adoption of DEMO.

In this chapter we are going to explain how well we were able to achieve this goal. Moreover, we are going to provide recommendations and possible opportunities that this research provides for further research.

7.1 Overview of the Results

In the beginning of our research we were interested to explore the problem of adoption of DEMO and find the possible factors that are influencing the adoption of DEMO. If we find the influencing factors of the adoption, we can improve the adoption of DEMO by manipulating the value of the identified factors. We limited our investigation on the personal adoption scale and performed the research on the DEMO Professionals as boundary spanners within their organizations.

7.1.1 Method of Analysis

Based on the literature we were able to identify some of the factors that are generally influencing adoption. We used the quantitative analysis methods to evaluate and prove the relation of some of these factors with the adoption of DEMO. In other words, we wanted to see whether these factors have a positive or negative influence on the adoption of DEMO and the scale to which they influence adoption. To also capture the actual experience of individuals in their organizations we went further by performing qualitative analysis. We interviewed individuals to confirm and find the reasons behind certain relations between the adoption of DEMO and the factors from the quantitative analysis. This step also helped with clarifying whether any unanticipated factors could be identified.

	Recent Adoption	Adoption in General
Reading new books and articles in the last 6 months	✔	✔
Support of management about DEMO	✔	✔
Adoption of coworkers	✔?	✗?
Portion of the Applicability of DEMO to the projects in the last 6 months	✗?	✗
Size of the company	✗?	✗
The duration from the last educational degree to today	✗?	✔
Number of new books and articles which have been read in the last 6 months	✗?	✗?
Being a consultant	✗?	✗
Number of exercises solved before application in practice	✗	✔
Current position duration	✗	✔

Table 7.1: Variables and their relation with General and Recent Adoption

Results of Quantitative Analysis

We performed the quantitative analysis with the help of survey research. We performed an online questionnaire in which the relation between factors like the size of the company, the type of training a person got in DEMO, the support of the management for applying DEMO, etc. (refer to table 4.3 for the complete list) with adoption was investigated. We defined the adoption of the individuals based on two factors. First, We wanted to see *whether or not an individual has ever applied DEMO in the projects he/she has worked on* (Adoption in General). Second, we wanted to know about the *portion of projects in which the individual has adopted DEMO in the last 6 months* (Recent Adoption).

Using data mining and data analysis methods, we were able to find several factors that influence the adoption of DEMO. For some other factors our methods were unable to validate or falsify relations i.e due to the existence of zero cells and small sample size (see section 5.4). Such unverifiable results fall into two categories. The first category are cases for which a relation was found but due to problems our methods could not surely validate the existence of the relation. The second category are cases for which a relation was not found but due to the problems a relation might still exist. Either way, the validation of these results require the problems to be solved (i.e. with a larger sample). We have summarized our findings in table 7.1 in which we provide all of our factors. The relations which are validated using the analytical models are shown by "✔" and the relations which are falsified are represented by "✗". If either "✔" or "✗" are accompanied with a **"?"** this means that the results fall into one of the two unsure categories that we just described.

Results of Qualitative Research

In the qualitative analysis phase, we have conducted 19 interviews to acquire a better understanding of the actual experience of DEMO Professionals within their organizations. Based on these interviews we were able to find a general trend of adoption of DEMO within the organizations. Based on this trend we can identify several levels of adoption in an organization:

1. DEMO can be adopted only for personal purposes. In this level, the other individuals are not aware of the application of DEMO by the individual or the individual is not communicating the results of DEMO with other individuals.

2. DEMO can be adopted in a project. In this stage DEMO can also be used as a basis to implement an information system.

3. DEMO can be used in a bigger scope. In this step DEMO is applied as one of the standard methodologies of a whole unit or a whole organization.

In any of the aforementioned steps DEMO may have been combined with existing methodologies within the organization. This way of adopting the DEMO methodology is very common among the interviewed individuals.

To be able to increase the level of adoption of DEMO from a personal level to the higher levels individuals should be able to communicate the added values and the results produced by DEMO to others. If the individual fails to communicate the results to other people within the organization in a correct manner, the people in the organization become resistant to the methodology and the adoption of DEMO in higher levels would be a much harder task.

For a methodology to be adopted as a standard methodology within a unit or an organization, we need the permission and the support of the management (high level management or process management). In many projects improving the adoption of DEMO from personal level to a project level is blocked by the process managers which shows the important role of this party in the acceptance or rejection of DEMO. Sophisticated tooling can make the models of DEMO more attractive and interesting. So, using such tools may lead to improvements in the view points of management about DEMO.

we also found that the support of coworkers will encourage the individuals to adopt DEMO in higher levels. We have seen that if an individual works in an organization in which many DEMO Professionals are present, he becomes more interested to apply DEMO in a level higher than personal level. This indicates that a larger network of DEMO professionals can also encourage the individuals and increase the adoption of DEMO by those individuals. Being connected to DEMO Professionals outside the organization has another advantage as well. It can keep an individual updated about the advancements and developments of DEMO that may have been performed by his connections. Other sources that can keep individuals updated are DEMO platform meetings, the DEMO Knowledge Center and new books or articles that are published about DEMO.

7.2 Recommendations

The goal of this research was to provide information about the factors that can influence the adoption of DEMO. Proven by statistical methods, the relations that were found are useful for choosing feasible and correct strategies by the participating parties when dealing with the adoption of DEMO. Strategies that improve any of the influencing factors could result in improving the adoption of DEMO. In this section we will recommend some strategies that we think can improve the adoption rate of DEMO. In this step we are more focused on the solutions that will not need a change in the models of DEMO.

Recommendation 1 *A direct flow of information should be facilitated among the DEMO Professionals working in different organizations.*

Many of the DEMO Professionals are updated about DEMO by communicating with their other DEMO Professional colleagues. As a result, a person who has a bigger network of DEMO Professionals will be more up to date. The importance of this connection is its ability to stimulate the flow of information on DEMO from one person to another. This way the individuals will be aware of the research and projects of other DEMO Professionals. This way individuals are able to find the appropriate references for solving their own problems. Communities in social network sites and online forums can facilitate such a connection. In these communities the individuals should be free to talk about the way they are adopting DEMO, the problems they are facing in applying DEMO and uploading new advancements they have made.

The connection among DEMO Professionals can also be central. The existence of the DEMO Knowledge center website and DEMO Platform meetings were good steps towards achieving this goal. Based on our analysis, people do not visit the website very often and the number of times they have visited the website does not have any effect on their adoption of DEMO methodology. This is an indication that the website is not fulfilling this goal properly or the DEMO Professionals are not used to this way of acquiring the information. Therefore, we believe that next to the website, email or paper based newsletters that DEMO Professionals subscribe for should become available.

Recommendation 2 *DEMO should be presented and promoted to the high level mangers and process managers in a language they understand.*

Most of the times, DEMO Professionals in the organizations are acting as boundary spanners. They try to promote DEMO to their colleagues and managers. But many times their efforts are blocked by process managers within the organization. Since the process managers are the people who should learn and apply new methodologies in the organization, shifting from their own techniques to DEMO means a lot of change and a large load of work for these people and naturally they are resistant to it.

This resistance can be decreased by decreasing the amount of change that would be forced to the organization and its processes while adopting DEMO. In this approach we let the change happen gradually over the time. Since DEMO has a theoretical background, to be able to use the models completely one should understand the concepts correctly. By

defining maturity levels for the adoption of DEMO, the individuals will have enough time to realize the exact meaning of the concepts and models of DEMO in each step. The maturity levels start with using the concepts of DEMO in combination with available methodologies in the organization. At this level, the processes that are made by other methodologies should be based on the essential transactions identified in the construction model of the organization. In this stage the possibility of combining DEMO with other methodologies in the organization should be investigated. After the individuals learn to use the concepts and the organization becomes stable, change towards adopting the other models of DEMO and higher maturity levels can proceed. This process can continue until all the models are adopted by the organization.

On the other hand, promoting DEMO to high level mangers can prevent the process mangers from blocking the adoption of DEMO. In cases where mangers push the adoption of a methodology, the process managers have to comply with the acquired changes (even though they are not happy about those changes). DEMO should be briefly presented in a way that can attract the attention of high level mangers in a short amount of time and keep them interested in the methodology. The use of visual aids (like advertisement clips) can be very useful in this situation. Presenting the success stories of DEMO and its added values in comparison with other methodologies is also another useful approach. We are aware that mandatory adoption may decrease the adoption rate however, if the high level management supports applying DEMO without mandating its adoption the adoption rate of DEMO should increase as our results indicate.

Recommendation 3 *DEMO Professionals should be incentivized and provided with the necessary facilities to act as boundary spanners.*

As mentioned before, DEMO Professionals within the organizations are acting as boundary spanners but most of the times they are faced with a resistance from others in the organization. One of the reasons behind this resistance can be related to the way they introduce DEMO to the organization. Since DEMO has a strong theoretical background, not every concept and model has the ability to be presented in the introduction of DEMO. The theoretical foundation may scare others away. For example, explaining the models before introducing the concepts of DEMO can be very confusing and people will not be attracted to the methodology. As a result, it is important that DEMO Professionals have access to standard instructions that explain the way they could present DEMO to their organization. Standard online video clips or power points that introduce the important concepts of DEMO to non professionals can be used by DEMO Professionals when introducing the methodology to their organization.

An increase in the number of individuals with knowledge of DEMO will decrease the risk that is assigned to adopting a new methodology like DEMO by the management. Moreover, the DEMO professionals themselves will become more eager to apply DEMO in their organizations when others are supporting and understanding the methodology. Providing trainings with special discounts for people from the same organization and online training sessions may increase the number of DEMO Professionals in an organization.

7.3 Future Work

This research was the first step into finding the influencing factors on the adoption of DEMO. Our research was one of the few researches that was conducted on adoption and the collected information throughout this research can lead to many new research questions and investigations. Each phase of our research can lead to different types of future research.

Our quantitative analysis was performed on a sample of DEMO Professionals. This sample was not a random sample therefore we could not generalize the gathered results to the whole population of DEMO Professionals. Moreover, due to small sample size we were not able to accept or reject several relations between adoption and other factors and we were not able to find appropriate treatments to solve these problems. Therefore to prove the accuracy of the results for the whole population of DEMO professionals who are working in practical fields, conducting further quantitative analysis with random samples and bigger sample sizes is preferred. Even though such research will be extremely hard to conduct due to the small population size and non response we believe it is a necessary step. Moreover, research can be conducted to find ways to treat the problems that occurred due to the small sample size in the data analysis phase. This type of research will require a more advanced knowledge about the statistical and data mining methods.

The results provided in the quantitative analysis phase can be used for *panel* research [20]. In panel research one can study individuals over the time to see whether there is a change in their behavior. Based on this type of research, DEMO Professionals can be studied to see whether their adoption rate (or other investigated factors) have changed over the time. This research can be very useful when several strategies have been chosen to increase the adoption of DEMO. The result of panel research can show whether the strategies are towards increasing the adoption rate or they are working in another direction.

Also recall that due to the nature of our research we excluded DEMO Professionals who were students from our investigation. Since we have gathered information about their knowledge and preferences regarding DEMO, it is interesting to see the relation between their current point of view about DEMO and their adoption behavior after they graduate from the university and start working in an organization.

Finally, in qualitative analysis we were able to identify several new factors that can influence the adoption of DEMO. The effect of these factors on the adoption should be validated by further quantitative analysis research. We were also able to identify several levels of adoption within organizations in contrast to the personal level that we investigated with our quantitative research. This information can also be used to conduct further research which investigates the adoption of DEMO at organizational scale.

Bibliography

[1] Icek Ajzen. The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2):179–211, 1991.

[2] Philip Anderson. Complexity theory and organization science. *Organization Science*, 10(3):216–232, May - June 1999.

[3] Ronald Christensen. *Log-Linear Models and Logistic Regression*. Springer Texts in Statistics. Springer, 2nd edition, 1997.

[4] Fred D. Davis. User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies*, 38(3):475 – 487, 1993.

[5] Fred D. Davis, Richard P. Bagozzi, and Paul R. Warshaw. User acceptance of computer technology: A comparison of two theoretical models. *Management Science*, 35(8), August 1989.

[6] Mark J. de Vries. *Philosophy of Technology: What and Why?*, volume 27, humanities, social sciences and law 2, pages 1–12. Springer Netherlands, http://www.springerlink.com/content/q2128q7012163030, 2006.

[7] Jan L. G. Dietz. *Enterprise Ontology: Theory and Methodology*. Springer, May 2006. ISBN 3540291695.

[8] Jan L.G. Dietz. Modelling the essential activities of an organization. In *Information Modelling and Knowledge Bases III*, pages 130–140. IOS Press, 1992.

[9] Jan L.G Dietz. Demo-3 models and representations. Available at www.DEMO.nl, September 2009.

[10] Mark Dumay. Demo or practice: Critical analysis of the language/action perspective. *CoRR*, cs.OH/0410006, 2004.

[11] B.S. Everitt and G. Dunn. *Applied Multivariate Data Analysis*. Arnold, London, 2nd edition, 2001.

[12] Martin Fishbein and I. Ajzen. *Belief, Attitude, Intention and Behavior: an Introduction to Theory and Research*. Addison-Wesley, 1975. ISBN 0201020890.

[13] Floyd J. Fowler(jr.). *Survey research methods*, volume 1 of *Applied Social Research Method Series*. Sage, London, United kingdom, 2nd edition, 1993.

[14] Floyd J. Fowler(jr.). *Improving Survey Questions: Design and Evaluation*, volume 38 of *Applied Social Research Method Series*. Sage, London, United kingdom, 1995.

[15] David Gefen and Detmar W. Straub. The relative importance of perceived ease of use in is adoption: A study of e-commerce adoption. *Journal of the Association for Information Systems*, 1(8), October 2000.

[16] Susan B. Gerber and Kristin Voelkl Finn. *Using SPSS For Windows - data analysis and graphics*. Springer New York, 2nd edition, 2005.

[17] Bart Jan Hommes. *The Evaluation of Business Process Modeling Techniques*. PhD thesis, TUDelft-Delft University of Technology, September 2004.

[18] J Hoogervorst. Enterprise architecture: Enabling integration, agility and change. *International Journal of Cooperative Information Systems*, 13(3):213–233, 2004.

[19] Mehmed Kantardzic. *Data mining concepts, models, methods and algorithms*. Wiley, 2003.

[20] Fred N. Kerlinger and Howard B. Lee. *Foundations of behavioral research*. Harcourt College Publishers, 4th edition, 2000.

[21] David G. Kleinbaum, Mitchel Klein, and Erica Rihl Pryor. *Logistic Regression - A Self-Learning Text*. Statistics for Biology and Health. Springer London, 2nd edition, 2002.

[22] Steinar Kvale. *Interviews : an introduction to qualitative research interviewing*. Sage Publications, Thousand Oaks, CA, 1996.

[23] R.G. Lee and B.G. Dale. Business process management: a review and evaluation. *Business Process Management Journal*, 4(3):214–225, 1998.

[24] Bert Noorman. Pronto: Bpm-approach sogeti. Copy right by Sogeti, September 2009.

[25] Marija J. Norusis. *SPSS 17.0 Advanced Statistical Procedures Companion*. Addison-Wesley. Pearson, 1st edition, 2009.

[26] A Rajaram. Coupling of demo and aris: based on theoretical ground. Master's thesis, TU Delft, Electrical Engineering, Mathematics, Computer Science, October 2008.

[27] Cynthia K. Riemenschneider, Bill C. Hardgrave, and Fred D. Davis. Explaining software developer acceptance of methodologies: A comparison of five theoretical models. *IEEE Trans. Softw. Eng.*, 28(12):1135–1145, 2002. ISSN 0098-5589.

[28] Albert H. Segars and Varun Grover. Re-examining perceived ease of use and usefulness: A confirmatory factor analysis. *MIS Quarterly*, 17(4):517–525, December 1993. ISSN 02767783.

[29] P. A. Smart, H. Maddern, and R. S. Maull. Understanding business process management: Implications for theory and practice. *British Journal of Management*, 20(4): 491–507, 2009.

