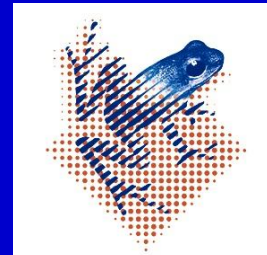


Exploring group-level antecedents of healthcare professionals' adoption intentions towards the implementation of an Electronic Health Record: *A case-study in the pre-implementation phase*

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Trefw adoption intentions; acceptance; resistance; IS adoption; Electronic Health Record; Electronic Patient Record; digitalization; work interdependencies; past experience

PREFACE

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ABSTRACT

Title

Exploring group-level antecedents of healthcare professionals' adoption intentions towards the implementation of an Electronic Health Record: A case-study in the pre-implementation phase

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Introduction

Previous research shows that many attempts to implement Information Systems in healthcare fail. This case-study investigated group-level antecedents of adoption intentions of healthcare professionals on towards an Electronic Health Record (EHR) in a Learning and Teaching Hospital in the Netherlands (LTHN). Using acceptance and resistance as complementary dimensions for measuring the adoption intentions.

Methods

The predefined antecedents of adoption intentions; usefulness, facilitating conditions and impact, were statistically tested using survey-data, and analyzed based on in-depth interviews. The antecedents degree of digitalization, degree of work interdependencies, and past experiences with digital systems were found through the inductive coding of the in-depth interviews.

Results

Both usefulness and impact influenced acceptance, and facilitating conditions influenced the support dimension. Digitalized departments were more likely to accept the system. Departments with more work interdependencies seemed to receive the EHR as more useful, and are therefore more likely to accept the system. Departments with more past experience expected a bigger impact; consequently they may be less likely to accept the system.

Conclusion

Group-level antecedents do influence the adoption intentions of healthcare professionals towards an Electronic Health Record. While it is not possible for managers to control adoption intentions, some ideas are formulated about enhancing the change on department and occupation level. Both system and organizational design should be adapted to each other, one or more (sub) visions are necessary, and tools to approach motivation and tools to avoid resistance can be used. The complementary view of acceptance and resistance can be used more often in researches and degree of digitalization, degree of work interdependencies and past experiences, should be further investigated.

1 INTRODUCTION

Implementing Information Systems (IS) in organizations is challenging, especially in the dynamic healthcare industry (Igira, 2012). Therefore, it is not very surprising that many attempts to implement IS in healthcare fail (Jensen and Aanestad, 2007). Moreover, the overall progress made in developing these systems for the healthcare industry is limited (Grimson, 2001). Currently healthcare organizations are attempting to implement Electronic Health Records (EHR), also called Electronic Patient Records (EPR) and many other names. The EHR captures the information from the current paper-based patient records electronically. It has been shown that the use of the EHR can lead to a more efficient healthcare industry (Glasgow, Kaplan, Ockene, Fisher, and Emmons, 2010; Jensen and Aanestad, 2007). Unfortunately many barriers arise while implementing such EHR systems, varying from infrastructural and technological barriers to human-related barriers (Igira, 2012). The human-related barriers are mainly caused by the fact that the implementation of the EHR is often driven by administrative and management considerations, and not by clinical requirements (Grimson, 2001). In the existing literature, most of the human-related barriers can be defined as resistance, which is the desire to not pursue the change (Lewin, 1945; Cawsey, Deszca & Ingols, 2012; p201). Acceptance of the system, which is seen as the opposite of resistance, is highly important when implementing an IS properly; hence, it is one of the fundamental concepts in IS literature (Davis, 1989; Venkatesh, Morris, Davis & Davis, 2003; Martinko, Henry & Zmud, 1996; Lapointe & Rivard, 2005). Van Offenbeek, Boonstra and Seo (2012) question the view of acceptance and resistance as mere opposites: they argue that acceptance and resistance can be seen as two dimensions, which are at least to some extent conceptually independent. Van Offenbeek et al. (2012, p2) recognize the two different independent dimensions in daily life: "People may use a technology while also resisting its consequences. [...] The opposite occurs when people support a technology without feeling obliged to use it themselves." In this definition, acceptance is not the opposite of resistance, but it is the actual use of the system to perform a task (Burton-Jones and Straub, 2006). Together, acceptance and support can result in the adoption of the system.

This master thesis aims to refine the knowledge on how adoption intentions towards IS in healthcare are dependent on group-level antecedents by performing a case study. First, predefined antecedents of adoption intentions will be tested using statistical analysis. Second, new antecedents will be explored, using the grounded theory method. And third, the relations between the antecedents will be explained. Accordingly, the practical contribution of this master thesis is that healthcare organizations gain better insights in the reasons underlying adoption intentions of healthcare professionals. By the identification of relevant antecedents influencing the adoption intentions of healthcare professionals, change managers become well equipped to increase the likelihood of a successful implementation of an information system. In order to do so, the following main research question is developed:

To what extent and how are healthcare professionals' adoption intentions of an Electronic Health Record (EHR) in the pre-implementation phase shaped by their occupational and departmental background?

At the start of the research four departments were selected for analysis. These departments differ in their degree of digitalization and in their degree of work interdependencies. The differences may influence the adoption intentions of professionals. The more digitalized departments may view the implementation of the EHR as an incremental change. Therefore these departments may be more likely to adopt the change (Nadler & Tushman, 1989; Daft, 2004; Cawsey et al. 2012). On the other hand, the more digitalized department may also suffer from the dialectics of lead (Romein, 1937). A better understanding on the influence of a group's degree of digitalization on the adoption intention is necessary.

(How) Do departments' current degree of digitalization influence the adoption intentions of healthcare professionals towards an EHR in the pre-implementation phase?

Multidisciplinary treatments and multidisciplinary teams are no exception in healthcare, and thus many work inter-

dependencies between departmental and occupational groups exist. With these work interdependencies, a need for information-sharing is created (Lee & Leifer, 1992). This need can be fulfilled by the use of an EHR. Therefore, it can be stated that when the degree of work interdependencies is high, there is a higher need for an EHR. Also, work interdependencies make the coordination of the work in groups more complex, the EHR can enhance coordination among interdependent groups (Malone and Crowston, 1990; Tellioglu, 2003). Even though possible relations between work interdependencies can be described, the exact relation between work interdependencies of departments and the adoption intentions has not yet been investigated.

(How) Do departments' degree of work interdependencies influence the adoption intentions of healthcare professionals towards an EHR in the pre-implementation phase?

To answer the 'how' part of the main question, this research takes an exploratory approach, using the method described by Eisenhardt (1989), which means open-ended case-study research. This thesis is an attempt to find more evidence about how adoption intentions are shaped in healthcare dependent on group-level antecedents, resulting in the third sub question:

Do other group-level factors based in the departmental or the occupational background of healthcare professionals influence their intentions to adopt an EHR in the pre-implementation phase? And if so, how?

This cross-sectioned case study is part of a longitudinal research and uses a measurement instrument developed within this longitudinal research (Appendix I). The measurement instrument is based on the view by van Offenbeek et al. (2012) on acceptance and resistance as two dimensions of adoption that are conceptually independent. This instrument is used to compare stakeholders' adoption intentions across different departments and occupation groups towards a not yet implemented EHR. The differences and similarities between the attitudes of these different department-groups and occupation-groups are explained by analysis of in-depth interviews. In this research the focus is on the departmental groups, since the occupa-

tion groups are already analyzed in previous research (Cordes, 2013; Van den Bos, 2013).

Following the introduction, the literature review examines the existing literature on adoption intentions, acceptance and resistance towards information systems in healthcare. In this literature review the available evidence about the influences of digitalization, of work independencies and of possible other antecedents of adoption intentions are highlighted. In the method section the case-study method suggested by Eisenhardt (1989) will be explained more in-depth. Also the research design, data collection methods, the data analysis methods and the reliability and validity of this research will be discussed. The analysis and results will be described in the Results chapter. The outcomes of the case study will be discussed, after which the conclusion will be drawn.

2 ADOPTION INTENTIONS

Adoption intentions can be categorized by the combination of acceptance and resistance as complementary concepts (Offenbeek et al., 2012). As stated in the introduction, this thesis uses the definition of acceptance according to Burton-Jones & Straub (2006): a user's employment of a system to perform a task, and resistance is defined as the desire to not pursue the change (Cawsey, Deszca & Ingols, 2012; p201). Where most authors view acceptance as the opposite of resistance (e.g. Martinko, Henry & Zmud, 1996; Lapointe & Rivard, 2005), van Offenbeek et al. (2012) demonstrate that support is the opposite of resistance and that acceptance is conceptually complementary to resistance. These definitions of acceptance and resistance as complementary concepts result into the four user types/adoption types by van Offenbeek et al. (2012) as shown in Figure 1; supporting users, resisting users, supporting non-users and resisting non-users.

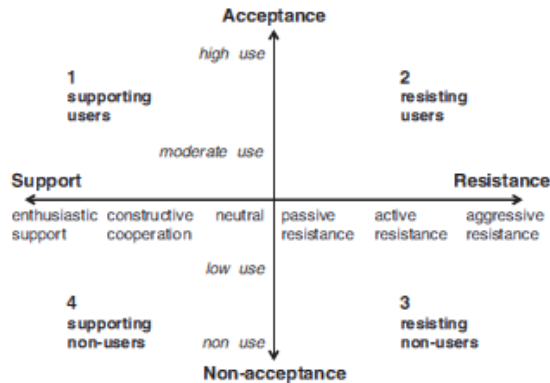


Figure 1 A two factor view on user reactions (Offenbeek et al., 2012)

The theory by van Offenbeek et al. (2012) is subject of theoretical refinement in this study; the focus is on the antecedents of adoption intentions. First, the factors acceptance and support will be discussed, then the additional factors work interdependencies and digitalization will be presented.

2.1 ACCEPTANCE

The foundation of today's change literature on acceptance is the Theory Acceptance Model (TAM; Davis, 1989). TAM concentrates on (1) perceived usefulness, which concerns the degree of enhancement by the system and (2) perceived ease of use, which concerns the degree of effort needed to use the system. Four longitudinal field studies show that TAM explains about 40% of the variance in attitudes towards change (Venkatesh & Davis, 2000). The theoretical extended version of TAM, named TAM2, adds that the subjective norm also influences user's acceptance (Venkatesh & Davis, 2000). The subjective norm is a social influence process which is grounded in the Theory of Reasoned Action (TRA) by Fishbein & Ajzen (1975); they state that an individual adapts his behavior to what most people think the individual should or should not do. In the Unified Theory of Acceptance and Use of Technology (UTAUT) TAM, TRA and six other acceptance models are united (Venkatesh et al., 2003). Three direct antecedents of intention to use are found: performance expectancy, effort expectancy, and social influence, and two direct antecedents of usage behavior are found; intention and facilitating conditions. Based on longitudinal data from four organizations, which was cross-validated using data from two additional organizations, Venkatesh et al. (2003) show that UTAUT explains even 70% of the adoption intentions. Jensen et al. (2007) add that sense-making is the key to explain acceptance behavior; sense-making is the process where organizational members attribute meaning to events (Weick, 1995). Their EHR-implementation case shows that acceptance is not an individual choice to adopt or reject a known system; the social and organizational context is highly important, and the system is not known. More recent studies agree that social networks in organizations can have positive as well as negative effects, due to their functions as channel for communication, social construction, and negotiation of the innovation (Venkatesh et al., 2003; Labianca & Brass, 2006; Jippes, Achterkamp, Brand, Kiewiet, Pols & van Engelen, 2010; Venkatesh, Zhang, & Sykes, 2011). All studies agree that social influence plays a role in developing adoption intentions. Therefore antecedents of adoption intentions should also be measured on group-

level. However, it has been shown that practices in healthcare create the need to cross groups' boundaries, for example with multidisciplinary work (Nicolini, Gherardi & Yonow, 2003; Mørk, Hoholm, Maaninen-Olsson & Aanestad, 2012). Based on Hernes (2004), Mørk et al. (2012) argue that organizations have multiple boundaries, boundaries are central to organizations, and that boundaries are not static. To enable interdisciplinary teams, hospitals should make a shift from functional structure with static boundaries to a more dynamic divisional or even a matrix structure as shown in Figure 2 (Daft, 2004; Fichman, Kohli, & Krishnan, 2011; Bradley, Pallas, Bashyal, Berman & Curry, 2010).

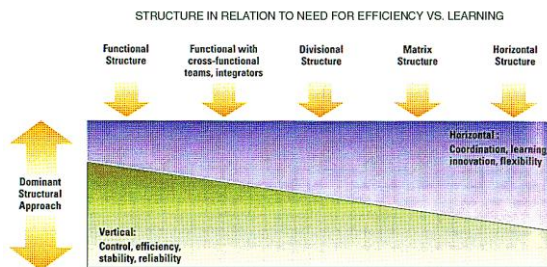


Figure 2 Structure in relation to need for efficiency and learning (Daft, 2004)

In healthcare, and especially within hospitals, there are different types of traditionally static groups; occupation-based groups and department-based groups (Venkatesh et al., 2011). The expectation is that individuals from the same occupation and another department will sooner form peer groups, than individuals from the same department but different professions (Venkatesh et al., 2011; Jensen, Kjærgaard & Svejvig, 2009). Consequently, previous research focused mainly on the analysis of occupation-based groups, the analysis of department-based groups is not yet performed.

2.2 RESISTANCE/SUPPORT

Many authors state that resistance can occur when a change is not desirable for an individual or group (e.g. Markus, 1983; Joshi, 1991; Lapointe & Rivard, 2005),

though they have varying explanations why it occurs and how it may be solved. In her frequently cited case study, Markus (1983, p431) describes three underlying theories of why resistance occurs; due to factors internal to the person or group (e.g. people resist all change), due to factors inherent in the application or system being implemented (e.g. systems are not user friendly), and due to the interaction between characteristics related to people and characteristics related to the system (e.g. systems that alter the balance of power in organizations will be resisted by those who lose power and accepted by those who gain power). The evaluation of the three underlying theories of resistance, based on a case study, shows that the interaction theory is most useful to implementers; it states that organizations need to be analyzed and diagnosed in order to fix organizational problems, before introducing the system. This analysis and diagnosis can be used to design a system that does not generate resistance or to come up with strategies to deal with, and utilize, resistance, once it occurs. According to Markus (1983) overcoming resistance is not the most important, but avoiding it in the first place, or else confront it constructively. The theory-based Equity-Implementation model by Joshi (1991) focuses only on the factors internal to the person or group (Markus, 1983). The model shows that individuals do not definitely resist every change. Instead, individuals evaluate most changes; favorably evaluated changes are not resisted, but changes which are unfavorable evaluated are resisted. The main idea is fairness of the discrepancy between the own inputs and the outcomes for the self (also; the change in equity). Moreover, this discrepancy is compared to outcomes for the employer and outcomes for other users. Lapointe & Rivard (2005) developed a multi-level view of resistance; they combine previous work to develop a multi-level model (e.g. from Markus, 1983; Joshi, 1991; Martinko et al., 1996). In their model individual- and group-level perspectives are combined; resistance is a bottom-up process by which individual resistance behaviors emerge into group resistance. Lapointe & Rivard (2005) describe the compilation process, which develops to a composition based resistance behavior on group-level. Compilation arises when individual resistance behaviors in the group do not converge. Composition emergence means that individuals in the group share perceptions and responses. Lapointe & Rivard (2005) argue that perceived threats cause resistance behaviors. Threats

perceived at the individual level lead to more merciful resistance, than threats perceived on group-level. Threats on group-level are have more impact; hence they argue that resistance should be measured on group-level. Lapointe & Rivard (2005) use Markus' interaction theory, by stating that the initial period following the introduction of a system is the best moment to adapt the system. In later stages resistance has become politicized and managing resistance becomes a more difficult undertaking. Even though resistance needs to be avoided or overcome when it is seen as a barrier to change, resistance can also be seen as a way for change receivers to give useful feedback on drawbacks of the system (Ford, Ford & d'Amelio, 2008; Lapointe & Rivard, 2005; Cawsey et al., 2012). Therefore, resistance can be useful for implementers.

2.3 ANTECEDENTS INFLUENCING ADOPTION INTENTIONS

The first two antecedents that influence the acceptance dimension are perceived usefulness of system (Davis, 1989; Davis et al., 1992; Compeau & Higgins, 1995; Venkatesh et al., 2003; Chin et al., 2008) and perceived ease-of-use (Davis, 1989; Chin et al., 2008) like described above in the section Acceptance. Also two other antecedents were found; intrinsic motivation (Davis et al., 1992), and self-efficacy (Compeau & Higgins, 1995). Also for the resistance/support dimension antecedents were found: changes in power and resources (Markus, 1983; Lapointe & Rivard, 2005), quality of work and life (Lapointe & Rivard, 2005), emotions (Knights & Murray, 1992), facilitating conditions (Venkatesh et al., 2003), and norms and values (Kappos & Rivard, 2008). In his master thesis, Cordes (2013) adds the antecedent impact, which has been found as antecedent for both support and acceptance. Impact is based on the models developed by Joshi (1991) and Lapointe & Rivard (2005), which imply that the implementation of an IS has an impact on (1) individuals' equity status, and (2) the interaction between initial conditions and features of the system. Individuals are more likely to use the system, if they believe that the EHR will enhance their jobs. Cordes (2013) applied the framework of van Offenbeek et al. (2012) to a real-life EHR-implementation case. A factor analysis reduced the number of antecedents to five; usefulness, impact, support, facilitating conditions, and acceptance. Usefulness is an antecedent of acceptance

and impact and facilitating conditions both influence support as well as acceptance, therefore he states that support and acceptance are not totally unrelated. According to Venkatesh (2003), facilitating conditions include both supporting organizational and technical infrastructure. In this research, there will be a focus on organizational infrastructure in the implementation phase; the technological infrastructure is yet to be defined. In this research, the influence of these group-level antecedents on the acceptance- and resistance/support dimensions will be analyzed. In the change management literature there is a larger focus on professional based networks (Venkatesh et al., 2011; Jensen, Kjærgaard and Svejvig, 2009), but lesser till none on department-based networks in healthcare. Therefore, the main focus in this research will be on department-level antecedents of adoption intentions; especially the degree of work interdependencies and the degree of digitalization.

2.3.1 WORK INTERDEPENDENCIES

As we have seen before, group boundaries are not static (Hernes, 2004; Mørk et al., 2012; Nicolini et al., 2003), in practice groups need to cooperate, which makes them interdependent. In healthcare most departments perform multidisciplinary treatments; these treatments require much cooperation and therefore it creates interdependencies amongst various departments. Also on occupation-level, many interdependencies exist; especially physicians and nurses have to work together closely. According to Thompson (1967), a main character in organizational theory, there are three types of work interdependencies: pooled interdependence, sequential interdependence and reciprocal interdependence. Pooled interdependence is the lowest level of interdependence, it insinuates a situation where every group contributes to- and is supported by the whole. Sequential interdependence means that there are direct dependencies in a serial form; the output for group X is input for group Y. When the outputs of each become inputs for others, then there is reciprocal interdependence between groups, which is the highest level of interdependence. Lee & Leifer (1992) analyzed the idea that information sharing is defined as a linking concept between organizational structures and IS structures. They found that network structures, work teams, task characteristics (for example the routineness), and technological interdependency are determinants of information sharing require-

ments. Figure 3 shows that the more interdependent groups are, the more information sharing is needed to cooperate properly (Thompson, 1967), and when lesser routine exist in task, more information sharing is needed (Nadler & Tushman, 1978). The communication and cooperation which is needed to share information can be made possible by the use of IS (Malone & Crowston, 1990; Tellioglu, 2003). While the interdependencies between groups make coordination of activities in the groups more complex, the use of IS can enhance this coordination (Malone & Crowston, 1990; Tellioglu, 2003).