[30] Detmar Straub, Mark Keil, and Walter Brenner. Testing the technology acceptance model across cultures: a three country study. *Information Management*, 33(1):1–11, 1997. ISSN 0378-7206.

[31] D Strijdhaftig. On the coupling of architectures: Leveraging demo theory within the aris framework. Master's thesis, TU Delft, Electrical Engineering, Mathematics, Computer Science, September 2008.

[32] Mark Toleman, Mustafa Ally, and Fiona Darroch. Aligning adoption theory with agile system development methodologies. In *8th Pacific-Asia Conference on Information Systems (PACIS 2004)*, Shanghai, China, July 2004.

[33] L.G. Tornatzky and L. Klein. Innovation characteristics and innovation-implementation: a meta-analysis of findings. *IEEE Transactions on Engineering Management*, 29:28–45, February 1982.

[34] Wil M. P. van der Aalst, Arthur H. M. ter Hofstede, and Mathias Weske. Business process management: A survey. In Wil M. P. van der Aalst, Arthur H. M. ter Hofstede, and Mathias Weske, editors, *Business Process Management: International Conference, BPM 2003, Eindhoven, The Netherlands, June 26-27, 2003, Proceedings*, pages 1–12. Springer, June 2003.

[35] Damjan Vavpotic and Marko Bajec. An approach for concurrent evaluation of technical and social aspects of software development methodologies. *Information and Software Technology*, 51(2):528 – 545, 2009.

[36] Kris Ven and Jan Verelst. The adoption of demo: A research agenda. In Antonia Albani, Joseph Barjis, and Jan L. G. Dietz, editors, *Advances in Enterprise Engineering III- 5th International Workshop CIAO!and 5th International Workshop EOMAS*, pages 157–171. Springer Berlin Heidelberg, June 2009.

[37] Viswanath Venkatesh and Hillol Bala. Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, 39(2):273–315, May 2008.

[38] T.F. Verhoef. *Effective Information Modelling Support*. PhD thesis, TUDelft-Delft University of Technology, 1993.

[39] Eric Vittinghoff, Stephen C. Shiboski, David V. Glidden, and Charles E. McCulloch. *Regression Methods in Biostatistics - Linear, Logistic, Survival, and Repeated Measures Models*, chapter 6 Logistic Regression. Statistics for Biology and Health. Springer New York, 2004.

[40] Y Wang. Transformation of demo models into exchangeable format. Master's thesis, TU Delft, Electrical Engineering, Mathematics, Computer Sci, Computer Science, JUNE 2009.

[41] G.M. Wijers. *Modeling Support in Information System Development*. Thesis Publishers Amsterdam, 1991.

[42] Ian H. Witten and Eibe Frank. *Data mining, practical machine learning tools and techniques*. Morgan Kaufmann, 2nd edition, 2005.

Appendix A

Questionnaire

Investigation of the Adoption of DEMO

This survey research is held to get more insight in the adoption of DEMO in practice. We want to investigate the factors that affect this adoption. These factors include specific factual information about the respondent as well as his/her perception, belief, feeling or experience regarding DEMO. We also want to investigate to what extent a particular way of working with DEMO (which shows how to make models, in what order, etc.) influences the factors under investigation and in the end may improve the adoption of DEMO.

As a first step in this investigation, we would like you to provide answers to the questions in this questionnaire.

The number of questions may vary based on your occupation and other answers you give during the questionnaire. As a result, you may have to answer between 20-48 questions.

It is possible to answer the questions in several sessions. This way you can answer the questionnaire in your free time.

Start with the question: *What are you currently doing?*

DEMO Professional

1. For how long do you know DEMO?
   When was the first time you heard about DEMO and thought it would have been interesting to know more about it?

- Less than 6 months
- Between 6 months and 1 year
- Between 1 year and 2 years
- Between 2 years and 3 years
- More than 3 years

DEMO Professional
DEMO professionals are people who passed the DEMO Prof exam and got a diploma which entitles them as a DEMO Professional.

2. Did you participate in a DEMO Professional exam?

- Yes
- No ➪ Continue with question 5.

3. In what year did you participate in the exam?

20

4. Did you get the DEMO Professional Degree?

- Yes
- No

Experience with DEMO
Academic Case Experience

5. Approximately how many exercises have you solved with DEMO before applying it in practice (e.g. cases in your work)?

- Less than 5 exercises
- Between 5−10 exercises
- More than 10 exercises

Learning Method

6. Have you had training in DEMO?

- Yes, I participated in a training workshop
- Yes, I participated in a training course which was not part of a study program
- Yes, I participated in a course as part of a study program at the university
- No but I can consult professionals whenever I have a question
- No, I didn?t get any training about DEMO and don?t get consultation from any professional either

➪

Employees

Please answer the following questions based on your experienece in the last job you had.

Company Properties

1. Company Properties
   How large is the company that you are/were working in?

- Less than 10 employees → Continue with question *Position Level*
- 10 − 99 employees → Continue with question *Position Level*
- 100 − 500 employees
- 500 or more employees

2. How large is the department (or group) you are/were working in?

- less than 20 employees
- 20 − 50 employees
- 50−100 employees
- More than 100 employees

Position

3. Position Level
   What is your job called? What is your current position in your working place?

4. In what category does your position fit in your company (department)?

- Managerial position
- Non− managerial position

5. How long have you been in that position?

- Less than 6 months
- Between 6 months and 1 year
- Between 1 year and 2 years
- Between 2 years and 3 years
- More than 3 years

→

Employees Adoption Behavior

Real Case Experience

1. In how many cases have you applied DEMO in your professional career?

- None ➪ Continue with question *Adoption behavior*
- Less than 5 cases
- Between 5−10 cases
- More than 10 cases

2. For how many years have you been applying DEMO in practice?

When talking about application in practice we mean applying DEMO in the cases you encountered in your professional career

- Less than 6 months
- Between 6 months and 1 year
- Between 1 year and 2 years
- Between 2 years and 3 years
- More than 3 years

Usage Convergence

3. On average how many projects have you been working on (managing) in the last 6 months?

- 1 or 2
- Less than 5
- Between 5−10
- More than 10

4. How many of the projects are still going on (not finished completely)?

- None
- 1 or 2
- Less than 5
- Between 5−10
- More than 10

Customers

5. Which of the following describes your job well?

- In last six months more than 50% of the projects that I have done were for clients outside the company
- In the last six months more than 50% of the projects that I have done were for departments inside the company

Usage opportunity

6. In how many of the projects that you have been working on in the last 6 months could DEMO (or part of DEMO or concepts of DEMO) have been applicable as a solution?

- None
- One
- Less than 5
- Between 5−10
- More than 10

If RCE Equals 1
AND ABUO Equals 1 ➪

Usage Frequency

7. In how many of the projects that you have been working on in the last 6months DEMO (or part of DEMO or concepts of DEMO) ?*have been applied*? as a solution?

The process of application should have been started at the moment

- None
- One
- Less than 5
- Between 5−10
- More than 10

If ABUO Equals 1
AND ABUF Equals 1
AND NFI Equals 0 ➪

Else if NFI Equals 0 ➪ *How frequent the models of DEMO have been used in the projects that you worked on in which DEMO was applied in the last 6 months?*

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8. In how many of the projects that you have been working on in the last 6months DEMO (or part of DEMO or concepts of DEMO) *"is planned to be applied"* as a solution?

- None
- One
- Less than 5
- Between 5−10
- More than 10

If ABUO Equals 1
AND ABUF Equals 1
AND isPlanned Equals 1 ➪

---

9. How frequent the models of DEMO have been used in the projects that you worked on in which DEMO was applied in the last 6 months?

	None	less than 50% of the projects	50% of the projects	50% − 80% of the projects	More than 80% of the projects
State Model	○	○	○	○	○
Construction Model:					
Interaction Model	○	○	○	○	○
Interstriction Model	○	○	○	○	○
Process model	○	○	○	○	○
Action Model	○	○	○	○	○

If NFI Equals 0 ➪ *Have you used any concepts of DEMO in your projects in the last six months?*

---

10. Which models are you planning to use later on for these projects?

- ☐ State model
- ☐ Construction Model
- ☐ Process Model
- ☐ Interistiction model
- ☐ Action Model

11. Have you used any concepts of DEMO in your projects in the last six months?

- Yes
- No ➪ Continue with question 24.

12. Please name the concepts of DEMO you have used in your projects in the last six months?

If NFI Equals 0

13. Which concepts do you think you may use later on for these projects? (Name them)

Employees Subjective Norm

Subjective Norm

1. Which of the following best describes the management possion in your comapny with respect to DEMO?

- ○ The management has not heard of DEMO
- ○ Management has heard of DEMO but does not have knowledge about the concepts and models of DEMO
- ○ Management knows about the concepts and models of DEMO but is not able to make correct models
- ○ Management knows about the concepts and models of DEMO and is able to make correct models for simple problems
- ○ Management knows about the concepts and models of DEMO and is able to make correct models most of the times

2. Which of the following best describes your company's situation with respect to DEMO?

- ○ Management does not support applying DEMO in any of the cases
- ○ Management supports applying DEMO in less than 50% of the cases
- ○ Management supports applying DEMO in 50% − 80% of the cases
- ○ Management supports applying DEMO in all the cases

Group Attitude

3. How many people that you know in your company (department) are DEMO Professionals?

Approximatly _____
People

4. How many people that you know in your company (department) apply DEMO in their day to day works?

Approximatly _____
People

5. What is the competitor methodology for DEMO at the company you are working in?

- ☐ Pronto
- ☐ RUP
- ☐ UML
- ☐ Others _____

Jump between sections manager

If PE Equals 6 ➪ *Company Properties*
Else if PE Equals 5 ➪ *Non workers*
Else if PE Equals 3 ➪ *Company Properties*
Else if PE Equals 1 ➪ *As a master student what is your situation at the moment?*
Else if PE Equals 2 ➪
Else if PE Equals 4 ➪
Else ➪ *For how long do you know DEMO? When was the first time you heard about DEMO and thought it would have been interesting to know more about it?*
Else if PE Does not equal 3 ➪
Else if PE Equals 3 ➪
Else if PE Equals 1
AND masterThesis Equals 1 ➪ *Real Case Experience*
Else if PE Equals 1
AND masterThesis Equals 2 ➪ *How probable it is that you pick a thesis topic related to DEMO?*
Else if PE Equals 4 ➪ *Real Case Experience*
Else if PE Equals 2
OR PE Equals 3 ➪ *Real Case Experience*
Else if PE Is greater than or equal to 5
OR PE Equals 3 ➪ *Real Case Experience*
Else ➪ *In what order do you usually apply DEMO model when designing?*
Else if Manager Equals 1 ➪ *Group Attitude*
Else if Manager Equals 2 ➪ *Subjective Norm*
Else if PE Equals 1
AND masterThesis Equals 1 ➪ *Subjective Norm*
Else if PE Equals 1
AND masterThesis Equals 2 ➪ *Group Attitude*
Else if PE Equals 2
OR PE Equals 4 ➪ *Subjective Norm*
Else ➪ *Participation*

Obtaining Knowledge

1. In what order do you usually apply DEMO model when designing?

	in the 1st step	in the 2nd step	in the third step	in the forth step	in the fifth step
State model	○	○	○	○	○
Interaction Model (Part of Construction Model)	○	○	○	○	○
Interstriction Model (Part ofConstruction Model)	○	○	○	○	○
Process Model	○	○	○	○	○
Action Model	○	○	○	○	○

Experience with other methodologies

2. Do you have experience with other methodologies?

- ☐ Pronto
- ☐ RUP
- ☐ UML
- ☐ Others

Obtainability of knowledge

Enterprise Ontology is the book written by Jan Dietz in which all the concepts and models of DEMO have been explained. There are other books available about DEMO and its related concepts. Also, the proceedings of several workshops on DEMO have been published.

3. Which books do you use as reference?

- ☐ Enterprise Ontology (By Jan Dietz)
- ☐ Enterprise governance and enterprise engineering (By Jan Hoogervorst)
- ☐ Enterprise Architecture (By Martine Op?tLand)
- ☐ Others

4. Have you read any new books or articles about DEMO in the last 6 months?

- ○ Yes
- ○ No → Continue with question 35.

5. How many articles have you read about DEMO in the last 6 months?

- ○ 1 or 2
- ○ Less than 5
- ○ Between 5−10
- ○ More than 10

6. Much information about DEMO can be found on the DEMO knowledge Center website http://www.demo.nl/. How many times have you visited that website in the last 6 months?

- ○ Never
- ○ 1 or 2
- ○ Less than 5
- ○ Between 5−10
- ○ More than 10

Occupation

Occupation
Practical Experience

1. What are you currently doing?

- Master Student
- Fulltime PhD Student
- Part time PhD student and part time working
- Just finished studying and looking for a job or a faculty position
- Currently not working and was employed before
- Currently employed

2. What was your last educational degree?

- Bachelor Degree
- Master Degree
- PhD Degree
- Other

3. How long ago did you get your last educational Degree?

- Less than 6 months
- Between 6 months and 1 year
- Between 1 year and 2 years
- Between 2 years and 3 years
- More than 3 years

As explained later this research is follwoed by several other steps.

After this questionnaire, an interview will be scheduled in which each participant talks about his/her experience extensively (The time and place of the interviews can be arranged based on your preferences).

Then, participants with different perceptions will get together in a Group Decision Session to discuss problems and collaborate to come up with possible changes to DEMO that they think can improve DEMO?s adoption. The use of a GDSS (Group Decision Support System) will increase the collaboration between the participants while keeping the anonymity which will decrease the influence of political behavior.

4. Are you willing to participate in any of afformetioned steps?

- yes
- No

5. Do you have anything you would like to add to this questionnaire?

PhdStudent/Employee Adoption Behavior

Real Case Experience

1. Did you apply DEMO (or part of DEMO or concepts of DEMO) in the thesis project of any of your privious educational studies?

- Yes
- No

Please answer the following questions based on your latest educational study

Adoption behavior

Usage opportunity

2. Could DEMO (or part of DEMO or concepts of DEMO) have been applicable in your thesis?

- Yes
- No

If RCEThesis Equals 2
AND PE Equals 4

Usage Frequency

3. Has DEMO (or part of DEMO or concepts of DEMO) been applied or used in your thesis project?

The process of application should have been started at the moment

- Yes
- No

4. Are you planning to apply or use DEMO (or part of DEMO or concepts of DEMO) in your thesis project later on?

- Yes
- No

If RCEThesis Equals 2
AND ABUFThesis Equals 2
AND isPlannedThesis Equals 2

---

5. Which models of DEMO have been used (or is planned to be used) in your thesis?

- [ ] State model
- [ ] Interaction Model (Part of Construction Model)
- [ ] Interstriction Model (Part of Construction Model)
- [ ] Process Model
- [ ] Action Model

6. Have you used any concepts of DEMO in your thesis project?

- Yes
- No Continue with question 48.

7. Please name the concepts of DEMO you have used in your project in the last six months?

If PE Equals 4

8. Which concepts do you think you may use later on for your thesis projects? (Name them)

End questionnaire

Student

1. As a master student what is your situation at the moment?

- I am a master student currently working on my thesis
- I am a master student who has not started my thesis yet

Student Adoption Behavior

Real Case Experience

1. Did you apply DEMO (or part of DEMO or concepts of DEMO) in the thesis project of any of your privious educational studies?