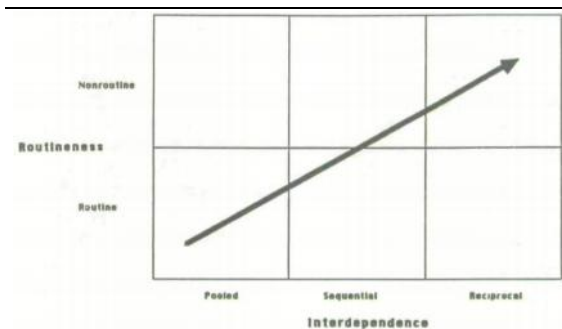


Figure 3 Level of information sharing required between groups (Lee and Leifer, 1992)

2.3.2 DIGITALIZATION

Two contradicting reactions can appear when the new technology will be implemented. First, the scope of change can have a negative influence on adoption intentions. By the definition of Nadler and Tushman (1989) the scope of change can vary from incremental to radical, where incremental change is described as continual progression and radical change as change which breaks the frame of reference (Daft, 2004; Cawsey et al., 2012). In case of an EHR-implementation, the more digitalized groups are expected to view the implementation as another small change towards full digitalization and may therefore adopt the change more easily. While paper-based groups are expected view the implementation as a more radical change, and may therefore be more reluctant to adopt the change. Or second, the scope of change will positively influence the adoption intentions. Digitalized departments can suffer from their leading position, when the leading position becomes a brake to innovation. This is called the dialectics of

lead (Romein, 1937), a law which states that when there is much invested in one innovation, and this is an obstacle to implement a newer innovation. Vice versa an underdeveloped organization can outperform the leading organization when implementing a newer innovation. Moreover, many authors state that individuals base their adoption intentions on past experiences (e.g. Fishbein & Ajzen, 1975 in their Theory of Reasoned Action; and Taylor & Todd, 1995; Venkatesh, Brown, Maruping & Bala, 2008). Therefore it can be stated that groups who are more digitalized have more past experiences with digital systems. They can base their adoption intentions on past experiences, which can be positive as well as negative.

In prior research, the relation between work interdependencies and adoption intentions is most likely to be positive; when more intensive work interdependencies exist, the need for an EHR is higher and therefore the chance that the system will be adopted is higher. The degree of digitalization can have a positive as well as a negative effect. In this research, the relationships between the degree of work interdependencies, the degree of digitalization and the adoption intentions will be further investigated.

3 METHODS

In order to refine the knowledge on how adoption intentions towards IS in healthcare develop dependent on group-level antecedents, an exploratory case-study was conducted as described by Eisenhardt (1989). A three-step method is used; first, predefined antecedents of adoption intentions will be tested using statistical analysis. Second, new antecedents will be explored, using the grounded theory method. And third, the relations between the antecedents will be explained, after analyzing the in-depth data. Case studies focus on understanding the dynamic contemporary events where behaviors are not manipulated (Yin, 2003; Eisenhardt, 1989). The type of evidence used in this research is mainly qualitative data, but also quantitative data. The data collection methods were interviews and surveys, and the research strategy was a single case study. This case study was focused on a group-level analysis, and consisted of one case including four departmental- and three occupational groups. Next to within-case analysis, cross-case analysis was made possible by approaching the groups within the case as separate cases. In doing so, Eisenhardt's theory building (1989) was used, which consists of the steps: getting started, selecting cases, crafting instruments and protocols, entering the field, analyzing cases, shaping hypothesis, enfolding literature, and reaching closure. The major part of the first three steps, getting started, selecting cases and crafting instruments and protocols, were already reported in the introduction, literature review and methodology.

- Getting started: includes the definition of the research problem, an a-priori specification of constructs, while leaving the constructs open for reconsideration, which was done in the introduction and literature review.
- Selecting cases: The departments were selected based on degree of digitalization and degree of work interdependencies. Further the occupation groups were selected based on future use and availability.

- Crafting instruments: Quantitative research will be conducted by analyzing the raw data from the State-of-Mind (SoM) survey, which consisted of 159 respondents in total for the selected departments. Qualitative research was done by conducting 12 in-depth interviews, and by running feedback sessions with the respondents.
- Entering the field: In this step it is of great importance to combine data gathering with data analysis. This means that while analyzing the data, the researcher needs to consider conducting additional interviews if needed. This was done through the application of the grounded theory method; in open coding new concepts were found, which were applied to all interviews in the selective coding (Glaser and Strauss, 1967).
- Analyzing data: in this step within case and cross-case analysis were done based on the gathered data, which is quantitative as well as qualitative.
- Shaping hypothesis: This is a two-part process involving (1) sharpening constructs, and (2) shaping hypotheses, and verifying that the emergent relationships between constructs fit with the evidence in each case. This was done in the discussion of the research.
- Enfolding literature and reaching closure: Finally, the findings were compared to existing literature in the steps enfolding literature and reaching closure. The literature review was expanded and updated.

3.1 RESEARCH DESIGN AND DATA COLLECTION

A Large Teaching Hospital in the Netherlands (LTHN) is planning on implementing a new EHR system in the near future. The LTHN consists of medical departments that widely vary both in their digitalization-level and in their degree of external work interdependencies. The EHR implementation team wants to monitor the recipients' attitudes towards the new system before, during and after the implementation. Therefore, longitudinal research was conducted by researchers from the University of Groningen. In a former stage of this longitudinal research, four hospital departments were selected to monitor more closely, based upon two criteria. The criteria were (1) the degree of digi-

talization (digitalized versus paper-based), and (2) the degree to which the department is interdependent with other departments (high versus low). These criteria led to the selection of four departments, which were made anonymous. The typology of the departments is depicted in Table 1.

Within this same longitudinal research, Cordes (2013) developed the quantitative State-of-Mind (SoM) survey (Appendix I). This survey measures acceptance, support, impact, usefulness and facilitating conditions on a multi-item scale. The data from the SoM was collected by Cordes and van den Bos (2013), this research extracted the data from the four selected departments out of the complete data set. The total data set consisted of 1,964 potential respondents, from which 587 actually responded (Appendix IV: response rates). The total population included in this research consisted of 442 potential respondents, from which 159 responded.

	Digitalization-level		Work interdependencies	
	Digitalized	Paper-based	High	Low
A		x	x	
B	x		x	
C		x		x
D	x			x

Table 1 Characteristics of the four selected departments

As stated in the theory section, in hospitals various groups exist; occupation-based groups and department-based groups. In the qualitative part of this research, respondents from both types of groups were interviewed. Every respondent belongs to two groups; a departmental group and an occupational group. The interviews were conducted by researchers from the University of Groningen, in agreement with the EHR implementation team. The interviews covered the characteristics of the respondents' department and occupation, the involvement of the department-based and occupation-based groups in the change, the expected

future impact of the EHR, the support, resistance and expected use of the department-based and occupation-based groups. Also the respondents' view on the implementation process, the cooperation between the department and the implementation team, and the interventions needed were questioned. Following the analysis of the interviews, feedback sessions with the respondents and some of their colleagues were held. In order to refine and supplement on the data found.

3.2 DATA ANALYSIS

First, a non-response analysis was done for the SoM survey, comparing the score means for departments, occupations, gender, age, and length of employment at the LTHN. The non-response analysis was done by comparison of own data with existing data as suggested by Armstrong & Overton (1977). It was made possible by using the information from the hospitals' Human Resource IS. Second, an analysis of variance (ANOVA) was executed for examining differences among means for two or more populations (Malhotra, 2009). In this case the independent variables were the departments and occupation-groups, which were measured at a nominal scale. The dependent variables were acceptance, support, impact, usefulness and facilitating conditions, which were measured at an interval scale, through the use of a multi-item scale. When differences in means were significant, a post-hoc analysis was done, to check which specific means differ from each other. Further, an analysis of covariance (ANCOVA) was done to control for differences in age and length of employment. Third, a regression analysis was done, to estimate the relationships between the variables. Fourth was the qualitative data analysis, which assisted in answering the 'how' questions in this research, and which was used to find possible new antecedents. The interviews were coded, based on both inductive and deductive coding, the code scheme can be found in Appendix II. After coding, a within-case and cross-case analysis was done, here evidence was searched for the antecedents degree of digitalization and degree of work interdependencies. The analyses methods suggested by Miles & Huberman (1994) were used for the within-case and cross-case analysis, these methods include the use of matrices. Then, the interview outcomes were adapted based on the

data from the feedback sessions and compared with the existing literature.

3.3 RELIABILITY AND VALIDITY

According to Eisenhardt (1989), theory-building using cases has both strengths and weaknesses. The strengths can be found in the likeliness of generating novel theory. The emergent theory is likely to be testable with the use of hypotheses, and the resultant theory is likely to be empirically valid. One weakness is that a theory based on a real-life case can be overly complex. Another weakness may be that the case results in a narrow and abnormal theory.

Reliability means that the study can be repeated, concluding in the same results (Yin, 2003). The reliability of this research is discussed by the use of triangulation of data collection methods, respondent selection and circumstances, as described by Aken, Berends and van der Bij (2012). The triangulation of data collection methods gave a stronger substantiation of constructs and hypotheses; hence it made this research more reliable (Eisenhardt, 1989). This research made use of a survey, in-depth interviews and feedback sessions. Also the selection of respondents influenced the reliability; all roles, departments and groups involved in the area of interest needed to be included. In this research of the four departments, two types of groups were not included. First, the healthcare administration, this group was undergoing a large downsizing, which would influence the results for this group. Second, the group of paramedics was often not employed by one department, and it was not yet defined who exactly had to be included in this group. Also it was unknown which paramedics would actually have to use the EHR. From all other groups a respondent was included; a physician, a nurse, and a manager were included from each of the four departments. Third, the circumstances in which the research took place should lead to results that are replicable. Therefore the data gathering should take place at various moments in time, this was not possible for one master thesis. Still, by having the feedback sessions with the respondents of the interviews, this master thesis was made more reliable.

Van Aken et al. (2012) also describe three types of validity; construct validity, internal validity, and external validity. Construct validity is the extent to which an instrument measures what it is intended to measure. In this research a

pre-defined survey was used, from which the loadings of the questions had been determined by a factor analysis. Also a Cronbachs Alpha test was used to determine the internal consistency of the survey-items. The interview was developed by the researchers of the University of Groningen, which can be entitled as experts. A study is internally valid when conclusions about relationships are justified and complete. Therefore, the statistical data also incorporated control variables. And the outcomes of the interview analysis were controlled with the respondents in a feedback session. External validity implies the generalizability of the results of a research to other situations, which can be reached by using analytical generalization. With analytical generalization a researcher tries to generalize the outcomes to a broader theory (Yin, 2003). In this research, the events derived from the in-depth interviews were translated to factors in a theoretical model, using Eisenhardt's (1989) literature unfolding step.

4 RESULTS

4.1 DESCRIPTIVE STATISTICS

In order to give an overview of the departments, descriptive statistics are given in Table 2. In total there are 159 respondents, from which 32 are employed in department A, 52 in department B, 39 in department C, and 36 in department D.