- Yes
- No

Please answer the following questions based on your latest educational study

Adoption behavior

Usage opportunity

2. Could DEMO (or part of DEMO or concepts of DEMO) have been applicable in your thesis?

- Yes
- No

If RCEThesis Equals 2
AND PE Equals 4 ➪

Else if PE Equals 4
AND Degree Equals 3 ➪ *Which models of DEMO have been used in your thesis?*

Usage Frequency

3. Has DEMO (or part of DEMO or concepts of DEMO) been applied or used in your thesis project?

The process of application should have been started at the moment

- Yes
- No

4. Are you planning to apply or use DEMO (or part of DEMO or concepts of DEMO) in your thesis project later on?

- Yes
- No

If RCEThesis Equals 2
AND ABUFThesis Equals 2
AND isPlannedThesis Equals 2 ➪

---

5. Which models of DEMO have been used in your thesis?

- ☐ State model
- ☐ Interaction Model (Part of Construction Model)
- ☐ Interstriction Model (Part of Construction Model)
- ☐ Process Model
- ☐ Action Model

If PE Equals 4 ➪ *Have you used any concepts of DEMO in your thesis project?*

---

6. Which models are you planning to use later on in your thesis?

- [ ] State model
- [ ] Construction Model
- [ ] Process Model
- [ ] Interistiction model
- [ ] Action Model

7. Have you used any concepts of DEMO in your thesis project?

- ○ Yes
- ○ No ➪ Continue with question 58.

8. Please name the concepts of DEMO you have used in your project in the last six months?

If PE Equals 4 ➪

---

9. Which concepts do you think you may use later on for your thesis projects? (Name them)

➪

---

10. How probable it is that you pick a thesis topic related to DEMO?

radio 0% probability
radio less than 50% probability
radio may be (50 − 50)
radio quite probable (more than 50%)
radio 100% probable

➪

Appendix B

Data Analysis Results

Crosstabs

DegreeTime * General Adoption Crosstabulation

			General Adoption		
			'No adoption'	'Adoption'	Total
DegreeTime	'Less than 6 months'	Count	3	0	3
		% within DegreeTime	100.0%	.0%	100.0%
	'Between 6 months and 1 year'	Count	1	0	1
		% within DegreeTime	100.0%	.0%	100.0%
	'Between 1 year and 2 years'	Count	0	3	3
		% within DegreeTime	.0%	100.0%	100.0%
	'Between 2 years and 3 years'	Count	0	2	2
		% within DegreeTime	.0%	100.0%	100.0%
	'More than 3 years'	Count	10	33	43
		% within DegreeTime	23.3%	76.7%	100.0%
	Total	Count	14	38	52
		% within DegreeTime	26.9%	73.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.993[a]	4	.011
Likelihood Ratio	13.937	4	.007
Linear-by-Linear Association	6.358	1	.012
N of Valid Cases	52		

a. 8 cells (80.0%) have expected count less than 5. The minimum expected count is .27.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.174	.064	2.082	.037
		DegreeTime Dependent	.000	.000	.[c]	.[c]
		General Adoption Dependent	.286	.121	2.082	.037
	Goodman and Kruskal tau	DegreeTime Dependent	.054	.047		.027[d]
		General Adoption Dependent	.250	.051		.013[d]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

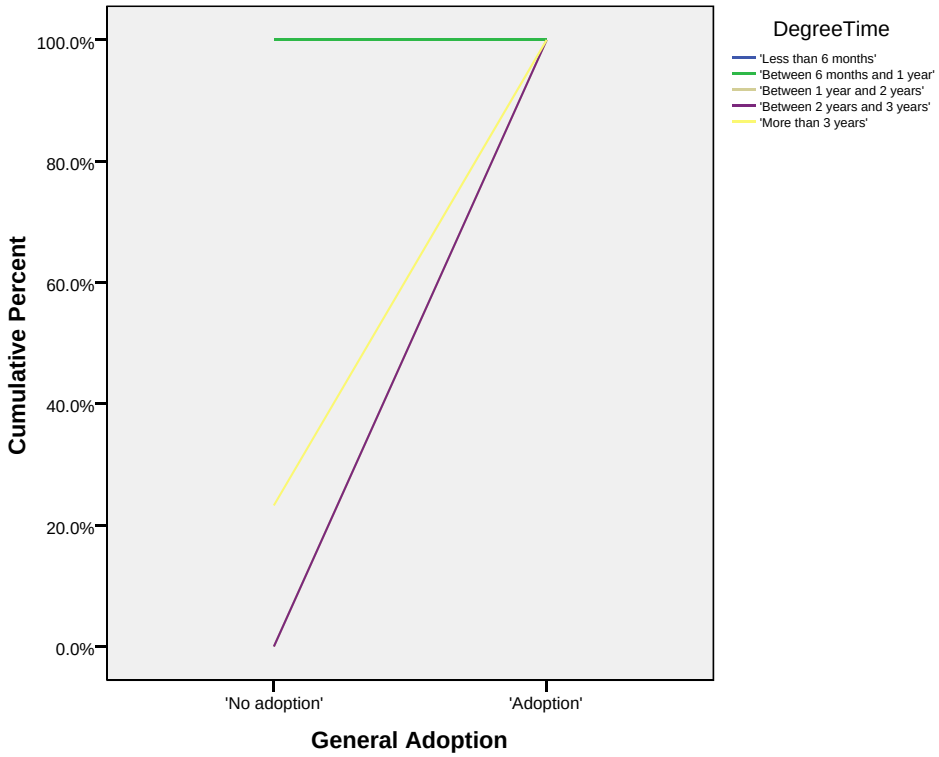
c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.500	.011
	Cramer's V	.500	.011
	N of Valid Cases	52	

Graph



Dependent Variable Encoding

Original ...	Internal Value
'No adoption'	0
'Adoption'	1

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 0	General Adoption	'No adoption'	0	14	.0
		'Adoption'	0	38	100.0
		Overall Percentage			73.1

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.999	.313	10.201	1	.001	2.714

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	DegreeTime	6.482	1	.011
		Overall Statistics	6.482	1	.011

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	5.747	1	.017
	Block	5.747	1	.017
	Model	5.747	1	.017

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	54.832[a]	.105	.152

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 1	General Adoption	'No adoption'	4	10	28.6
		'Adoption'	0	38	100.0
		Overall Percentage			80.8

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	DegreeTime	.661	.299	4.883	1	.027	1.937
	Constant	-1.954	1.381	2.002	1	.157	.142

Crosstabs

ManagementSupport * General Adoption Crosstabulation

			General Adoption		
			'No adoption'	'Adoption'	Total
ManagementSupport	noSupport	Count	11	14	25
		% within ManagementSupport	44.0%	56.0%	100.0%
	supportLessThanHalf	Count	3	15	18
		% within ManagementSupport	16.7%	83.3%	100.0%
	supportMoreThanHalf	Count	0	9	9
		% within ManagementSupport	.0%	100.0%	100.0%
	Total	Count	14	38	52
		% within ManagementSupport	26.9%	73.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.984[a]	2	.018
Likelihood Ratio	10.062	2	.007
Linear-by-Linear Association	7.678	1	.006
N of Valid Cases	52		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 2.42.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.024	.130	.186	.853
		ManagementSupport Dependent	.037	.196	.186	.853
		General Adoption Dependent	.000	.000	.[c]	.[c]
	Goodman and Kruskal tau	ManagementSupport Dependent	.084	.051		.014[d]
		General Adoption Dependent	.154	.078		.020[d]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

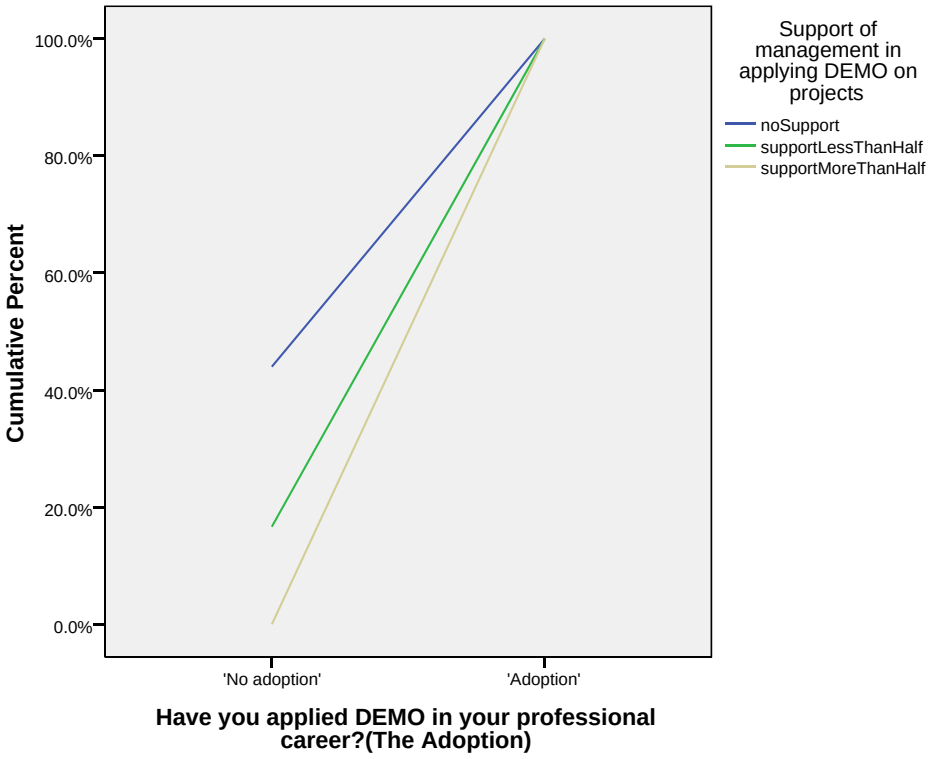
c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.392	.018
	Cramer's V	.392	.018
	N of Valid Cases	52	

Graph



Logistic Regression

Case Processing Summary

Unweighted Cases [a]		N	Percent
Selected Cases	Included in Analysis	52	100.0
	Missing Cases	0	.0
	Total	52	100.0
	Unselected Cases	0	.0
	Total	52	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original …	Internal Value
'No adoption'	0
'Adoption'	1

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 0	General Adoption	'No adoption'	0	14	.0
		'Adoption'	0	38	100.0
		Overall Percentage			73.1

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.999	.313	10.201	1	.001	2.714

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	ManagementSupport	7.829	1	.005
		Overall Statistics	7.829	1	.005

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	9.380	1	.002
	Block	9.380	1	.002
	Model	9.380	1	.002

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	51.199[a]	.165	.240

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	.422	1	.516

Contingency Table for Hosmer and Lemeshow Test

		General Adoption = 'No adoption'		General Adoption = 'Adoption'		
		Observed	Expected	Observed	Expected	Total
Step 1	1	11	11.268	14	13.732	25
	2	3	2.464	15	15.536	18
	3	0	.268	9	8.732	9

Classification Table[a]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 1	General Adoption	'No adoption'	0	14	.0
		'Adoption'	0	38	100.0
		Overall Percentage			73.1

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	ManagementSupport	1.643	.652	6.345	1	.012	5.173
	Constant	-1.446	.919	2.472	1	.116	.236

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Subjective Norm * General Adoption	37	71.2%	15	28.8%	52	100.0%

Subjective Norm * General Adoption Crosstabulation

			General Adoption		
			'No adoption'	'Adoption'	Total
Subjective Norm	None	Count	7	7	14
		% within Subjective Norm	50.0%	50.0%	100.0%
	lessThanHalf	Count	4	8	12
		% within Subjective Norm	33.3%	66.7%	100.0%
	MoreThanHalf	Count	0	11	11
		% within Subjective Norm	.0%	100.0%	100.0%
	Total	Count	11	26	37
		% within Subjective Norm	29.7%	70.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.482[a]	2	.024
Likelihood Ratio	10.349	2	.006
Linear-by-Linear Association	7.019	1	.008
N of Valid Cases	37		

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is 3.27.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.118	.191	.593	.553
		Subjective Norm Dependent	.174	.168	.954	.340
		General Adoption Dependent	.000	.340	.000	1.000
	Goodman and Kruskal tau	Subjective Norm Dependent	.100	.049		.028[c]
		General Adoption Dependent	.202	.078		.026[c]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

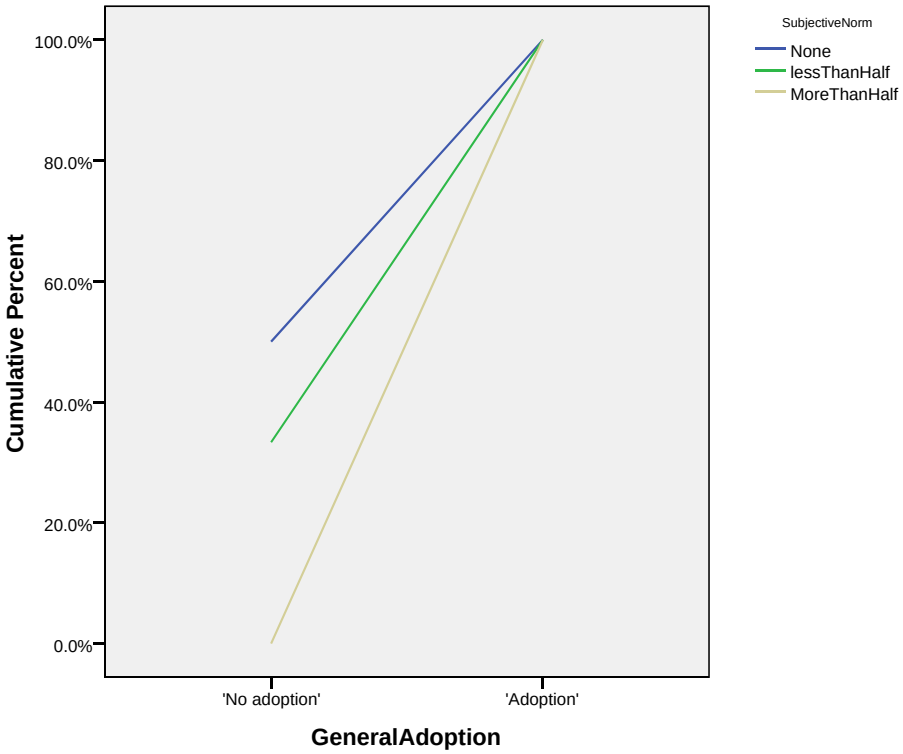
c. Based on chi-square approximation

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.450	.024
	Cramer's V	.450	.024
	N of Valid Cases	37	

Graph

[DataSet2]



Logistic Regression

```
[DataSet1] C:\Users\Saman\Desktop\My Dropbox\Thesis\Data Analysis\DataSets\Fo
rDecisionTree\DataReadyForDecisionTree(V1)_2.sav
```

Case Processing Summary

Unweighted Cases [a]		N	Percent
Selected Cases	Included in Analysis	37	71.2
	Missing Cases	15	28.8
	Total	52	100.0
	Unselected Cases	0	.0
	Total	52	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original …	Internal Value
'No adoption'	0
'Adoption'	1

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 0	General Adoption	'No adoption'	0	11	.0
		'Adoption'	0	26	100.0
		Overall Percentage			70.3

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.860	.360	5.720	1	.017	2.364

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	DEMOProFriends AdoptionPercentage Category	7.214	1	.007
		Overall Statistics	7.214	1	.007

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	8.009	1	.005
	Block	8.009	1	.005
	Model	8.009	1	.005

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	37.024[a]	.195	.276

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	1.748	1	.186

Contingency Table for Hosmer and Lemeshow Test

		General Adoption = 'No adoption'		General Adoption = 'Adoption'		
		Observed	Expected	Observed	Expected	Total
Step 1	1	7	7.678	7	6.322	14
	2	4	2.643	8	9.357	12
	3	0	.678	11	10.322	11

Classification Table[a]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 1	General Adoption	'No adoption'	7	4	63.6
		'Adoption'	7	19	73.1
		Overall Percentage			70.3

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	DEMOProFriends AdoptionPercentage Category	1.458	.597	5.964	1	.015	4.299
	Constant	-1.653	1.004	2.708	1	.100	.192

Crosstabs

ReadingNewBooksArticles * General Adoption Crosstabulation

			General Adoption		
			'No adoption'	'Adoption'	Total
ReadingNewBooks Articles	Yes	Count	5	26	31
		% within ReadingNewBooks Articles	16.1%	83.9%	100.0%
	No	Count	9	12	21
		% within ReadingNewBooks Articles	42.9%	57.1%	100.0%
	Total	Count	14	38	52
		% within ReadingNewBooks Articles	26.9%	73.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.546[a]	1	.033		
Continuity Correction[b]	3.289	1	.070		
Likelihood Ratio	4.505	1	.034		
Fisher's Exact Test				.055	.035
Linear-by-Linear Association	4.458	1	.035		
N of Valid Cases	52				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.65.