	A	B	C	D
n	32	52	39	36
Occupation				
Management	1	3	1	1
Physicians	16	12	14	8
Nurses	12	18	9	17
Other	3	19	15	10
Gender				
Male	34.4%	11.5%	35.9%	27.8%
Female	66.6%	88.5%	64.1%	72.2%
Age				
20-39	50%	36.6%	41%	50%
40-59	50%	53.9%	51.3%	30.5%
60-69	0.0%	9.6%	7.7%	19.4%
Length of Employment				
0-1 year	21.9%	5.8%	10.3%	11.1%
2-10 years	43.8%	42.3%	53.8%	36.1%
11-20 years	25.0%	23.1%	20.5%	41.7%
>20 years	9.4%	28.8%	15.4%	11.1%

Table 2: Descriptive statistics per department

Since there are differences between gender, age, and length of employment, these will be used as control variables in the analysis of covariance.

4.1.1 DESCRIPTION OF THE VARIABLES

In this subsection a description is given of the variables. The overview in Table 3 can enhance the understanding of the data (Appendix III: bar charts per department).

The average score on acceptance of the EHR in the SoM is relatively high, though support has lower average scores. It shows that managers are more supportive (3.3 for managers, against 3.1 for nurses and 2.9 for physicians). Also managers have a higher expectancy of the EHR to be more useful than other groups do (3.8 for managers, against 3.4 for nurses and 3.1 for physicians). Both the managers and the physicians do expect a great impact (3.8 for managers, and 3.9 for physicians), and nurses score lower on impact (with a score of 3.4). Managers feel better facilitated than nurses and physicians (3.9 for managers, against 3.3 for nurses, and 3.2 for physicians).

	N	Mean	SD
Usefulness	137	3.3796	0.81267
Impact	104	3.6466	0.80473
Support	101	3.0198	1.06021
Facilitating Conditions	118	3.3220	0.71337
Acceptance	149	4.0168	0.86293
Valid N (listwise)	62		

Table 3 N, Mean, and Standard Deviation per variable

The big difference between the average scores for acceptance and support confirm that acceptance and support should be seen as two separate variables. Further, interesting differences between occupation groups are found, which will be explained further in the statistical analysis.

4.1.2 NON-RESPONSE

Table 4 shows the differences that exist between the response rates in the selected departments and the other departments (also Appendix IV). The average response in

the four selected departments is 36 percent, while the average response in the other department is 28.1 percent. Therefore, it might be that the response from the selected departments was influenced by their being selected for more in-depth research. However, the differences in scores are limited as will be shown in the ANOVA. Therefore, it is concluded that the data derived from the SoM survey for the four departments are not biased by the selection process and are generalizable for most departments in the LTHN.

Department	Sample	Respondents	Response rate	Non-response rate
A	115	32	27.8	72.2
Sub A	11	2	18.2	81.8
B	137	51	37.2	62.8
C	100	38	38.0	62.0
D	90	38	42.2	57.8
Other	1522	428	28.1	64.0

Table 4 Response rates for the departments

Further, the differences in response rates between the departments are rather interesting; department A has a response rate (27.8) which is 10-15 percent lower than all other selected departments (37.2; 38.0; and 42.2 for department B, C, and D respectively). The sub department from A, which was originally selected, only scores 18.2 percent. This means that there were only two respondents in this sub department, which is insufficient for statistical research. Therefore, in this case department A as a whole will be the unit of analysis. In the feedback sessions with the respondents it is indicated by the respondents, that the different sub departments are experienced as homogeneous in their behavior. No problems are expected while comparing the quantitative data of department A as a whole, with the in-depth data from the sub department.

Department D has the highest response rate of the four selected departments. This seems not to influence their scores in the SoM survey, because the scores of department D on all measured factors are close to average.

Based on the analysis of occupation groups, it becomes clear that nurses show a low response rate of 31.8 percent, against 37.6 percent from the physicians. This can be explained by the fact that physicians expect more *impact* (3.9) than the nurses (3.5). Hence it can be stated that nurses may not recognize the importance and urgency of the SoM-survey. For the managers no data is available, because they are part of the groups physicians and nurses in the hospital's Human Resource IS. In prior master theses by Cordes (2013) and Bos (2013) the managers were filtered out these groups hospital-wide. They showed a response-rate of 52.0%, which is very high. A possible explanation for this high response-rate, is that managers are more involved in the project of EHR-implementation, and therefore feel more responsible for the delivery of management information to the EHR-implementation group. It can be assumed that the response-rate will be similar in the four departments to this number for the whole organization. In the results it can be found that managers are more positive than other groups, still they do not expect to use it.

The selected departments are found to be representative for the hospital's average scores. Though there are differences in response from in the departments, this does not influence their average scores much. Differences between occupation groups are again confirmed in the non-response analysis. In the statistical analysis, it will be shown if significant differences exist between departmental or occupational groups.

4.2 STATISTICAL ANALYSIS

The outcomes from the statistical analyses ANOVA (and post-hoc analysis), ANCOVA and regression will be discussed. This section gives insight in the differences between departments and occupation groups, and also insight in the effect from the predefined antecedents (usefulness, impact, and facilitating conditions) on acceptance and support. The outcomes of this section will be used in order to formulate a model in section 4.4, describing the antecedents of adoption intentions. For the ANOVA and ANCOVA, the total data set of 525 respondents is used,

which include the respondent on the selected as well as not selected departments. The regression uses only the data derived from the selected departments.

4.2.1 ANOVA

From the ANOVA analysis it is found that *impact* ($F(4, 368) = 2.41, p=0.049$) and *facilitating conditions* ($F(4,407) = 3.892, p = 0.004$) differ significantly between the departments (appendix V). When conducting a post-hoc test only *facilitating conditions* shows a significant higher score in department B, than department A ($p=0.003<0.01$) and department D ($p=0.099<0.1$). Also Department A scores lower on *facilitating conditions* than the 'other' departments which were not selected for the in-depth interviews ($p=0.84<0.1$). This means that there are few differences between departments, based on the ANOVA. From a second ANOVA analysis based on occupation (appendix V), it is found that all variable scores differ significantly between the occupation groups (*usefulness*: $F(4,491) = 5.518, p = 0.000$; *impact*: $F(4, 366) = 11.626, p=0.000$; *support*: $F(4,355) = 8.556, p = 0.000$; *facilitating conditions*: $F(4,405) = 6.523, p = 0.000$; *acceptance*: $F(4,528) = 10.561, p=0.000$). From the post-hoc analysis, it is found that management gives a higher score to *usefulness* than physicians ($p=0.009<0.01$); physicians give a higher score to *impact* than nurses ($p=0.04<0.05$); management gives a higher score to *support* than both physicians ($p=0.002<0.01$) and nurses ($p=0.006<0.01$); management scores higher on *facilitating conditions* than both physicians ($p=0.000<0.001$) and nurses ($p=0.003<0.01$). No differences were found between management, physicians, and nurses on the *acceptance* scale. This means that there are many differences between occupation groups based on the ANOVA.

4.2.2 ANCOVA

In this test the significant outcomes from the ANOVA will be controlled for covariance with gender, age, and length of employment. The data is tested for the interdependence between the covariate and the independent variable, the homogeneity of regression slopes, and the continuity of the covariates before conducting the ANCOVA. All variables have been found suitable for analysis with an $\alpha = 0.05$, except for gender as covariate, because this is a non-continuous variable. There was a significant effect of de-

partments on both *impact* and *facilitating conditions* after controlling for the effect of age and length of employment (*impact*: $F(4, 366) = 2.619, p = 0.035<0.05$; *facilitating conditions*: $F(4,405) = 4.049, p = 0.003<0.01$). Also on occupation level, there was a significant effect of the occupation groups on *usefulness*, *support*, *impact* *facilitating conditions* after controlling for the effect of age and length of employment (*usefulness*: $F(4, 489) = 6.282, p = 0.000<0.001$; *support*: $F(4,353) = 8.242, p = 0.000<0.001$; *impact*: $F(4,364) = 6.342, p = 0.000<0.001$; *facilitating conditions*: $F(4,403) = 5.929, p = 0.000<0.001$; *acceptance*: $F(4,526) = 10.299, p = 0.000<0.001$). Therefore it can be stated that the variables stated above are influenced by the department or occupation, even when controlled for age or length of employment.

4.2.3 REGRESSION

Based on the data of only the four selected departments, the ΔR^2 in the regression on both the antecedent *acceptance* and the antecedent *support* are significant as shown in Table 5. This means that both *acceptance* and *support* are influenced by *usefulness*, *impact*, or *facilitating conditions*. For *acceptance*, the influence of *impact* is not significant, the influence of *usefulness* and *facilitating conditions* is; 36.8% of the variance is explained by these variables. For *support*, all factors are individually insignificant, but taken together there is a significant explanation of 16.2%. The low ΔR^2 scores indicate that also other antecedents than *usefulness*, *impact*, or *facilitating conditions*, influence acceptance and support.

4.3 EXPLORING GROUP-LEVEL ANTECEDENTS OF ADOPTION INTENTIONS

The statistical analysis only showed differences between occupational groups, though from the in-depth interviews and the feedback sessions differences between departments are found as well. Differences exist in the field of digitalization, work interdependencies, and past experiences. The in-depth data shows that the departments A, B, and D are digitalized and have high work interdependencies, while they were different categorized in the methods section. Department C is the only exception; this department is paper-based and has low work interdependencies. The in-

depth data will be used (in combination with the statistical data) to answer the research questions (Appendix VI).

β	Acceptance		Support	
	step 1	step 2	step 1	step 2
Gender	0.108	0.014	0.082	0.051
Age	-0.041	-0.104	0.100	0.195
Length of Employment	0.089	0.068	-0.086	-
Usefulness		0.458**		0.194
Impact		0.058		0.073
Facilitating conditions		0.260*		0.253
Adjusted R ²	0.003	0.360**	-0.036	0.088
R ²	0.040	0.408**	0.014	0.177
ΔR^2		0.368**		0.162
				*

n=82
n=63

* Significant at 0.05 level
 ** Significant at 0.001 level

Table 5 Regression analysis

4.3.1 WORK INTERDEPENDENCIES, USEFULNESS AND ACCEPTANCE

(How) Do departments' degree of work interdependencies influence the adoption intentions of healthcare professionals towards an EHR in the pre-implementation phase?

It seems that design needs differ between the departments with high work interdependencies and the department with low work interdependencies. A tension exists between organization-wide uniformity and department-specific information. The cases show that an EHR is most likely more useful for departments with high work interdependencies. This might be because uniformity enhances multidisciplinary work. Departments with low work interdependencies state that they need a system which is only department-specific, in order to prevent the healthcare professionals from an unnecessary information overload.