b. Computed only for a 2x2 table

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.114	.098	1.081	.280
		ReadingNewBooks Articles Dependent	.190	.160	1.081	.280
		General Adoption Dependent	.000	.000	.[c]	.[c]
	Goodman and Kruskal tau	ReadingNewBooks Articles Dependent	.087	.079		.035[d]
		General Adoption Dependent	.087	.080		.035[d]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

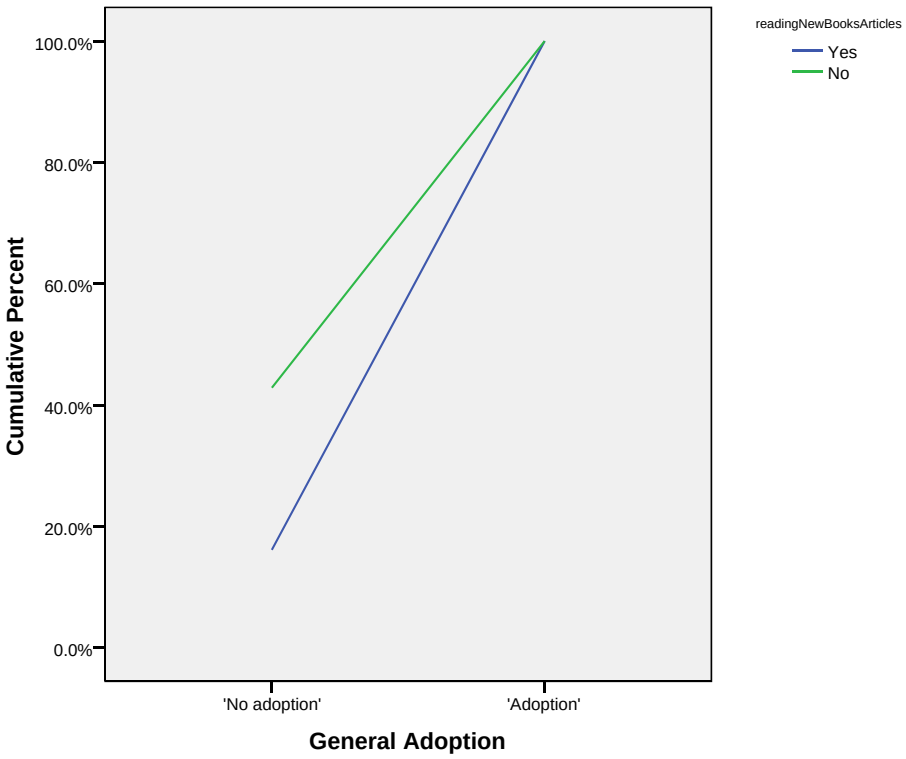
c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	-.296	.033
	Cramer's V	.296	.033
	N of Valid Cases	52	

Graph



Logistic Regression

Case Processing Summary

Unweighted Cases [a]		N	Percent
Selected Cases	Included in Analysis	52	100.0
	Missing Cases	0	.0
	Total	52	100.0
	Unselected Cases	0	.0
	Total	52	100.0

a. If weight is in effect, see classification table for the total number of cases.

Dependent Variable Encoding

Original ...	Internal Value
'No adoption'	0
'Adoption'	1

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 0	General Adoption	'No adoption'	0	14	.0
		'Adoption'	0	38	100.0
		Overall Percentage			73.1

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.999	.313	10.201	1	.001	2.714

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	ReadingNewBooks Articles	4.546	1	.033
		Overall Statistics	4.546	1	.033

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	4.505	1	.034
	Block	4.505	1	.034
	Model	4.505	1	.034

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	56.074[a]	.083	.121

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 1	General Adoption	'No adoption'	0	14	.0
		'Adoption'	0	38	100.0
		Overall Percentage			73.1

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	ReadingNewBooks Articles	-1.361	.658	4.279	1	.039	.256
	Constant	3.010	1.072	7.888	1	.005	20.280

Crosstabs

NoNewArticles * General Adoption Crosstabulation

			General Adoption		
			'No adoption'	'Adoption'	Total
NoNewArticles	None	Count	9	12	21
		% within NoNewArticles	42.9%	57.1%	100.0%
	Some	Count	2	19	21
		% within NoNewArticles	9.5%	90.5%	100.0%
	Many	Count	3	7	10
		% within NoNewArticles	30.0%	70.0%	100.0%
	Total	Count	14	38	52
		% within NoNewArticles	26.9%	73.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.989[a]	2	.050
Likelihood Ratio	6.471	2	.039
Linear-by-Linear Association	1.605	1	.205
N of Valid Cases	52		

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 2.69.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.156	.114	1.277	.202
		NoNewArticles Dependent	.226	.158	1.277	.202
		General Adoption Dependent	.000	.000	.[c]	.[c]
	Goodman and Kruskal tau	NoNewArticles Dependent	.073	.051		.024[d]
		General Adoption Dependent	.115	.079		.053[d]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.339	.050
	Cramer's V	.339	.050
	N of Valid Cases	52	

Graph

```
[DataSet1] C:\Users\Saman\Desktop\My Dropbox\Thesis\Data Analysis\DataSets\Fo
rDecisionTree\DataReadyForDecisionTree(V1)_1.sav
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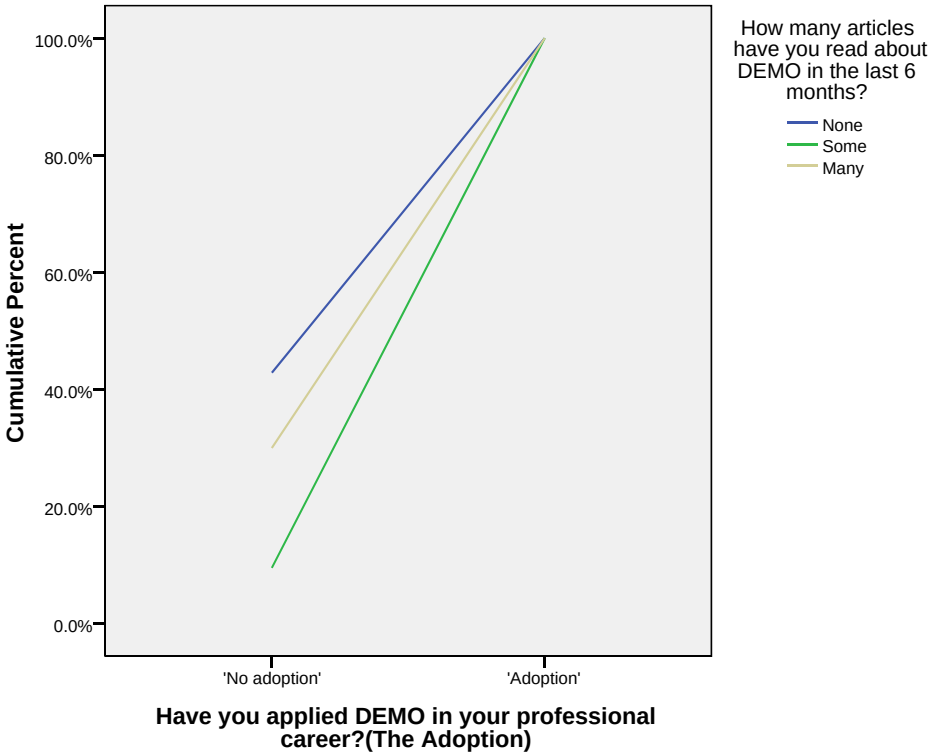

Logistic Regression

Dependent Variable Encoding

Original …	Internal Value
'No adoption'	0
'Adoption'	1

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 0	General Adoption	'No adoption'	0	14	.0
		'Adoption'	0	38	100.0
		Overall Percentage			73.1

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.999	.313	10.201	1	.001	2.714

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	NoNewArticles	1.637	1	.201
		Overall Statistics	1.637	1	.201

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	1.699	1	.192
	Block	1.699	1	.192
	Model	1.699	1	.192

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	58.881[a]	.032	.047

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	4.606	1	.032

Contingency Table for Hosmer and Lemeshow Test

		General Adoption = 'No adoption'		General Adoption = 'Adoption'		
		Observed	Expected	Observed	Expected	Total
Step 1	1	9	7.498	12	13.502	21
	2	2	5.004	19	15.996	21
	3	3	1.498	7	8.502	10

Classification Table[a]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 1	General Adoption	'No adoption'	0	14	.0
		'Adoption'	0	38	100.0
		Overall Percentage			73.1

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	NoNewArticles	.574	.455	1.589	1	.207	1.775
	Constant	.588	.432	1.856	1	.173	1.801

Crosstabs

PositionDu * General Adoption Crosstabulation

			General Adoption		
			'No adoption'	'Adoption'	Total
PositionDu	'Less than 6 months'	Count	4	1	5
		% within PositionDu	80.0%	20.0%	100.0%
	'Between 6 months and 1 year'	Count	1	3	4
		% within PositionDu	25.0%	75.0%	100.0%
	'Between 1 year and 2 years'	Count	3	3	6
		% within PositionDu	50.0%	50.0%	100.0%
	'Between 2 years and 3 years'	Count	4	8	12
		% within PositionDu	33.3%	66.7%	100.0%
	'More than 3 years'	Count	2	23	25
		% within PositionDu	8.0%	92.0%	100.0%
	Total	Count	14	38	52
		% within PositionDu	26.9%	73.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.592[a]	4	.009
Likelihood Ratio	13.544	4	.009
Linear-by-Linear Association	10.539	1	.001
N of Valid Cases	52		

a. 7 cells (70.0%) have expected count less than 5. The minimum expected count is 1.08.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.122	.115	1.010	.313
		PositionDu Dependent	.074	.087	.822	.411
		General Adoption Dependent	.214	.210	.912	.362
	Goodman and Kruskal tau	PositionDu Dependent	.087	.044		.001[c]
		General Adoption Dependent	.261	.114		.010[c]

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on chi-square approximation

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.511	.009
	Cramer's V	.511	.009
	N of Valid Cases	52	

Graph

```
[DataSet1] C:\Users\Saman\Desktop\My Dropbox\Thesis\Data Analysis\DataSets\Fo
rDecisionTree\DataReadyForDecisionTree(V1)_1.sav
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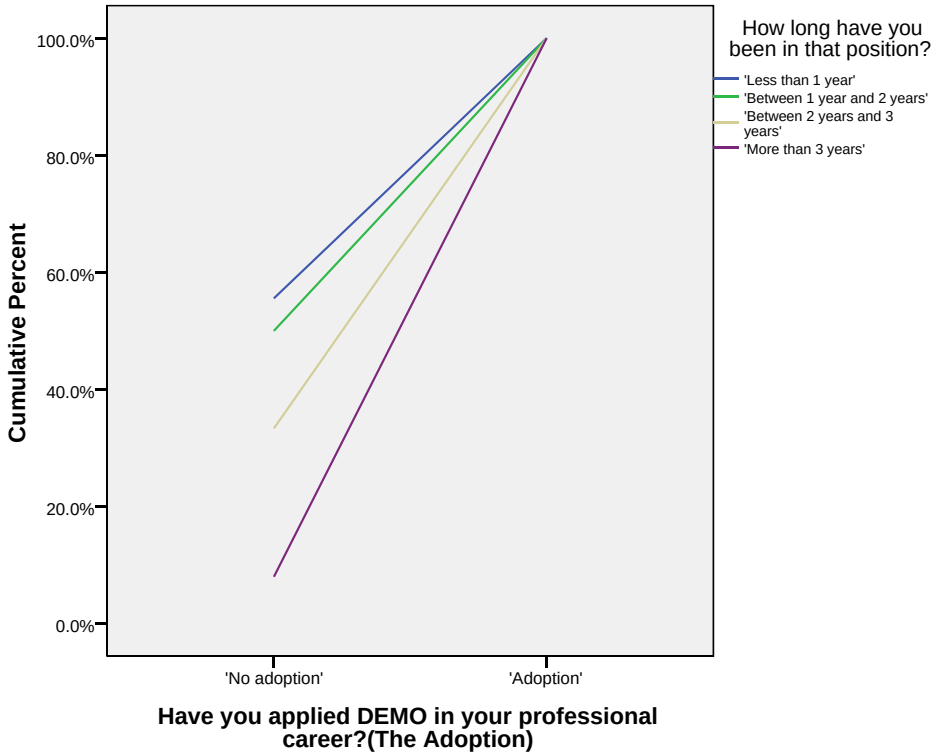


Logistic Regression

Dependent Variable Encoding

Original …	Internal Value
'No adoption'	0
'Adoption'	1

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 0	General Adoption	'No adoption'	0	14	.0
		'Adoption'	0	38	100.0
		Overall Percentage			73.1

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.999	.313	10.201	1	.001	2.714

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	PositionDu	10.746	1	.001
		Overall Statistics	10.746	1	.001

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	10.263	1	.001
	Block	10.263	1	.001
	Model	10.263	1	.001

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	50.316[a]	.179	.260

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	3.296	3	.348

Contingency Table for Hosmer and Lemeshow Test

		General Adoption = 'No adoption'		General Adoption = 'Adoption'		
		Observed	Expected	Observed	Expected	Total
Step 1	1	4	3.705	1	1.295	5
	2	1	2.288	3	1.712	4
	3	3	2.305	3	3.695	6
	4	4	2.708	8	9.292	12
	5	2	2.995	23	22.005	25

Classification Table[a]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 1	General Adoption	'No adoption'	5	9	35.7
		'Adoption'	4	34	89.5
		Overall Percentage			75.0

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	PositionDu	.761	.258	8.688	1	.003	2.141
	Constant	-1.812	.983	3.402	1	.065	.163

Crosstabs

NoExcercise * General Adoption Crosstabulation

			General Adoption		
			'No adoption'	'Adoption'	Total
NoExcercise	'Less than 5 exercises'	Count	11	14	25
		% within NoExcercise	44.0%	56.0%	100.0%
	'Between 5-10 exercises'	Count	2	13	15
		% within NoExcercise	13.3%	86.7%	100.0%
	'More than 10 exercises'	Count	1	11	12
		% within NoExcercise	8.3%	91.7%	100.0%
	Total	Count	14	38	52
		% within NoExcercise	26.9%	73.1%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.221[a]	2	.027
Likelihood Ratio	7.618	2	.022
Linear-by-Linear Association	6.240	1	.012
N of Valid Cases	52		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 3.23.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T	Approx. Sig.
Nominal by Nominal	Lambda	Symmetric	.000	.000	.[b]	.[b]
		NoExcercise Dependent	.000	.000	.[b]	.[b]
		General Adoption Dependent	.000	.000	.[b]	.[b]
	Goodman and Kruskal tau	NoExcercise Dependent	.081	.052		.016[c]
		General Adoption Dependent	.139	.090		.029[c]

a. Not assuming the null hypothesis.