Further, a higher perceived usefulness leads to higher acceptance, as defined in the regression analysis. This relationship makes sense, because when the EHR enhances the job, people are more likely to use the system. Departments with a higher degree of work interdependencies are likely to be digitalized, probably because an IS enhances interdepartmental work. Departments with low work interdependencies do not feel the urge to use digital systems, they state that they have efficient paper-based work methods. Also with the implementation of the EHR, the digitalized departments with higher work interdependencies are more willing to accept the system, than the paper-based department with low work interdependencies currently does.

4.3.2 DIGITALIZATION AND ACCEPTANCE

(How) Do departments' current degree of digitalization influence the adoption intentions of healthcare professionals towards an EHR in the pre-implementation phase?

	Acceptance		
	Nurse (department B)	Nurse (department C)	Manager (department D)
	<i>'My colleagues, there are two groups: the young ones who state that it is a good development, and some older ones who have doubts about their abilities: can I manage this change?'</i>	<i>'...the first reaction was: dig your heels in, and say: that is not possible with our equipment.'</i>	<i>(About physicians) 'A few will stay put until they really have to, I think. It is a minority. Paper-based notes are no more allowed, that is not possible in the new patient record.'</i>

Table 6 Quotes concerning Acceptance from the in-depth interviews

The digitalized departments have many doubts, and lack information, but still they intent to accept the EHR. The paper-based department lacks trust in the abilities of the system. They think problems will arise when connecting the EHR to their equipment, which are currently used on paper-base. The paper-based department is very content with the

current paper-based work methods; when the system goes down, this department is not disturbed. Consequently, the paper-based department chooses to be more cautious when it comes to implementing IS like the EHR. Table 6 shows some clarifying quotes on the acceptance. It is clear that the departments are intending to accept system once it is implemented, but the question is whether or not the departments (especially the paper-based department) will really adopt the system after the implementation. A mechanism causing this possible difference between current acceptance and adoption intentions can be freedom of choice or voluntariness. In this case the system is imposed; it is clear that it will be implemented, and everyone has to work with it. This may cause individuals and groups to accept the system because they have to, while if they had choice they would not work with the system. This lack of voluntariness seems to result in a lack of support of the system.

4.3.3 PAST EXPERIENCE AND IMPACT

Do other group-level factors based in the departmental or the occupational background of healthcare professionals influence their intentions to adopt an EHR in the pre-implementation phase? And how?

Many individuals have negative experiences with digital systems, especially in the paper-based department. Based on these negative past experiences, respondents have cold feet for the EHR implementation. Some example quotes concerning past experiences with digital systems are given in table 7.

The more digitalized departments seem to expect a bigger impact from the EHR on the work methods; especially department D as shown in Table 8. According to the digitalized departments the implementation of the EHR will have both positive and negative effects; for example better transparency, but more administrative work for physicians. The paper-based department seems to expect a smaller impact on work methods. The paper-based department expects more negative effects, like a decrease of efficiency. This could be due to the past experiences with digital systems, the amount and evaluation of past experience differs between the paper-based and digitalized departments.

Past Experiences		
Physician (department B)	Nurse (department C)	Nurse (department D)
<i>'Since the implementation of [system name], the efficiency in the Operating Room dropped.'</i>	<i>'There were days that the system failed and everybody had to go home. Luckily, we didn't have to, with our paper records.'</i>	<i>'Last year, the system failed 3 or 4 times, that was annoying.'</i>

Table 7 Quotes concerning Past Experiences from the in-depth interviews

The digitalized departments have more past experiences with digitalization and consequently, they are better able to estimate the impact of the change.

Impact		
Physician (department A)	Physician / nurse (department C)	Manager (department D)
<i>'We're changing from electronic to electronic, hopefully it only gets better. [...] 'The EHR is a patient record. We will not be forced to change our processes.'</i>	<i>'In essence our work will not change much' 'So, our work will be translated from paper-based to something digital.'</i>	<i>'Organization-wide uniformity means that some need to let go their old work methods.'</i>

Table 8 Quotes concerning Impact from the in-depth interviews

Their experiences are both positive and negative, which cause them to see both advantages and disadvantages of a new system. Paper-based departments have less experience with digitalization, because earlier attempts they undertook to implement a digitalized system failed. Hence, they were not able to experience working with an embedded system. The paper-based departments' evaluation of these attempts to digitalization are all negative.

4.3.4 SUPPORT AND FACILITATING CONDITIONS

Do other group-level factors based in the departmental or the occupational background of healthcare professionals influence their intentions to adopt an EHR in the pre-implementation phase? And how?

Solely acceptance is probably not enough to reach adoption of a system; support may be a key factor. In this case, the support is very low at all departments as shown in Table 10. When the system will be implemented, it will be used, but possibly not integrated in daily routines. Also it is likely that the work methods will not be changed; only the functions in the EHR that substitute the paper records might be used and the complementary functions might not be used. A factor causing the lack of support seems to be facilitating conditions. The regression analysis found that none of the measured antecedents influence support, though the in-depth data shows that the degree of experienced facilitating conditions has a major influence on support. Like shown by the quote on facilitating conditions from the manager of department A in Table 10, The most important part of facilitation in the pre-implementation phase is informing individuals and groups about the implementation process and about the outcome (the system to be implemented).

Groups which are more involved in the change process seem to be more supportive. These groups have more information available. Others feel that they cannot influence the change as individual or group. Managers are most involved and, therefore, most supportive. Also in the survey they show significantly more support and they experience significantly more facilitation than both physicians and nurses. Physicians and nurses that are not involved in the change project lack information. Therefore, they cannot be as supportive as the managers are.

Support		
Nurse (department B)	Physician (department C)	Manager (department D)
'I am not involved in the EHR project. [...] You can try to define anything, but in the end, we do not affect the purchase of the system. We will see.'	'We have so little information on the program [...] I feel that we are imagining something in the void'	'I think it is important that the EHR will be implemented properly in our department, it would be annoying to work with an imposed system.'

Table 9 Quotes concerning Support from the in-depth interviews

Most physicians are already digitalized, and show a need for information on work methods, the amount of (extra) administrative work, and education on the use of the system. The nurses are generally less digitalized, consequently, they are a group which has to undergo a major change.

Facilitating conditions		
Manager (department A)	Physician (department B)	Nurse (department C)
'You are expected to give input, but that is difficult if you do not know anything about the outcome'	'I question myself if this preparation isn't all bark and no bite. [...] Practically, it is the same as building a new hospital, once you occupy it, it is always disappointing.'	'The communication is fine'
		Physician (department D)
		'I think the process is managed very professional.'

Table 10 Quotes concerning Facilitating Conditions from the in-depth interviews

Nurses need to be prepared in many ways; they show a need for protocols and systematic work methods, and they are not used to work with a digital system at all. While facilitating conditions do influence acceptance according to the survey data, in the in-depth data no evidence was found. Therefore, this relationship is not included in the theoretical model developed in the next section.

4.4 ANTECEDENTS OF ADOPTION INTENTIONS ON GROUP-LEVEL

As recommended by Yin (2003), a theoretical model is developed. Appendix VII shows the model in which all antecedents of adoption intentions on group-level are taken together. This model shows that both acceptance and support may be independent dimensions, since they both have their own antecedents. Support is influenced by the antecedent facilitating conditions; acceptance is influenced by the work-interdependencies-usefulness mechanism, and the degree of digitalization-impact mechanism, which is moderated by the number of past experiences. In the discussion, the relationships and mechanisms in this model will be interpreted in light of the existing theories.

5 DISCUSSION

This theory refining case study searched for (new) antecedents of adoption intentions on department and occupation level. Some of the predefined antecedents were tested with quantitative statistical tests, as well as through the analysis of qualitative in-depth interview data. Using exploratory research methods, two antecedents were added to this model; digitalization and work interdependencies of departments. During these explorations another antecedent was found, using inductive coding; past experience with digital systems.

Van Offenbeek et al. (2012) have a remarkable view on acceptance and resistance, compared to how the concepts were viewed traditionally. Traditionally, they were seen as opposites, van Offenbeek et al. (2012) viewed them as complementary. In this research it seems that acceptance and support are independent concepts; in the case, acceptance was high, and support was low. There were good indications that acceptance as a stand-alone concept does not lead to the adoption of the EHR; support may be needed. Moreover, most departments intended to use the system, but did not intend to adapt their working methods accordingly. This idea is supported by the theory of May & Finch (2009) in which they describe the normalization process. In their theory they state that implementation of a system is the social organization of the work, while embedding is the process of making practices routine elements of everyday life, and integration is sustaining embedded practices in their social contexts. Acceptance is between implementing and embedding, while adoption is a step further between embedding and integration. Support is needed to reach integration of the system. Also, no antecedents which influenced both dimensions were found, which makes them look like independent dimensions. In order to get better insight in the legitimacy of this complementary view, more change management research should use and investigate this complementary view.

Departments in this research were defined as digitalized or paper-based, but many hybrid forms exist. In this case digitalization mainly meant; the presence of digital systems, which are used.

But when the digital system is used as replacement for the paper record, and no advantages are encountered from the use; then what is the utility of digitalization? Digitalized systems advantages can only be encountered, when work methods are adapted accordingly. In this case, the paper-based department was less positive about accepting the system than the digitalized department. No differences were found at the support dimension. Once the system is implemented, Romein's (1937) dialectics of lead, might be applicable in this case. This is a law which states that when there is much invested in one innovation, this is an obstacle to implement a newer innovation. Healthcare professionals in the more digitalized departments were aware of the fact that their existing IS was working at full force, and lacks the capacity to improve much further. The paper-based department does lag behind, and is very likely to catch up with the other departments through the new system. It is not possible to state whether or not the paper-based departments will overtake the digitalized departments in terms of digitalization and development after the implementation of the EHR.

Further, Lee & Leifer (1992) found that information sharing (via an EHR) is needed when work interdependencies exist. This research agreed; the autonomous paper-based department had a lower need for an IS, than the departments with reciprocal interdependencies through their interdisciplinary work. The departments with the reciprocal interdependencies expected the system to be more useful. Like stated in prior research, this research showed that the usefulness may influence the acceptance dimension of adoption intentions (Davis, 1989; Davis et al., 1992; Compeau & Higgins, 1995; Venkatesh et al., 2003; Chin et al., 2008). The differences between expected usefulness of the departments with high work interdependencies and the departments with low(er) interdependencies, led to the discussion between a more uniform system design and a more department-specific system design. Most important, the system design and the organization design should match (Markus, 1983). According to Thompson (1967), reciprocal interdependencies ask for a horizontal structure. Consequently, the system design should than be more uniform than specific.