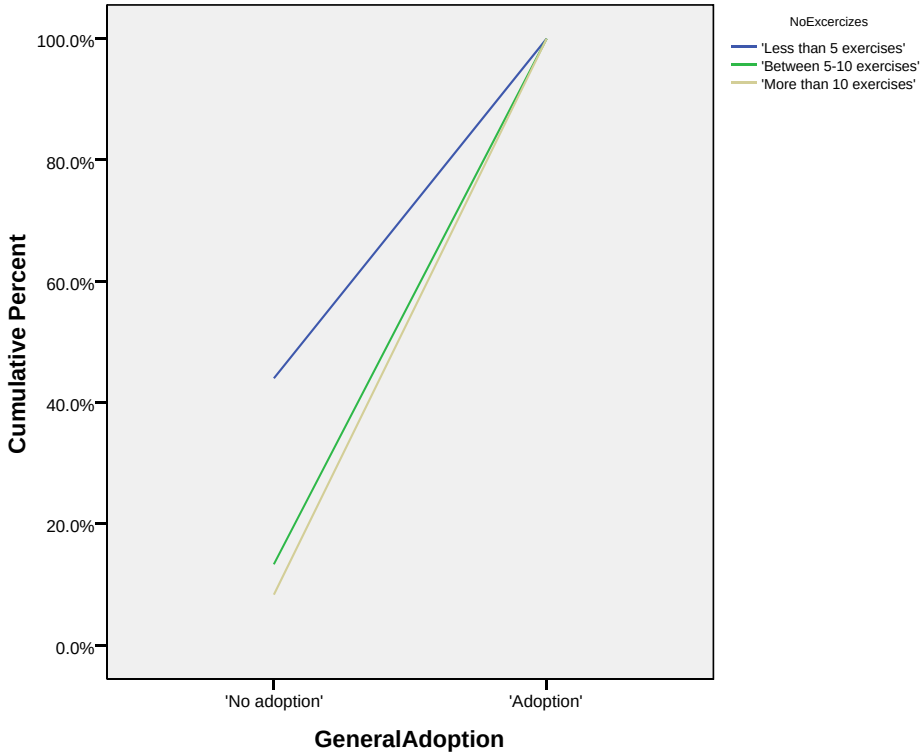
b. Cannot be computed because the asymptotic standard error equals zero.

c. Based on chi-square approximation

Symmetric Measures

		Value	Approx. Sig.
Nominal by Nominal	Phi	.373	.027
	Cramer's V	.373	.027
	N of Valid Cases	52	

Graph



Logistic Regression

Dependent Variable Encoding

Original …	Internal Value
'No adoption'	0
'Adoption'	1

Block 0: Beginning Block

Classification Table[a,b]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 0	General Adoption	'No adoption'	0	14	.0
		'Adoption'	0	38	100.0
		Overall Percentage			73.1

a. Constant is included in the model.

b. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.999	.313	10.201	1	.001	2.714

Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	NoExcercise	6.363	1	.012
		Overall Statistics	6.363	1	.012

Block 1: Method = Enter

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	7.271	1	.007
	Block	7.271	1	.007
	Model	7.271	1	.007

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	53.308[a]	.130	.190

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	.353	1	.553

Contingency Table for Hosmer and Lemeshow Test

		General Adoption = 'No adoption'		General Adoption = 'Adoption'		
		Observed	Expected	Observed	Expected	Total
Step 1	1	11	10.685	14	14.315	25
	2	2	2.630	13	12.370	15
	3	1	.685	11	11.315	12

Classification Table[a]

			Predicted		
			General Adoption		
	Observed		'No adoption'	'Adoption'	Percentage Correct
Step 1	General Adoption	'No adoption'	0	14	.0
		'Adoption'	0	38	100.0
		Overall Percentage			73.1

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1	NoExcercise	1.256	.541	5.382	1	.020	3.511
	Constant	-.963	.822	1.373	1	.241	.382

CompanySize * RecentAdoptionPortion Crosstabulation

			RecentAdoptionPortion			
			None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects	Total
CompanySize	'Less than 10 employees'	Count	4	2	4	10
		% within CompanySize	40.0%	20.0%	40.0%	100.0%
	'10 - 99 employees'	Count	6	0	0	6
		% within CompanySize	100.0%	.0%	.0%	100.0%
	'100 - 500 employees'	Count	0	0	1	1
		% within CompanySize	.0%	.0%	100.0%	100.0%
	'500 or more employees'	Count	18	11	6	35
		% within CompanySize	51.4%	31.4%	17.1%	100.0%
	Total	Count	28	13	11	52
		% within CompanySize	53.8%	25.0%	21.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.888[a]	6	.065
Likelihood Ratio	13.219	6	.040
Linear-by-Linear Association	.179	1	.672
N of Valid Cases	52		

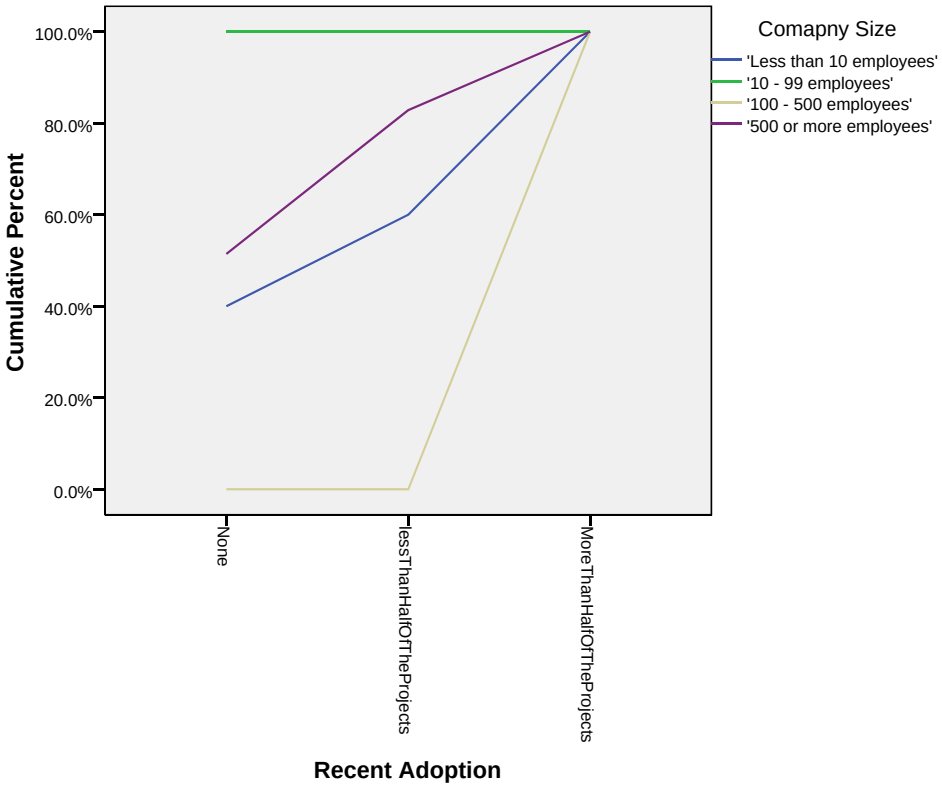
a. 8 cells (66.7%) have expected count less than 5. The minimum expected count is .21.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.031	.134	-.231	.817
		CompanySize Dependent	-.028	.122	-.231	.817
		RecentAdoptionPortion Dependent	-.034	.148	-.231	.817

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.



PLUM - Ordinal Regression

Warnings

There are 4 (33.3%) cells (i.e., dependent variable levels by combinations of predictor variable values) with zero frequencies.

Case Processing Summary

		N	Marginal Percentage
RecentAdoptionPortion	None	28	53.8%
	lessThanHalfOfThe Projects	13	25.0%
	MoreThanHalfOfThe Projects	11	21.2%
	Valid	52	100.0%
	Missing	0	
	Total	52	

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	25.455			
Final	25.393	.062	1	.803

Link function: Logit.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	11.669	5	.040
Deviance	13.157	5	.022

Link function: Logit.

Pseudo R-Square

Cox and Snell	.001
Nagelkerke	.001
McFadden	.001

Link function: Logit.

Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	[RecentAdoptionPortion = 1.00]	-.023	.730	.001	1	.975	-1.454	1.408
	[RecentAdoptionPortion = 2.00]	1.139	.750	2.306	1	.129	-.331	2.610
Location	CompanySize	-.055	.213	.065	1	.798	-.473	.364

Link function: Logit.

Cell Information

Frequency

CompanySize		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
'Less than 10 employees'	Observed	4	2	4
	Expected	5.079	2.596	2.325
	Pearson Residual	-.682	-.430	1.254
'10 - 99 employees'	Observed	6	0	0
	Expected	3.129	1.533	1.338
	Pearson Residual	2.346	-1.435	-1.312
'100 - 500 employees'	Observed	0	0	1
	Expected	.535	.251	.214
	Pearson Residual	-1.073	-.579	1.919
'500 or more employees'	Observed	18	11	6
	Expected	19.203	8.637	7.161
	Pearson Residual	-.408	.927	-.486

Link function: Logit.

Cell Information

Cumulative Frequency

CompanySize		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
'Less than 10 employees'	Observed	4	6	10
	Expected	5.079	7.675	10.000
	Pearson Residual	-.682	-1.254	.
'10 - 99 employees'	Observed	6	6	6
	Expected	3.129	4.662	6.000
	Pearson Residual	2.346	1.312	.
'100 - 500 employees'	Observed	0	0	1
	Expected	.535	.786	1.000
	Pearson Residual	-1.073	-1.919	.
'500 or more employees'	Observed	18	29	35
	Expected	19.203	27.839	35.000
	Pearson Residual	-.408	.486	.

Link function: Logit.

Cell Information

Percentage

CompanySize		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
'Less than 10 employees'	Observed	40.0%	20.0%	40.0%
	Expected	50.8%	26.0%	23.3%
'10 - 99 employees'	Observed	100.0%	.0%	.0%
	Expected	52.1%	25.6%	22.3%
'100 - 500 employees'	Observed	.0%	.0%	100.0%
	Expected	53.5%	25.1%	21.4%
'500 or more employees'	Observed	51.4%	31.4%	17.1%
	Expected	54.9%	24.7%	20.5%

Link function: Logit.

Cell Information

Cumulative Percentage				
		RecentAdoptionPortion		
CompanySize		None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
'Less than 10 employees'	Observed	40.0%	60.0%	100.0%
	Expected	50.8%	76.7%	100.0%
'10 - 99 employees'	Observed	100.0%	100.0%	100.0%
	Expected	52.1%	77.7%	100.0%
'100 - 500 employees'	Observed	.0%	.0%	100.0%
	Expected	53.5%	78.6%	100.0%
'500 or more employees'	Observed	51.4%	82.9%	100.0%
	Expected	54.9%	79.5%	100.0%

Link function: Logit.

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	25.393			
General	23.613	1.779	1	.182

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

Crosstabs

NewCompanySize * RecentAdoption Crosstabulation

			Recent Adoption			
			None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects	Total
NewCompanySize	'Less than 10 employees'	Count	4	2	4	10
		% within NewCompanySize	40.0%	20.0%	40.0%	100.0%
	'10 - 499 employees'	Count	6	0	1	7
		% within NewCompanySize	85.7%	.0%	14.3%	100.0%
	'500 or more employees'	Count	18	11	6	35
		% within NewCompanySize	51.4%	31.4%	17.1%	100.0%
	Total	Count	28	13	11	52
		% within NewCompanySize	53.8%	25.0%	21.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.244[a]	4	.182
Likelihood Ratio	7.477	4	.113
Linear-by-Linear Association	.363	1	.547
N of Valid Cases	52		

a. 5 cells (55.6%) have expected count less than 5. The minimum expected count is 1.48.

Crosstabs

Consultant * RecentAdoptionPortion Crosstabulation

			RecentAdoptionPortion			
			None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects	Total
Consultant	Consultant (OutsideClients)	Count	15	3	7	25
		% within Consultant	60.0%	12.0%	28.0%	100.0%
	NotAConsultant (InsideClients)	Count	13	10	4	27
		% within Consultant	48.1%	37.0%	14.8%	100.0%
	Total	Count	28	13	11	52
		% within Consultant	53.8%	25.0%	21.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.660[a]	2	.097
Likelihood Ratio	4.871	2	.088
Linear-by-Linear Association	.004	1	.953
N of Valid Cases	52		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.29.

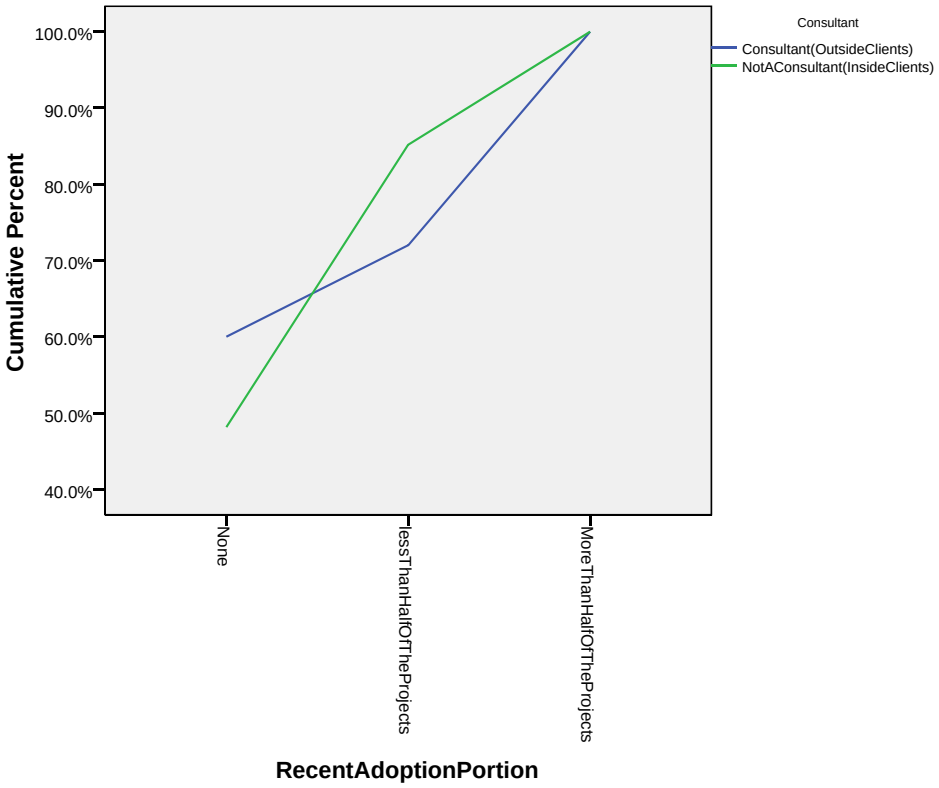
Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.030	.135	.219	.827
		Consultant Dependent	.027	.124	.219	.827
		RecentAdoptionPortion Dependent	.033	.149	.219	.827

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Graph



PLUM - Ordinal Regression

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	17.863			
Final	17.811	.051	1	.821

Link function: Logit.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	4.634	1	.031
Deviance	4.820	1	.028

Link function: Logit.

Pseudo R-Square

Cox and Snell	.001
Nagelkerke	.001
McFadden	.000

Link function: Logit.

Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	[RecentAdoptionPortion = 1.00]	.345	.857	.162	1	.687	-1.335	2.025
	[RecentAdoptionPortion = 2.00]	1.507	.884	2.909	1	.088	-.225	3.240
Location	Consultant	.122	.532	.052	1	.819	-.921	1.165

Link function: Logit.

Cell Information

Frequency

		RecentAdoptionPortion		
Consultant		None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
Consultant (OutsideClients)	Observed	15	3	7
	Expected	13.890	6.108	5.002
	Pearson Residual	.447	-1.447	.999
NotAConsultant (InsideClients)	Observed	13	10	4
	Expected	14.185	6.867	5.947
	Pearson Residual	-.457	1.384	-.904

Link function: Logit.

Cell Information

Cumulative Frequency

Consultant		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
Consultant (OutsideClients)	Observed	15	18	25
	Expected	13.890	19.998	25.000
	Pearson Residual	.447	-.999	.
NotAConsultant (InsideClients)	Observed	13	23	27
	Expected	14.185	21.053	27.000
	Pearson Residual	-.457	.904	.

Link function: Logit.

Cell Information

Percentage

Consultant		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
Consultant (OutsideClients)	Observed	60.0%	12.0%	28.0%
	Expected	55.6%	24.4%	20.0%
NotAConsultant (InsideClients)	Observed	48.1%	37.0%	14.8%
	Expected	52.5%	25.4%	22.0%

Link function: Logit.

Cell Information

Cumulative Percentage

Consultant		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
Consultant (OutsideClients)	Observed	60.0%	72.0%	100.0%
	Expected	55.6%	80.0%	100.0%
NotAConsultant (InsideClients)	Observed	48.1%	85.2%	100.0%
	Expected	52.5%	78.0%	100.0%

Link function: Logit.

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	17.811			
General	12.992	4.820	1	.028

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

Crosstabs

DegreeTime * RecentAdoptionPortion Crosstabulation

			RecentAdoptionPortion			
			None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects	Total
DegreeTime	'Less than 6 months'	Count	3	0	0	3
		% within DegreeTime	100.0%	.0%	.0%	100.0%
	'Between 6 months and 1 year'	Count	1	0	0	1
		% within DegreeTime	100.0%	.0%	.0%	100.0%
	'Between 1 year and 2 years'	Count	0	3	0	3
		% within DegreeTime	.0%	100.0%	.0%	100.0%
	'Between 2 years and 3 years'	Count	0	0	2	2
		% within DegreeTime	.0%	.0%	100.0%	100.0%
	'More than 3 years'	Count	24	10	9	43
		% within DegreeTime	55.8%	23.3%	20.9%	100.0%
	Total	Count	28	13	11	52
		% within DegreeTime	53.8%	25.0%	21.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.967[a]	8	.010
Likelihood Ratio	19.569	8	.012
Linear-by-Linear Association	.753	1	.385
N of Valid Cases	52		

a. 12 cells (80.0%) have expected count less than 5. The minimum expected count is .21.

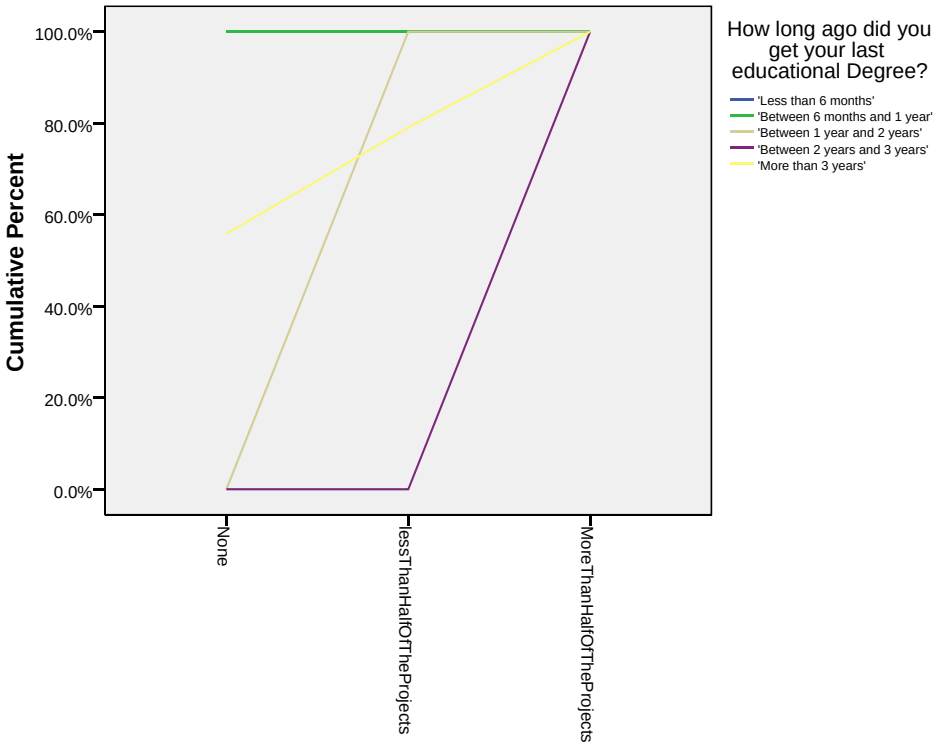
Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.018	.116	-.154	.877
		DegreeTime Dependent	-.013	.087	-.154	.877
		RecentAdoptionPortion Dependent	-.026	.172	-.154	.877

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Graph



PLUM - Ordinal Regression

Warnings

There are 8 (53.3%) cells (i.e., dependent variable levels by combinations of predictor variable values) with zero frequencies.

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	27.199			
Final	26.479	.720	1	.396

Link function: Logit.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	21.137	7	.004
Deviance	18.849	7	.009

Link function: Logit.

Pseudo R-Square

Cox and Snell	.014
Nagelkerke	.016
McFadden	.007

Link function: Logit.

Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	[RecentAdoptionPortion = 1.00]	1.146	1.281	.801	1	.371	-1.365	3.657
	[RecentAdoptionPortion = 2.00]	2.318	1.310	3.131	1	.077	-.249	4.885
Location	DegreeTime	.218	.271	.647	1	.421	-.313	.749

Link function: Logit.

Cell Information

Frequency

DegreeTime		RecentAdoptionPortion: None	lessThanHalfOfTheProjects	MoreThanHalfOfTheProjects
'Less than 6 months'	Observed	3	0	0
	Expected	2.150	.522	.327
	Pearson Residual	1.089	-.795	-.606
'Between 6 months and 1 year'	Observed	1	0	0
	Expected	.670	.197	.132
	Pearson Residual	.701	-.496	-.390
'Between 1 year and 2 years'	Observed	0	3	0
	Expected	1.862	.660	.478
	Pearson Residual	-2.216	3.260	-.754
'Between 2 years and 3 years'	Observed	0	0	2
	Expected	1.136	.482	.381
	Pearson Residual	-1.622	-.797	2.914
'More than 3 years'	Observed	24	10	9
	Expected	22.107	11.153	9.740
	Pearson Residual	.578	-.401	-.270

Link function: Logit.

Cell Information

Cumulative Frequency

DegreeTime		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
'Less than 6 months'	Observed	3	3	3
	Expected	2.150	2.673	3.000
	Pearson Residual	1.089	.606	.
'Between 6 months and 1 year'	Observed	1	1	1
	Expected	.670	.868	1.000
	Pearson Residual	.701	.390	.
'Between 1 year and 2 years'	Observed	0	3	3
	Expected	1.862	2.522	3.000
	Pearson Residual	-2.216	.754	.
'Between 2 years and 3 years'	Observed	0	0	2
	Expected	1.136	1.619	2.000
	Pearson Residual	-1.622	-2.914	.
'More than 3 years'	Observed	24	34	43
	Expected	22.107	33.260	43.000
	Pearson Residual	.578	.270	.

Link function: Logit.

Cell Information

Percentage

DegreeTime		RecentAdoptionPortion		
		None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
'Less than 6 months'	Observed	100.0%	.0%	.0%
	Expected	71.7%	17.4%	10.9%
'Between 6 months and 1 year'	Observed	100.0%	.0%	.0%
	Expected	67.0%	19.7%	13.2%
'Between 1 year and 2 years'	Observed	.0%	100.0%	.0%
	Expected	62.1%	22.0%	15.9%
'Between 2 years and 3 years'	Observed	.0%	.0%	100.0%
	Expected	56.8%	24.1%	19.1%
'More than 3 years'	Observed	55.8%	23.3%	20.9%
	Expected	51.4%	25.9%	22.7%

Link function: Logit.

Cell Information

Cumulative Percentage

DegreeTime		RecentAdoptionPortion		
		None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
'Less than 6 months'	Observed	100.0%	100.0%	100.0%
	Expected	71.7%	89.1%	100.0%
'Between 6 months and 1 year'	Observed	100.0%	100.0%	100.0%
	Expected	67.0%	86.8%	100.0%
'Between 1 year and 2 years'	Observed	.0%	100.0%	100.0%
	Expected	62.1%	84.1%	100.0%
'Between 2 years and 3 years'	Observed	.0%	.0%	100.0%
	Expected	56.8%	80.9%	100.0%
'More than 3 years'	Observed	55.8%	79.1%	100.0%
	Expected	51.4%	77.3%	100.0%

Link function: Logit.

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	26.479			
General	25.793	.687	1	.407

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

Crosstabs

newDegreeTime * Recent Adoption Crosstabulation

			RecentAdoption			
			None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects	Total
newDegreeTime	'Less than 3years'	Count	4	3	2	9
		% within newDegreeTime	44.4%	33.3%	22.2%	100.0%
	'More than 3 years'	Count	24	10	9	43
		% within newDegreeTime	55.8%	23.3%	20.9%	100.0%
	Total	Count	28	13	11	52
		% within newDegreeTime	53.8%	25.0%	21.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.487[a]	2	.784
Likelihood Ratio	.473	2	.789
Linear-by-Linear Association	.182	1	.670
N of Valid Cases	52		

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is 1.90.

Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
		Symmetric	.000	.000	.[c]	.[c]
		newDegreeTime Dependent	.000	.000	.[c]	.[c]
		In how many of the projects that you have been working on in the last 6 months DEMO (or part of DEMO or concepts of DEMO) has been applied (or is planned to be applied) as a solution? Dependent	.000	.000	.[c]	.[c]
Goodman and Kruskal tau		newDegreeTime Dependent	.009	.028		.788[d]
		In how many of the projects that you have been working on in the last 6 months DEMO (or part of DEMO or concepts of DEMO) has been applied (or is planned to be applied) as a solution? Dependent	.006	.016		.755[d]
Ordinal by Ordinal	Somers' d	Symmetric	-.062	.122	-.503	.615
		newDegreeTime Dependent	-.045	.090	-.503	.615
		In how many of the projects that you have been working on in the last 6 months DEMO (or part of DEMO or concepts of DEMO) has been applied (or is planned to be applied) as a solution? Dependent	-.096	.189	-.503	.615

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Cannot be computed because the asymptotic standard error equals zero.

d. Based on chi-square approximation

Crosstabs

ReadingNewBooksArticles * RecentAdoptionPortion Crosstabulation

			RecentAdoptionPortion			
			None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects	Total
ReadingNewBooks Articles	Yes	Count	14	7	10	31
		% within ReadingNewBooks Articles	45.2%	22.6%	32.3%	100.0%
	No	Count	14	6	1	21
		% within ReadingNewBooks Articles	66.7%	28.6%	4.8%	100.0%
	Total	Count	28	13	11	52
		% within ReadingNewBooks Articles	53.8%	25.0%	21.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.729[a]	2	.057
Likelihood Ratio	6.689	2	.035
Linear-by-Linear Association	4.584	1	.032
N of Valid Cases	52		

a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 4.44.

Directional Measures[c]

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	-.263	.116	-2.216	.027
		ReadingNewBooks Articles Dependent	-.237	.104	-2.216	.027
		RecentAdoptionPortion Dependent	-.296	.133	-2.216	.027

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. In reading new books and articles yes is assigned to 1 and nor is assigend to 2. So, the higher numbers show lower values. as a result -.296 shows a positive relation between recent adoption and the fact that a person has read new books recently

Graph

```
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rDecisionTree\DataReadyForDecisionTree(V1)_1.sav
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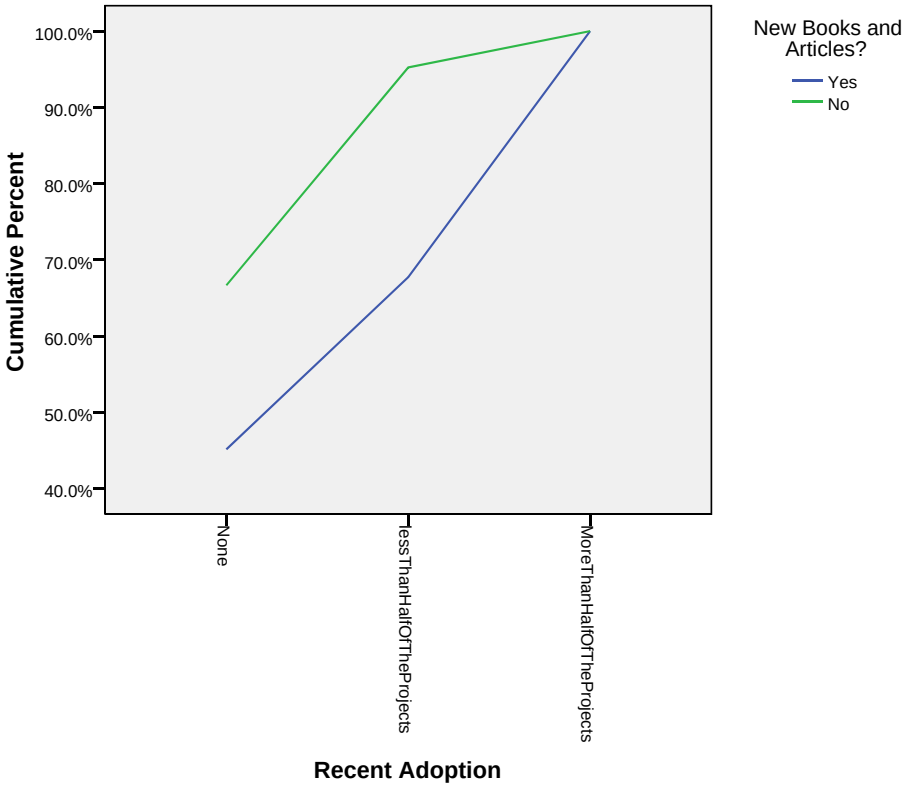

PLUM - Ordinal Regression

```
[DataSet1] C:\Users\Saman\Desktop\My Dropbox\Thesis\Data Analysis\DataSets\Fo
rDecisionTree\DataReadyForDecisionTree(V1)_2.sav
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Case Processing Summary

		N	Marginal Percentage
RecentAdoptionPortion	None	28	53.8%
	lessThanHalfOfThe Projects	13	25.0%
	MoreThanHalfOfThe Projects	11	21.2%
	Valid	52	100.0%
	Missing	0	
	Total	52	

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	19.121			
Final	15.047	4.075	1	.044

Link function: Logit.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	2.456	1	.117
Deviance	2.614	1	.106

Link function: Logit.

Pseudo R-Square

Cox and Snell	.075
Nagelkerke	.087
McFadden	.039

Link function: Logit.

Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[RecentAdoptionPortion = 1.00]	-1.435	.837	2.942	1	.086	-3.075	.205
	[RecentAdoptionPortion = 2.00]	-.201	.817	.060	1	.806	-1.803	1.401
Location	ReadingNewBooks Articles	-1.118	.577	3.760	1	.052	-2.249	.012

Link function: Logit.

Cell Information

Frequency

ReadingNewBooksArticles		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
Yes	Observed	14	7	10
	Expected	13.068	9.083	8.849
	Pearson Residual	.339	-.822	.458
No	Observed	14	6	1
	Expected	14.499	4.076	2.425
	Pearson Residual	-.235	1.061	-.973

Link function: Logit.

Cell Information

Cumulative Frequency

ReadingNewBooksArticles		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
Yes	Observed	14	21	31
	Expected	13.068	22.151	31.000
	Pearson Residual	.339	-.458	.
No	Observed	14	20	21
	Expected	14.499	18.575	21.000
	Pearson Residual	-.235	.973	.

Link function: Logit.

Cell Information

Percentage

ReadingNewArticles		RecentAdoptionPortion		
		None	lessThanHalfOfTheProjects	MoreThanHalfOfTheProjects
Yes	Observed	45.2%	22.6%	32.3%
	Expected	42.2%	29.3%	28.5%
No	Observed	66.7%	28.6%	4.8%
	Expected	69.0%	19.4%	11.5%

Link function: Logit.

Cell Information

Cumulative Percentage

ReadingNewArticles		RecentAdoptionPortion		
		None	lessThanHalfOfTheProjects	MoreThanHalfOfTheProjects
Yes	Observed	45.2%	67.7%	100.0%
	Expected	42.2%	71.5%	100.0%
No	Observed	66.7%	95.2%	100.0%
	Expected	69.0%	88.5%	100.0%

Link function: Logit.

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	15.047			
General	12.432	2.614	1	.106

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

Crosstabs

NoNewArticles * RecentAdoptionPortion Crosstabulation

			RecentAdoptionPortion			
			None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects	Total
NoNewArticles	None	Count	14	6	1	21
		% within NoNewArticles	66.7%	28.6%	4.8%	100.0%
	Some	Count	8	7	6	21
		% within NoNewArticles	38.1%	33.3%	28.6%	100.0%
	Many	Count	6	0	4	10
		% within NoNewArticles	60.0%	.0%	40.0%	100.0%
	Total	Count	28	13	11	52
		% within NoNewArticles	53.8%	25.0%	21.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.762[a]	4	.045
Likelihood Ratio	13.093	4	.011
Linear-by-Linear Association	2.916	1	.088
N of Valid Cases	52		

a. 4 cells (44.4%) have expected count less than 5. The minimum expected count is 2.12.