There may be a connection between the degree of digitalization and the work interdependencies; departments with high work interdependencies were more likely to already be digitalized. In this research only the extremes were found; departments which were both digitalized and had many work interdependencies, and a department which was paper-based and was autonomous. Once the EHR will be implemented the currently paper-based department will become a digitalized department. It would be interesting to see whether or not this department remains autonomous, or will discover opportunities for interdisciplinary work. When this department stays autonomous, this could contradict the theory that there is a relationship between work interdependencies and digitalization. Still, it should be taken into account, that this system is imposed. Previous research found that the less voluntary the behavior, the less one's attitude toward usage predicts use (Moore, 1991; Karahanna, Straub & Chervany, 1999). It is almost certain that the EHR will be used, which is in this case imposed acceptance. The question remains whether the departments will become supporting or resisting.

Supporting or resisting intentions could possibly be influenced by facilitating conditions, which is also proposed by the theory of Venkatesh et al. (2003). In this previous research by Venkatesh et al. (2003), also a relationship was found between facilitating conditions and acceptance. In this research, this relationship was not proven by the in-depth interview data, which might be designated to the differences in definitions. The definition from Venkatesh et al. (2003) included both supporting organizational and technical infrastructure. This research focuses on organizational infrastructure in the pre-implementation phase. When the technical infrastructure was included, the case might have resulted in another outcome.

Like expected, impact influenced only the acceptance dimension, not the support dimension (Joshi, 1991; Lapointe & Rivard, 2005). An explanation might be that impact is an antecedent which focuses more on the outcome, like the acceptance dimension, then on the process like the support dimension. This view is also explained by DeLone and McLean (1992), who showed in their overview that some research found that impact can be measured by determining whether or not the output of the system causes the receiver to change his or her behavior. In this research, some of the major differences in adoption intentions for the pa-

per-based and digitalized departments could be designated to difference in expected impact. The relationship between these antecedents is moderated by the number of past experiences with digital systems. Digitalized departments expected a big impact on the current work methods, while the paper-based departments did not expect the work methods to change. The paper-based department lacked trust in an electronic system (outcome issues), while the digitalized departments foresaw problems around the implementation (process issues). On occupational level, also differences in expected impact exist. It was expected that more digitalized groups would have more past experience in implementing systems; in this case all departments had at least some past experiences with digital systems, even the paper-based department. It needs to be said that the experiences of the digitalized departments were more in-depth and the experiences from the paper-based department were more superficial, but more negative. Which means that the concept past experience can be measured in two ways; measuring the depth of the experience, and measuring the degree of positivity or negativity. Also there can be a difference between past experience with change, and past experience with the use of the system. The latter, past experience with the use of the system, is used in this research. As Taylor & Todd (1992) argue; the difference between intention and behavior represents an expectation gap, which is smaller for the more experienced user. So, experience with digital systems can fill the expectation gap in upfront. The effect of the past experiences was in both the digitalized and paper-based departments mostly negative. Still, positive future expectations might outweigh the negative past experiences.

5.1 THEORETICAL CONTRIBUTION

This research was one of the first attempts to apply the two factor view of van Offenbeek et al. (2012) in practice and underlying antecedents were tested. In doing so, a renewed hypothetical model of antecedents and mechanisms was developed.

The first mechanism in the model is the indirect effect from work interdependencies on the acceptance dimension, through the direct antecedent usefulness. The second mechanism is the direct effect of current degree of digitalization and impact on acceptance, which is moderated by

the number of past experiences. The last mechanism is the direct effect of facilitating conditions on support. The mechanisms operate at group-level, though intragroup differences might exist. These mechanisms provide a new view on how adoption intentions may evolve.

This research agrees on the view of van Offenbeek et al. (2012), which conceptualizes acceptance and resistance as mere opposites. Acceptance and resistance seem to be complementary concepts which are both essential to reach adoption of the system. Taking into account this research in the IS literature and change management literature, the traditional views on acceptance and support can be questioned.

5.2 PRACTICAL CONTRIBUTIONS

For the management of an EHR implementation project, it is important to know how to get grip on the implementation process. Many elements of the change can hardly be controlled, like the adoption intentions. Still, it is important to understand how adoption intentions evolve and how to respond to certain events. To help the change managers understand the process, this research attempted to find out which factors in healthcare professionals' background influence the adoption intentions. It became clear that both healthcare professionals' departmental background and occupational background have an influence on their adoption intentions. Using Markus' interaction theory (1983), which states that resistance can occur due to the interaction between characteristics related to people and characteristics related to the system, both the system and the organization need to be adapted to each other.

First, the EHR design should match the organizational design. At the very moment, the LTHN has a divisional main design where vertical departments are grouped together in patient-focused sectors (Daft, 2004). The divisional structure could be enhanced by a more uniform design of the EHR per sector. In order to support interdisciplinary work, the LTHN should develop the divisional structure more in-depth. Only the implementation of the EHR is not enough. Next to creating a liaison role or creating a temporary multidisciplinary task force, the strongest tools are creating a full-time integrator function and creating more permanent multifunctional project teams (Daft, 2004; Cawsey, 2012).

Further, Grimson (2001) states that different departments have different needs and different ways to store and present the information, therefore an EHR must enable diversity and be adaptable to meet local needs. Therefore the autonomous departments, like department C, should have an EHR with a more department-specific user-interface. While the departments with high work interdependencies, like departments A, B, and D, should have a more uniform user-interface corresponding with the departments they are interdependent with.

Second, everyone should understand the need for the EHR and understand the benefits for themselves. In the case of the LTHN, everybody understands the need for this change, but they do not see the benefits for themselves. This could be due to the lack of a proper overall change vision and sub-visions per user-group. A good change vision specifies the purpose of the change and gives direction and guidance for action (Cawsey et al., 2012). A good vision motivates people and has a positive influence on attitude and performance. Because differences in expected impact, support and abilities to work with digitalized systems are found on the occupational level, sub-visions should be carried out on this level. Visions can be developed top-down or bottom-up (Jick, 2003). In the case of LTHN, the bottom-up or employee-centric approach will be best applicable. This bottom-up approach works best if employees are diverse and have mixed feelings.

Third, the EHR-team should handle resistance, through the use of change intervention tools on the occupational-level as well as department-level. Next to inform and educate groups in order to increase the perceived facilitating conditions, there are other tools to approach motivation and tools to avoid resistance (Knowles and Linn, 2008). To approach motivation, the LTHN could make use of a department or a specific occupation-group within a department which is doing very well. This department or specific occupation group can be hold as benchmark for other departments. Next to being benchmark, this group can gain incentives, which they may invest in something enhancing the implementation of the EHR in their department. In order to avoid resistance, the EHR-team could counterargue their own arguments; let people know you are aware of negative sides of the EHR. The data found in this research can be basis for counterarguments. It seems that the EHR-team tries to make the change recipient an expert, by using

a bottom-up approach to the design of the EHR. When the change recipient has the feeling that he masters the change, it is less likely that the recipient will be resistant.

5.3 LIMITATIONS AND FUTURE RESEARCH

Reliability and validity received attention in the methods section of this research, however, some limitations were found. The respondents from the four departments selected for this research may be biased by the fact that they were selected. These departments showed a higher response rate in the survey, and showed more support in the in-depth interviews than showed in the survey. Also, the selection of departments was not properly done; one of the departments which was indicated to be paper-based, was digitalized. And one of the departments which was indicated to have low work interdependencies, had high work interdependencies. Therefore, only one department differed from the other three, fortunately on both the degree of digitalization and the degree of work interdependencies. The selection of the four departments also caused the number of respondents in statistical analysis to be lower than it should be. This was solved for the ANOVA and ANCOVA by including all the departments. For the regression this was not a suitable solution. Green (1991) argues there should be $N > 50 + 8m$ respondents for a regression analysis, where m is the number of independent variables. In this research there were 3 independent variables. Therefore, there should be at least 74 respondents for the regression analysis. For the acceptance dimension there were 82 respondents effectively, unfortunately for the support dimension there were only 63. The power of the regression analysis of the support dimension is consequently lower than it should be.

More researchers could use the complementary view of van Offenbeek et al. (2012), in order to confirm or contradict this view. Further, it would be very constructive to check what degree the expectations and intentions determined in this research come true. In order to do so, a longitudinal case study would be called for. Next, the influence of the possible antecedents for adoption intentions found in the case, degree of digitalization, degree of work interdependencies and past experiences, should be tested. Also, the relationship between the degree of digitalization and the degree of work interdependencies deserves more at-

ention. This research indicated that a correlation might exist. Last, there should be more in-depth research on the effect of past experiences with digital systems and how to use these experiences in favor of the change.

5.4 CONCLUSION

This research attempted to explain the evolvement of adoption intentions of healthcare professionals when implementing an Electronic Health Record (EHR). The view of van Offenbeek et al. (2012) on acceptance and support as complementary concepts was applied to a case.

It was found that the adoption intentions of healthcare professionals of an EHR in the pre-implementation phase are shaped by both their departmental and occupational background. Both the degree of digitalization and the degree of work interdependencies of the departmental or occupational group seem to influence the adoption intention. Even coherence between the degree of digitalization and the degree of work interdependencies may exist. This research found that hybrid forms of digitalization may exist; departments are not just digitalized or paper-based. Further the dialectics of lead may be applicable to the more digitalized departments. Paper-based department may overtake their leading role in development. It was found that the reciprocal interdependencies, which arise when interdisciplinary work is performed, ask for horizontal structures. The horizontal organizational design, asks for an organization-wide uniform system design. Also, past experience with digital systems might be an antecedent of major importance in explaining the evolvement of adoption. Past experience may influence the expected impact. Differences in expected impact, may lead to differences in acceptance. In this research, the paper-based department had many outcome issues, while the digitalized department had a focus on process issues. Further, an imposed system, may lead to acceptance. Still, to reach adoption, support is needed. The only antecedent influencing the support dimension of adoption intention seemed to be facilitating conditions.

The results of this research indicate that the complementary view by van Offenbeek et al. (2012) might be correct; both the acceptance dimension and the support dimension seem to be essential to reach adoption of an EHR. While it is not possible for managers to control adoption intentions, some ideas are formulated about enhancing the change on

department and occupation level. Both system and organizational design should be adapted to each other, one or more (sub) visions are necessary, and tools to approach motivation and tools to avoid resistance can be used.

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APPENDICES

APPENDIX I – STATE OF MIND SURVEY (IN DUTCH)

State-of-mind Vragenlijst, 10 april 2013

The name of the hospital is changed in 'ziekenhuis'.