Directional Measures

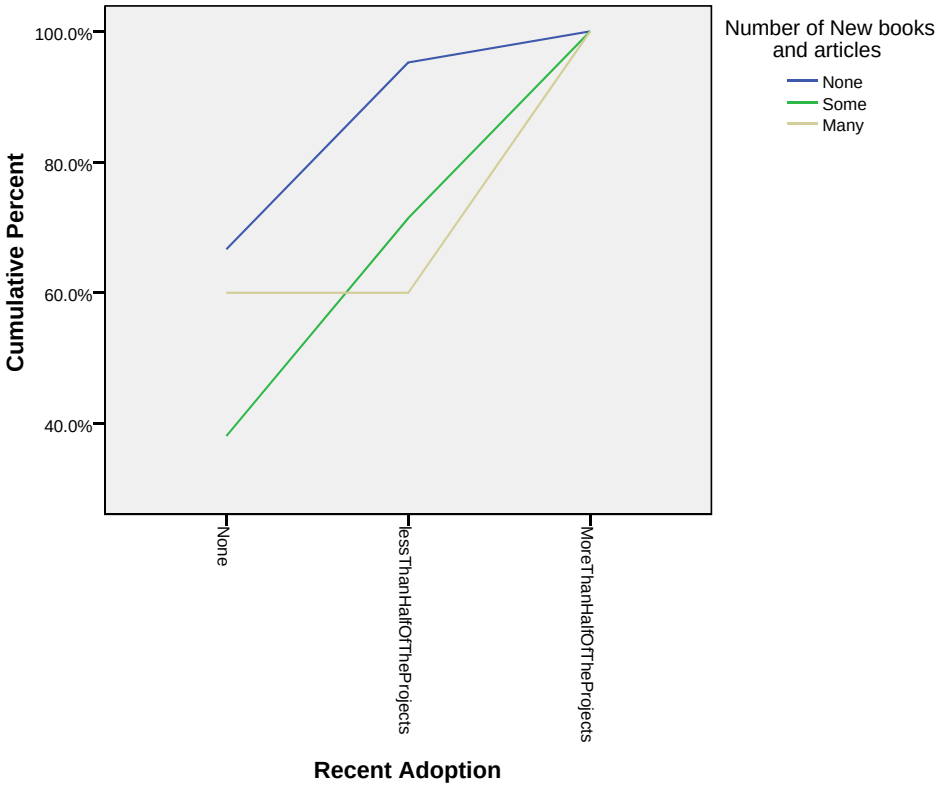
			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.209	.127	1.623	.105
		NoNewArticles Dependent	.215	.129	1.623	.105
		RecentAdoptionPortion Dependent	.203	.127	1.623	.105

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Graph

[DataSet1] C:\Users\Saman\Desktop\My Dropbox\Thesis\Data Analysis\DataSets\ForDecisionTree\DataReadyForDecisionTree(V1)_1.sav



PLUM - Ordinal Regression

Warnings

There are 1 (11.1%) cells (i.e., dependent variable levels by combinations of predictor variable values) with zero frequencies.

Case Processing Summary

		N	Marginal Percentage
RecentAdoptionPortion	None	28	53.8%
	lessThanHalfOfThe Projects	13	25.0%
	MoreThanHalfOfThe Projects	11	21.2%
	Valid	52	100.0%
	Missing	0	
	Total	52	

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	27.628			
Final	25.287	2.341	1	.126

Link function: Logit.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	7.651	3	.054
Deviance	10.752	3	.013

Link function: Logit.

Pseudo R-Square

Cox and Snell	.044
Nagelkerke	.051
McFadden	.022

Link function: Logit.

Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	[RecentAdoptionPortion = 1.00]	.571	.410	1.941	1	.164	-.232	1.373
	[RecentAdoptionPortion = 2.00]	1.774	.477	13.843	1	.000	.839	2.708
Location	NoNewArticles	.574	.363	2.502	1	.114	-.137	1.286

Link function: Logit.

Cell Information

Frequency

NoNewArticles		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
None	Observed	14	6	1
	Expected	13.417	4.536	3.047
	Pearson Residual	.265	.776	-1.268
Some	Observed	8	7	6
	Expected	10.481	5.656	4.863
	Pearson Residual	-1.083	.661	.588
Many	Observed	6	0	4
	Expected	3.594	2.920	3.486
	Pearson Residual	1.585	-2.031	.341

Link function: Logit.

Cell Information

Cumulative Frequency

NoNewArticles		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
None	Observed	14	20	21
	Expected	13.417	17.953	21.000
	Pearson Residual	.265	1.268	.
Some	Observed	8	15	21
	Expected	10.481	16.137	21.000
	Pearson Residual	-1.083	-.588	.
Many	Observed	6	6	10
	Expected	3.594	6.514	10.000
	Pearson Residual	1.585	-.341	.

Link function: Logit.

Cell Information

Percentage

NoNewArticles		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
None	Observed	66.7%	28.6%	4.8%
	Expected	63.9%	21.6%	14.5%
Some	Observed	38.1%	33.3%	28.6%
	Expected	49.9%	26.9%	23.2%
Many	Observed	60.0%	.0%	40.0%
	Expected	35.9%	29.2%	34.9%

Link function: Logit.

Cell Information

Cumulative Percentage

NoNewArticles		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
None	Observed	66.7%	95.2%	100.0%
	Expected	63.9%	85.5%	100.0%
Some	Observed	38.1%	71.4%	100.0%
	Expected	49.9%	76.8%	100.0%
Many	Observed	60.0%	60.0%	100.0%
	Expected	35.9%	65.1%	100.0%

Link function: Logit.

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	25.287			
General	17.606	7.681	1	.006

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

```
SET Printback=On.
```

Crosstabs

RecentpossibilityPortion * RecentAdoptionPortion Crosstabulation

			RecentAdoptionPortion			
			None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects	Total
RecentpossibilityPortion	None	Count	5	0	0	5
		% within RecentpossibilityPortion	100.0%	.0%	.0%	100.0%
	lessThanHalfOfThe Projects	Count	4	7	0	11
		% within RecentpossibilityPortion	36.4%	63.6%	.0%	100.0%
	MoreThanHalfOfThe Projects	Count	19	6	11	36
		% within RecentpossibilityPortion	52.8%	16.7%	30.6%	100.0%
	Total	Count	28	13	11	52
		% within RecentpossibilityPortion	53.8%	25.0%	21.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.317[a]	4	.003
Likelihood Ratio	18.593	4	.001
Linear-by-Linear Association	3.447	1	.063
N of Valid Cases	52		

a. 5 cells (55.6%) have expected count less than 5. The minimum expected count is 1.06.

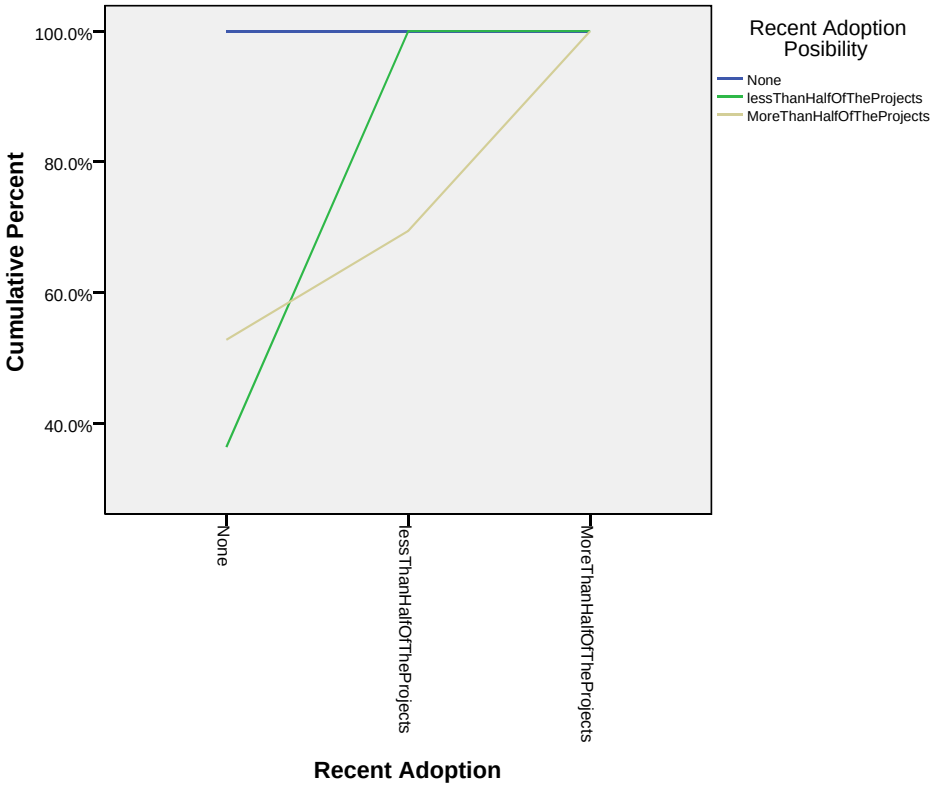
Directional Measures

			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.183	.110	1.579	.114
		RecentpossibilityPortion Dependent	.162	.100	1.579	.114
		RecentAdoptionPortion Dependent	.209	.125	1.579	.114

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Graph



PLUM - Ordinal Regression

Warnings

There are 3 (33.3%) cells (i.e., dependent variable levels by combinations of predictor variable values) with zero frequencies.

Case Processing Summary

		N	Marginal Percentage
RecentAdoptionPortion	None	28	53.8%
	lessThanHalfOfThe Projects	13	25.0%
	MoreThanHalfOfThe Projects	11	21.2%
	Valid	52	100.0%
	Missing	0	
	Total	52	

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	28.689			
Final	25.640	3.049	1	.081

Link function: Logit.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	15.621	3	.001
Deviance	15.544	3	.001

Link function: Logit.

Pseudo R-Square

Cox and Snell	.057
Nagelkerke	.066
McFadden	.029

Link function: Logit.

Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	[RecentAdoptionPortion = 1.00]	2.103	1.279	2.704	1	.100	-.404	4.610
	[RecentAdoptionPortion = 2.00]	3.310	1.322	6.270	1	.012	.719	5.902
Location	RecentpossibilityPortion	.759	.467	2.636	1	.104	-.157	1.674

Link function: Logit.

Cell Information

Frequency

RecentpossibilityPortion		RecentAdoptionPortion: None	lessThanHalfOfTheProjects	MoreThanHalfOfTheProjects
None	Observed	5	0	0
	Expected	3.966	.672	.362
	Pearson Residual	1.142	-.881	-.624
lessThanHalfOfTheProjects	Observed	4	7	0
	Expected	7.067	2.364	1.569
	Pearson Residual	-1.929	3.403	-1.353
MoreThanHalfOfTheProjects	Observed	19	6	11
	Expected	16.449	10.112	9.438
	Pearson Residual	.853	-1.525	.592

Link function: Logit.

Cell Information

Cumulative Frequency

RecentpossibilityPortion		RecentAdoptionPortion: None	lessThanHalfOfTheProjects	MoreThanHalfOfTheProjects
None	Observed	5	5	5
	Expected	3.966	4.638	5.000
	Pearson Residual	1.142	.624	.
lessThanHalfOfTheProjects	Observed	4	11	11
	Expected	7.067	9.431	11.000
	Pearson Residual	-1.929	1.353	.
MoreThanHalfOfTheProjects	Observed	19	25	36
	Expected	16.449	26.562	36.000
	Pearson Residual	.853	-.592	.

Link function: Logit.

Cell Information

Percentage

RecentpossibilityPortion		RecentAdoptionPortion		
		None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
None	Observed	100.0%	.0%	.0%
	Expected	79.3%	13.4%	7.2%
lessThanHalfOfThe Projects	Observed	36.4%	63.6%	.0%
	Expected	64.2%	21.5%	14.3%
MoreThanHalfOfThe Projects	Observed	52.8%	16.7%	30.6%
	Expected	45.7%	28.1%	26.2%

Link function: Logit.

Cell Information

Cumulative Percentage

RecentpossibilityPortion		RecentAdoptionPortion		
		None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
None	Observed	100.0%	100.0%	100.0%
	Expected	79.3%	92.8%	100.0%
lessThanHalfOfThe Projects	Observed	36.4%	100.0%	100.0%
	Expected	64.2%	85.7%	100.0%
MoreThanHalfOfThe Projects	Observed	52.8%	69.4%	100.0%
	Expected	45.7%	73.8%	100.0%

Link function: Logit.

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	25.640			
General	16.328	9.311	1	.002

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

Crosstabs

Subjective Norm * RecentAdoptionPortion Crosstabulation

			RecentAdoptionPortion			
			None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects	Total
Subjective Norm	None	Count	10	2	2	14
		% within Subjective Norm	71.4%	14.3%	14.3%	100.0%
	lessThanHalf	Count	7	5	0	12
		% within Subjective Norm	58.3%	41.7%	.0%	100.0%
	MoreThanHalf	Count	4	3	4	11
		% within Subjective Norm	36.4%	27.3%	36.4%	100.0%
	Total	Count	21	10	6	37
		% within Subjective Norm	56.8%	27.0%	16.2%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.867[a]	4	.097
Likelihood Ratio	9.206	4	.056
Linear-by-Linear Association	3.199	1	.074
N of Valid Cases	37		

a. 6 cells (66.7%) have expected count less than 5. The minimum expected count is 1.78.

Directional Measures

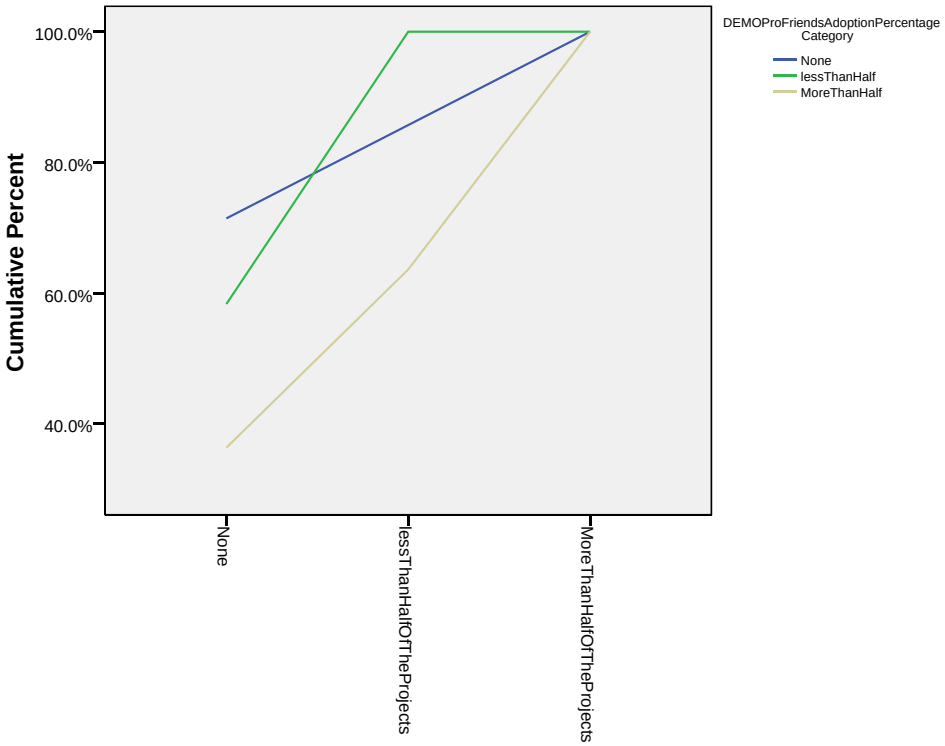
			Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Ordinal by Ordinal	Somers' d	Symmetric	.275	.156	1.751	.080
		Subjective Norm Dependent	.295	.167	1.751	.080
		RecentAdoptionPortion Dependent	.258	.147	1.751	.080

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

Graph

```
[DataSet1] C:\Users\Saman\Desktop\My Dropbox\Thesis\Data Analysis\DataSets\Fo
rDecisionTree\DataReadyForDecisionTree(V1)_1.sav
```



PLUM - Ordinal Regression

Warnings

There are 1 (11.1%) cells (i.e., dependent variable levels by combinations of predictor variable values) with zero frequencies.

Case Processing Summary

		N	Marginal Percentage
RecentAdoptionPortion	None	21	56.8%
	lessThanHalfOfThe Projects	10	27.0%
	MoreThanHalfOfThe Projects	6	16.2%
	Valid	37	100.0%
	Missing	15	
	Total	52	

Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	22.326			
Final	18.666	3.660	1	.056

Link function: Logit.

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	3.963	3	.266
Deviance	5.546	3	.136

Link function: Logit.

Pseudo R-Square

Cox and Snell	.094
Nagelkerke	.110
McFadden	.051

Link function: Logit.

Parameter Estimates

							95% Confidence Interval	
		Estimate	Std. Error	Wald	df	Sig.	Lower Bound	Upper Bound
Threshold	[RecentAdoptionPortion = 1.00]	1.824	.902	4.092	1	.043	.057	3.592
	[RecentAdoptionPortion = 2.00]	3.307	1.019	10.542	1	.001	1.311	5.303
Location	DEMOProFriends AdoptionPercentage Category	.797	.415	3.676	1	.055	-.018	1.611

Link function: Logit.

Cell Information

Frequency

Subjective Norm		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
None	Observed	10	2	2
	Expected	10.310	2.638	1.052
	Pearson Residual	-.188	-.436	.961
lessThanHalf	Observed	7	5	0
	Expected	6.690	3.478	1.832
	Pearson Residual	.180	.969	-1.471
MoreThanHalf	Observed	4	3	4
	Expected	3.985	3.874	3.141
	Pearson Residual	.010	-.552	.573

Link function: Logit.

Cell Information

Cumulative Frequency

Subjective Norm		RecentAdoptionPortion None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
None	Observed	10	12	14
	Expected	10.310	12.948	14.000
	Pearson Residual	-.188	-.961	.
lessThanHalf	Observed	7	12	12
	Expected	6.690	10.168	12.000
	Pearson Residual	.180	1.471	.
MoreThanHalf	Observed	4	7	11
	Expected	3.985	7.859	11.000
	Pearson Residual	.010	-.573	.

Link function: Logit.

Cell Information

Percentage

Subjective Norm		RecentAdoptionPortion		
		None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
None	Observed	71.4%	14.3%	14.3%
	Expected	73.6%	18.8%	7.5%
lessThanHalf	Observed	58.3%	41.7%	.0%
	Expected	55.7%	29.0%	15.3%
MoreThanHalf	Observed	36.4%	27.3%	36.4%
	Expected	36.2%	35.2%	28.6%

Link function: Logit.

Cell Information

Cumulative Percentage

Subjective Norm		RecentAdoptionPortion		
		None	lessThanHalf OfTheProjects	MoreThanHalf OfTheProjects
None	Observed	71.4%	85.7%	100.0%
	Expected	73.6%	92.5%	100.0%
lessThanHalf	Observed	58.3%	100.0%	100.0%
	Expected	55.7%	84.7%	100.0%
MoreThanHalf	Observed	36.4%	63.6%	100.0%
	Expected	36.2%	71.4%	100.0%

Link function: Logit.

Test of Parallel Lines[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	18.666			
General	18.666	.000	1	.996

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

Appendix C

Interview Questions

Comments:
Before we start let me tell you a little bit about the interview process. In the interview I will ask you about your opinion regarding some aspects of DEMO or the effect of DEMO on some aspects of your work.

In some of the questions I may ask you to answer the question in your own words. For this part it is important that I document your opinion exactly as you say it. Since we are using English for communication which is not the native language for both of us, misunderstandings may occur. Summarizing your answer may result in losing the context in which you said something as well as the content of what you were talking about. By documenting your exact words and reviewing the exact conversation after the meeting, I can identify the misunderstandings and ask for explanations afterwards by e-mail. There are two ways to achieve this way of documenting. First one is letting me record this session and investigate the recorded session later on (after investigation the recording will be deleted). Second one is waiting for me to write exactly what you are saying which can be distracting. Also, the session may take longer than scheduled.

Some other questions are multiple choice questions. In these questions I will give you a set of answers and you should choose from the answers. Please tell me if none of the answers describes your situation.

The interview starts with some questions about your experience with DEMO in your job. Then I will continue by asking questions about your experience with other methodologies. After that, questions about your opinion about DEMO will be asked. At the end, I will ask some questions about the attitude of your colleagues and customers regarding DEMO.

It is very important that you answer the questions accurately and if you didn't understand a question ask me to explain it for you.

Case Example

Recall the last case you were working on and answer the following questions:

1. Would you explain in short what the last project that you have been working on was? What was the project definition?

(Job Relevancy (perceived usefulness))

2. Did you use DEMO to solve the case?

   (If yes ->) {

   1) In what way did you use DEMO to solve your problem?

   2) How well do you think DEMO solved the problem? (Assign 1 to not good at all and 5 to very well) ***(Output Quality)***

1	2	3	4	5

   3) What were your expectations? Did DEMO produce the results you expected from it?

*(**Result Demonstrability)**:*

4) In your opinion has using DEMO brought about any improvements for the project or has the situation got worse?

5) Why do you think applying DEMO caused this change in the project?

6) Did the customer or other team members notice these changes? (Yes/No) ***(observeability)***

7) How easy or hard was it to show the advantages of using DEMO to the customers and other team members (like the project manager)?
(Assign 1 to very hard and 5 to very easy) ***(Communicability)***

1	2	3	4	5

8) When introducing DEMO, how confident was the customer that DEMO will solve the problem at hand?
(Assign 1 to not confident at all and 5 to very confident)
(Implication on Customers)

1	2	3	4	5

9) Why do you think the customer had such a point of view?

10) How easy or hard was it to show the progress of the project to the customer? (Assign 1 to very hard and 5 to very easy) ***(Communicability)***

1	2	3	4	5

11) Why did it have s this difficulty level?

12) What did the customer think about the progress speed of the project? (was it slow or acceptable for him)
(Assign 1 to slower than customer expected and 5 to faster than customer expected)

1	2	3	4	5

13) Do you agree with the customer's opinion? Explain

14) Overall, what was the customer's impression about the outcome of the project after applying DEMO? (Assign 1 to not satisfied at all and 5 to completely satisfied***)***
(Implication on Customers)(Understanding Complexity)

1	2	3	4	5

15) Recall another project in which DEMO could have been applicable but you didn't apply DEMO and go to If NO ->

}

(If No ->) {

1) What methodology did you use to solve the problem?
2) Why did you use this methodology instead of DEMO?

Not applicable

Not compatible with other methodologies
It was forced by manager or the customer
…

3) Recall a case that you were using DEMO in it *(and go to (2) IF Yes ->))*
4) If there is no case done by DEMO go to next question

}

(Usefulness)

3. What models of DEMO do you think would have improved the result, if you had applied them on the projects you have been working on in the last 6months?
    a. State model
    b. Construction Model
    c. Process Model
    d. Action Model

4. In what cases are you confident enough that applying DEMO is a good solution? (What properties should a project have for DEMO to become a good candidate methodology?) Time/cost constrain, complexity, size, …)

5. Why do you think DEMO is a good candidate for projects with these properties?
6. What methodology do you use for the other type of projects?

General questions:

Compatibility With other methodologies

7. Have you ever used DEMO (or some models of DEMO) in combination with other methodologies?

(If yes =>){

8. What was the methodology you used with DEMO?
9. Were you responsible for modeling with … (the other) methodology as well?
10. What were the important hurdles/issues when combining these two methodologies? Explain

}

(We already know the methodologies the respondent knows)

11. In your opinion, what is the competing methodology for DEMO at your work place?
    a. Pronto
    b. RUP
    c. UML
    d. Others (NAME even more than 1)

Adoption behavior

Methodology preference

12. Rank the methodologies that you prefer to use: (the first methodology is your first choice and the list goes on until your last preference)

13. How many years have you been using … (*the first methodology mentioned)* methodology?
    a. Less than 6 months
    b. Between 6months and 1 year
    c. Between 1 year and 2 years

d. More than 2 years

Compatibility

Practical Compatibility

14. In this part of interview I would like to ask some questions about way of working in DEMO and … (the other mentioned) methodology.
    Way of Working is composed of a set of tasks with their subtasks and possible orders of those tasks. Also, the available instructions explain how to perform each mentioned task in the way of working.
    These tasks can be either modeling tasks or non-modeling tasks (Our focus here is only on modeling tasks). Any action in which a model is produced or changed in any way is called a modeling task.
    Now, compare DEMO and your preferred methodology based on following aspects:

    (First ask all the questions about the other methodology then ask the same questions about DEMO)

Description	**1st methodology**	**DEMO**
Is there a way of working provided for this methodology that has any of the above mentioned properties? (Yes/No)		
Is there a description available that explains how to make each model of the methodology? (Yes/No) (if Yes=>) Using this description, can you finish a modeling task without any mistakes? a) Yes, the modeling task finishes without any mistakes b) No, the modeling task usually finishes with some small mistakes. c) No, the modeling task usually finishes with mistakes that can have huge effect on the correctness of the model.		
Does the methodology provide an order of the modeling tasks? (yes/No) *(if Yes) =>)* { How well do you follow the order provided? What do you think about the advantages and disadvantages of the provided order? Explain }		
Prerequisites For making a model: Each modeling task will manipulate some types of concepts. These concepts are also modeling concepts that are part of way of modeling. Have these concepts specified for each model of the methodology? (do you exactly know what concepts will be created or changed during a modeling task) (rank between not specified for none of the models (assign 1) to specified for all the models (assign 5)) 1 2 3 4 5		*Don't ask this question for DEMO. This question will be asked (model by model)*

Sometimes there are some information dependencies between a modeling task and the models that are produced before that modeling task. Have these information dependencies specified for each model of the methodology? (rank between not specified for none of the models (assign 1) to specified for all the models (assign 5)) 1 | 2 | 3 | 4 | 5 How useful is the list of these concepts and models that are specified for each modeling task? (rank between not useful at all (assign 1) to very useful (assign 5)) 1 | 2 | 3 | 4 | 5 Does the provided list have some models and concepts that you think you can skip for finishing a modeling task?		*in the next section for DEMO*
Is there any information provided that specifies which models are useful for which situations? (Yes/ No) How useful do you find the provided information? (Assign 1 to not useful at all and 5 to very useful) ***(also usefulness)*** 1 | 2 | 3 | 4 | 5 Why did you choose this number?		

15. Overall do you think DEMO is compatible with other methodologies that are mostly used in your field? (Yes/No)

    (If No =>)
    Why do you think DEMO is not compatible?

Adaptability to user needs

16. Do you think people without specific training in DEMO can understand DEMO models?

17. Based on your experience do, you think people without specific training in DEMO can apply DEMO on a real life problem only by using the available information (like books, articles, websites …)?

Model specific questions:

Answer these questions based on a case presented to you:

(I am thinking of providing the "EU-Rent Case" to the respondent, ask him to look at it and the models made for it. Then I will ask him to provide me with the following answers.
The following questions will be asked for each model. The models we are talking about are:

State model
Construction Model
Process Model
Action Model

)

Learning Complexity
Understanding Complexity

18. How would you rate your understanding about … model? (assign 1 to Don't understand at all and 5 to Understand completely)

1	2	3	4	5

19. Rate … model based on its familiarity of symbols/shapes used in the model compared to what you have been used to before? (assign 1 to unfamiliar at all and 5 to familiar)

1	2	3	4	5

Known concepts

20. What is your understanding level of the concepts presented in this model? (assign 1 to very hard to understand and 5 to very easy to understand)

1	2	3	4	5

Compatibility
Practical Compatibility

Each modeling task will manipulate some types of concepts. These concepts are also modeling concepts that are part of way of modeling.

21. Have these concepts specified for this DEMO model? (Do you exactly know what concepts will be created or changed during creating this model?) (Rank between not specified for none of the models (assign 1) to specified for all the models (assign 5))

1	2	3	4	5

Sometimes there are some information dependencies between a modeling task and the models that are produced before that modeling task.

22. Have these information dependencies specified for this DEMO model of the methodology?(Rank between not specified for none of the models (assign 1) to specified for all the models (assign 5))

1	2	3	4	5

23. How useful is the list of these concepts and models that are specified for this model? (rank between not useful at all (assign 1) to very useful (assign 5))

1	2	3	4	5

24. Does the provided list have some models and concepts that you think you can skip for finishing a modeling task?
25. Do you know in which cases this model is useful?
    (If yes =>)
    In what situations do you use this model?

Perceived Ease of Use
Methodology Self-Efficiency

26. How well do you think you can perform the following Modeling tasks regarding EU-Rent Case? (assign 1 to not correct at all … 5 to completely correct)
    If the model is:
    a. (Construction model) then
        a. Making a correct Construction Model
            i. Identifying transactions correctly
                1. Identifying Coordination acts and results from the case
                2. Identifying Production acts and results from the case
                3. Identifying Self-activated transactions
            ii. Distinguishing between B-I-D layers
            iii. Identifying external Banks
    b. (State model) Then
        a. Producing a correct State model
            i. Identifying P-fact
            ii. Identifying Object classes
            iii. Identifying relation between object classes
            iv. Identifying Existence rules
    c. (Process Model) then
        a. Producing a correct Process Model
            i. Relation between different steps (c-act and c-result)
                a. Which step should wait for another step
                b. Cardinality of steps
    d. (Action Model) then
        a. Producing a correct Action Model
            i. Understanding the concept of action rules
            ii. Making formal statements
27. Do you think any improvements can be done in this model to increase its usefulness? Explain
    (If yes =>)
    Is it possible to combine this model with other concepts represented in the filled to get to a more enriched model? ***(Possible extensions)***

Social Factors
Implication on Customers

28. Have you ever applied this model in a case in practice? (Yes/No)
    (If Yes =>){
    a. What was the customer's understanding about the … model?

(Assign 1 to didn't understand at all and 5 to understood it very well***) (Implication on Customers)(Understanding Complexity)***

1	2	3	4	5

b. What was the customer's reaction when you were explaining DEMO's …model to them? (Did they think it is too complicated or easy to understand? Why do you think they thought that way about DEMO?) ***(Perceived ease of use)***

1	2	3	4	5

c. When explaining DEMO Models to the customer what is the understanding of the customer about <u>the concepts</u> used in the … model? (Rate from not understanding at all..understanding perfectly)

1	2	3	4	5

}

Again General questions

(If there are DEMO Professionals in respondent's work place who did not apply DEMO =>)

29. Why do you think some of your colleagues do not apply DEMO?
    a. I think DEMO is not applicable to the type of work they do
    b. I think they want to apply DEMO but they are not in the position to make that decision
    c. I think DEMO is not their preference
    d. Others (open question)

(For people who have colleagues who can apply DEMO but they don't)

30. Have you ever tried to introduce DEMO to your working community?(y/n)

(If no and the adoption is yes =>){

(This is a sensitive question may be I have to present it in card or a form)

Why didn't you introduce DEMO to your working community?

a. I think the introduction of DEMO by me may have a negative effect on the way people think about me
b. Introducing a new methodology may have some additional responsibilities for me
c. I am not confident enough about DEMO to introduce that to the company (department)
d. Others (open question)
    i. fear of negative reaction
    ii. acting against the flow
    iii. making enemies
    iv. position vulnerability
    v. jeopardizing reputation
    vi. …

}

(If introduction yes =>){

1) What concepts did you explain to your colleagues? *(Open question)*

2) In explaining DEMO to your colleagues what was the degree of understanding of your colleagues about the concepts?

(Assign 1 to didn't understand at all … 5 to understand completely)

1	2	3	4	5

3) What was their opinion about DEMO in general?
    a. Too theoretical
    b. Too difficult
    c. …

}