De invoering van het [EHR] is een veelomvattend, langlopend programma. Het programmamanagement wil de voorbereiding, ontwikkeling en ingebruikname van [EHR] zorgvuldig begeleiden. Uw inbreng is daarbij onontbeerlijk. Door het invullen van deze periodieke monitor laat u ons anoniem weten hoe u op dit moment persoonlijk tegenover het [EHR] staat. De vragenlijst bestaat uit slechts 25 stellingen en enkele open vragen.

Bedenk dat er geen foute antwoorden zijn, het gaat er alleen om hoe u tegen het [EHR] aankijkt vanuit uw persoonlijke perspectief. Beantwoording kost vijf minuten. Uw gegevens worden vertrouwelijk verwerkt door onafhankelijke onderzoekers die niet weten welke individuele medewerkers zijn aangeschreven. Hierdoor wordt uw anonimiteit gewaarborgd. Zo spoedig mogelijk na verwerking worden samenvattende resultaten op het intranet gepubliceerd.

Toelichting bij het invullen: eerst krijgt u de 25 stellingen over het [EHR] voorgelegd, en dan enkele open vragen. Geef steeds aan in hoeverre u het eens of oneens bent met de betreffende stelling aan de hand van de vijf keuzemogelijkheden. Daarnaast is er de optie 'weet niet / geen mening'. Gebruik deze optie uitsluitend als u zich geen enkele indruk hebt gevormd over deze stelling.

Vraagnr.		Volledig mee oneens	Mee oneens	Neutraal	Mee eens	Volledig mee eens	Weet niet / geen mening
1.	Ik kan invloed uitoefenen op de inrichting van het [EHR].	1	2	3	4	5	<input type="checkbox"/>
2.	Ik draag actief bij aan een succesvolle invoering van het [EHR].	1	2	3	4	5	<input type="checkbox"/>
3.	Ik vertel mensen, dat het goed is dat het [EHR] er komt.	1	2	3	4	5	<input type="checkbox"/>
4.	Ik bemoei me niet met de invoering van het [EHR].	1	2	3	4	5	<input type="checkbox"/>
5.	Ik uit mijn bezwaren tegen het [EHR].	1	2	3	4	5	<input type="checkbox"/>
6.	Als het aan mij ligt ga ik het [EHR] zo snel mogelijk gebruiken.	1	2	3	4	5	<input type="checkbox"/>

7.	Als het [EHR] beschikbaar komt, ga ik er zelf actief mee aan de slag.	1	2	3	4	5	<input type="checkbox"/>
8.	Door invoering van het [EHR] verwacht ik meer invloed te krijgen op de manier waarop ik mijn werk doe.	1	2	3	4	5	<input type="checkbox"/>
9.	Door invoering van het [EHR] verwacht ik afhankelijker van anderen te worden.	1	2	3	4	5	<input type="checkbox"/>
10.	Mijn werk zal na invoering van [EHR] ongeveer gelijk blijven.	1	2	3	4	5	<input type="checkbox"/>
11.	Ik verwacht dat het [EHR] veel invloed zal hebben op de manier waarop ik mijn werk doe.	1	2	3	4	5	<input type="checkbox"/>
12.	Ik verwacht dat het [EHR] veel invloed zal hebben op de manier waarop de meeste <i>ziekenhuis</i> medewerkers hun werk doen.	1	2	3	4	5	<input type="checkbox"/>
13.	Ik verwacht dat het [EHR] veel invloed zal hebben op de patiëntenzorg binnen <i>ziekenhuis</i> .	1	2	3	4	5	<input type="checkbox"/>
14.	Gebruik van het [EHR] sluit goed aan bij mijn professionele normen en waarden.	1	2	3	4	5	<input type="checkbox"/>
15.	Gebruik van het [EHR] past bij het leveren van professioneel verantwoorde zorg.	1	2	3	4	5	<input type="checkbox"/>
16.	Ik ben er trots op dat het <i>ziekenhuis</i> het [EHR] krijgt.	1	2	3	4	5	<input type="checkbox"/>
17.	Ik maak me zorgen over het [EHR].	1	2	3	4	5	<input type="checkbox"/>
18.	Ik verwacht dat het [EHR] eenvoudig in gebruik zal zijn.	1	2	3	4	5	<input type="checkbox"/>
19.	Ik verwacht dat werken met het [EHR] me weinig (extra) mentale inspanning zal kosten.	1	2	3	4	5	<input type="checkbox"/>
20.	Ik verwacht dat ik door het [EHR] mijn werk beter kan uitvoeren.	1	2	3	4	5	<input type="checkbox"/>
21.	Ik verwacht dat ik met het [EHR] in mijn werk beter zal worden ondersteund.	1	2	3	4	5	<input type="checkbox"/>
22.	Ik denk dat de patiëntenzorg door het [EHR] beter wordt.	1	2	3	4	5	<input type="checkbox"/>

- | | | | | | | | |
|-----|--|---|---|---|---|---|--------------------------|
| 23. | Het <i>ziekenhuis</i> ondersteunt de overgang naar het werken met het [EHR]. | 1 | 2 | 3 | 4 | 5 | <input type="checkbox"/> |
| 24. | Belangrijke mensen om mij heen vinden dat het [EHR] er moet komen. | 1 | 2 | 3 | 4 | 5 | <input type="checkbox"/> |
| 25. | De invoering van het [EHR] wordt goed aangepakt. | 1 | 2 | 3 | 4 | 5 | <input type="checkbox"/> |
-
26. Nu volgt een open vraag over [EHR].

Wat zijn voor u de belangrijke aandachtspunten met betrekking tot het [EHR]?

1.
2.
3.

Kunt u tenslotte een paar vragen over uw werksituatie en uw persoonlijke situatie beantwoorden. We willen nogmaals benadrukken dat de resultaten van het onderzoek anoniem worden verwerkt en niet herleidbaar tot personen zullen zijn.

-
27. Op welke afdeling werkt u? _____ (voorselecteren? Welke?)
-
28. Tot welke beroepsgroep behoort u? _____ (voorselecteren? Welke)
-
29. Welke functie heeft u? _____ (voorselecteren? Welke)
-
30. Sinds welk jaar bent u werkzaam in het *ziekenhuis*? _____
-
31. Wat is uw geslacht? man vrouw
-
32. Wat is uw geboortejaar? _____
-

Bedankt voor het invullen van de vragenlijst. Wij hechten veel waarde aan uw visie op de invoering van het [EHR]. Graag willen wij u daarom vragen om in de toekomst een soortgelijke vragenlijst in te vullen om wederom uw mening te peilen.

APPENDIX II – CODING SCHEME

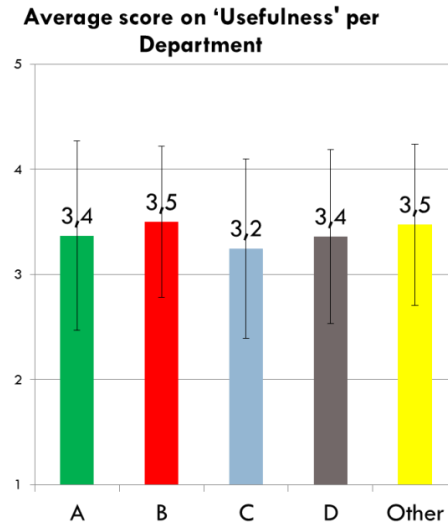
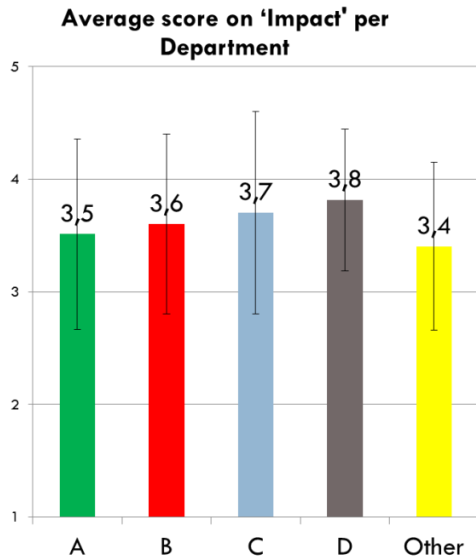
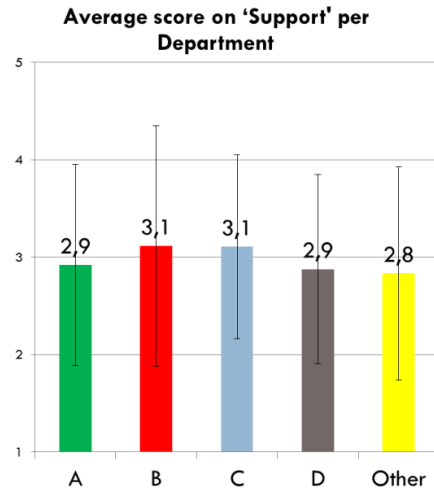
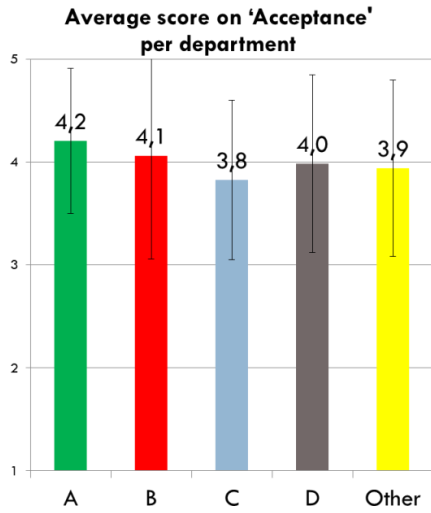
Subject	Category	Definition	Code	Induct. (I) Deduct.(D)	Description	Example quote (in Dutch)
Attitude	Acceptance	<i>A user's employment of a system to perform a task: ranging from (expected) non-use till (expected) high use</i>	Expected non-use	D	The respondent does not expect to use the system (fully) when introduced.	<i>...en zeker de wat oudere generatie, die schrijft vanuit de veiligheid.</i>
			Expected use	D	The respondent does expect to use the system (fully) when introduced.	<i>Er komt een [EHR]. Mensen gaan dat wel gebruiken.</i>
	Support	<i>The desire to (not) pursue the change: ranging from enthusiastic support till aggressive resistance</i>	Support	D	The respondent is positive about the upcoming change.	<i>Vanuit afdeling A wordt het positief ontvangen, vanuit een positieve houding.</i>
			Resistance	D	The respondent is negative about the upcoming change.	<i>Als je moet veranderen denk je altijd, wat ik heb dat is veilig en bekend.</i>
			Neutral/passive	D	The respondent has a wait and see attitude.	<i>...het is zinvol dat het komt en hoe het eruit gaat zien dat zien we dan wel</i>
			Current involvement	I	Feeling or being involved in the preparation-stage of the EHR implementation.	<i>...ik zit de EHR-werkgroepen voor.</i>

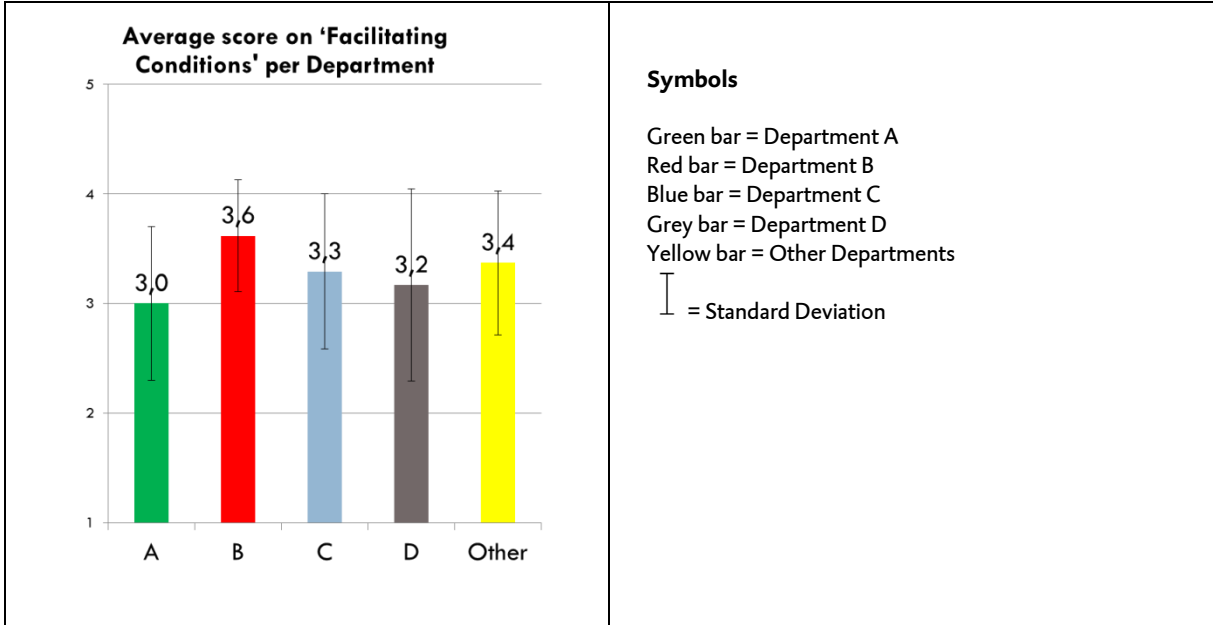
			No involvement	I	Not feeling or being involved in the preparation-stage of the EHR implementation.	<i>Maar echt actief met het EHR in het [ziekenhuis] ben ik niet.</i>
Impact	Digitalization	<i>The degree to which computer applications are already in use.</i>	Digitalized	I	Current use of computer applications.	<i>...we werken met veel digitale systemen.</i>
			Paper-based	I	Current non-use of computer applications.	<i>Ons verpleegkundig dossier is een papieren dossier.</i>
	Work methods	<i>The degree to which work methods connect to the use of EHR</i>	Change work methods	I	Current work methods do not connect to the use of the EHR.	<i>...dan moet je de processen anders organiseren</i>
			Same work methods	I	Current work methods connect to the use of the EHR.	<i>...want het werk blijft hetzelfde alleen hoe je het gaat vertalen in een dossier is anders.</i>
Usefulness	Expectations	<i>The expected consequences of the use of the EHR.</i>	Positive consequences	I	The EHR will have positive consequences for me, my colleagues and my patients.	<i>Wat dat betreft is er wel hoop op het EHR dat dat beter wordt.</i>
			Negative consequences	I	The EHR will have negative consequences for me, my colleagues and my patients.	<i>Je bent heel kwetsbaar bij stroomuitval.</i>

			No consequences	I	The EHR will have no influence for me, my colleagues and my patients.	<i>Nee, dat zal met het EHR niet opgelost worden.</i>
	Outcome	<i>Outcome-related lack of clarity or issues</i>	Functionality	I	The ease-of-use, lay-out, content, and functions of the EHR.	<i>...dat je die paar minuten die je met een patiënt hebt niet achter de computer zit i.p.v. met de patiënt bezig bent</i>
			EHR Characteristic	I	Uniform or department-specific characteristics of the EHR	<i>...zou je liever hebben dat je gewoon binnen elkaar systemen zou kunnen kijken.</i>
			ICT support	I	The availability of hardware and the support with software-problems.	<i>Dan moet je zorgen dat er overal voldoende beeldschermen en voldoende snelle computers zijn.</i>
			Security	I	The EHR ensures privacy of patient information.	<i>Maar de kwaliteit van de zorg en veiligheid moeten gewoon geborgd blijven.</i>
	Other	-	Preparation	I	Preliminary work outside the EHR implementation project in order to let the implementation run smoothly.	<i>...en kijken wat de mogelijkheden zijn voor digitalisering en zorgen dat we daarop aansluiten.</i>
Facilitating	Process	<i>Process-related lack of clarity or issues</i>	Actions department	I	Understanding of actions (need to be) taken by the own department, and why.	<i>Ik weet niet wie uiteindelijk verantwoordelijk is.</i>

			Actions EHR-team	I	Understanding of actions (need to be) taken by the EHR-team, and why.	<i>Maar daar zit een beetje iets scheefs. Het is net of wat ze daar bedenken, nou dat is dan allemaal heel belangrijk.</i>
			Transparency	I	The amount of information given by the EHR-team to the end-users during the process.	<i>...de bezuinigingen van de zorgadministratie... Waar die taakstelling op gebaseerd is, weet ook niemand.</i>
			Transition	I	Issues around the actual moment of implementation of the EHR.	<i>Ook ben ik wel bang voor de overgangperiode.</i>
			Trust	I	Trust in EHR-team, colleagues who are involved in EHR practices, and capabilities of ICT-systems.	<i>Ik weet niet hoe ze dat bedacht hebben, maar dat gaat dus never-nooit lukken.</i>
	Other	-	Past experience	I	Past experience with digital systems	<i>Ja, we hebben wel eens gehad dat die server het niet meer deed.</i>

APPENDIX III – BAR CHARTS OF THE AVERAGE OUTCOMES PER DEPARTMENT





APPENDIX IV – RESPONSE RATES

RESPONSE RATES

	Population*	Sample*	Response-rate from population
Total organization	1964	587	29,9%
Total four departments	442	159	36,0%

Departments

Department A	115	32	27,8%
Sub department A	11	2	18,2%
Department B	137	51	37,2%
Department C	100	38	38,0%
Department D	90	38	42,2%
Other departments	1522	428	28,1%

Occupation groups**

Managers	No information available.		
Physicians	133	50	37,6%
Nurses	176	56	31,8%
Other occupation groups	133	53	39,8%

Gender**

Male	105	41	39,0%
Female	337	118	35,0%

Age**			
20-29 years old	65	23	35,4%
30-39 years old	135	46	34,1%
40-49 years old	85	37	43,5%
50-59 years old	109	38	34,9%
60-69 years old	46	15	32,6%

Length of Employment **			
0-1 years	61	18	29,5%
2-10 years	181	70	38,7%
11-20 years	105	43	41,0%
>20 years (longest: 44 years)	95	28	29,5%

* Number of individuals

** Measured in the four selected departments

APPENDIX V - OUTCOMES ANOVA & ANCOVA

		Department				Occupation			
		Anova		Ancova		Anova		Ancova	
		df	F	df	F	df	F	df	F
Usefulness	Between Groups	4	0,871			4	5,518*	4	6,282*
	Within Groups	493				491		489	
Impact	Between Groups	4	2,407*	4	2,619*	4	11,626*	4	12,033*
	Within Groups	368		366		366		364	
Support	Between Groups	4	0,770			4	8,556*	4	8,242*
	Within Groups	356				355		353	
Facilitating Conditions	Between Groups	4	3,892*			4	6,523*	4	5,929*
	Within Groups	407				405		403	
Acceptance	Between Groups	4	1,109	4	4,049*	4	10,561*	4	10,299*
	Within Groups	531		405		528		526	

* Significant at the 0.05 level

Post-hoc: Mean difference (I-J): department

Variable	Department (J)	Department (I)					
		A	B	C	D	Other	
Usefulness	A			,12979	-,12157	-,00769	,10517
	B	-,12979		-,25136	-,13748	-,02462	
	C	,12157	,25136		,11388	,22674	
	D	,00769	,13748	-,11388		,11286	
	Other	-,10517	,02462	-,22674	-,11286		
Impact	A		,08913	,19283	,30492	-,10845	
	B	-,08913		,10370	,21579	-,19758	
	C	-,19283	-,10370		,11209	-,30129	
	D	-,30492	-,21579	-,11209		-,41337	
	Other	,10845	,19758	,30129	,41337		
Support	A		,19458	,18667	-,04281	-,28125	
	B	-,19458		-,00792	-,23739	-,27333	
	C	-,18667	,00792		-,22947	-,04386	
	D	,04281	,23739	,22947		-,08667	
	Other	,08667	,28125	,27333	,04386		
Facilitating Conditions	A		,61789**	,29032	,16667	,37075*	
	B	-,61789**		-,32756	-,45122	-,24714	
	C	-,29032	,32756		-,12366	,08043	
	D	-,16667	,45122*	,12366		,20408	
	Other	-,37075*	,24714	-,08043	-,20408		
Acceptance	A		-,14190	-,37880	-,21925	-,26385	
	B	,14190		-,23690	-,07735	-,12195	
	C	,37880	,23690		,15955	,11495	
	D	,21925	,07735	-,15955		-,04459	
	Other	,26385	,12195	-,11495	,04459		

* Significant at the 0.1 level

** Significant at the 0.05 level

Post-hoc: Mean difference (I-J: occupation)

Variable	Occupation (I)					
	Occupation (J)	Nurses	Physicians	Para- and Perimedics	Management	Healthcare Administration
Usefulness	Nurses		-,20643	-,19400	,34559	,14034
	Physicians	,20643		,01243	,55202**	,34677*
	Para- and Perimedics	,19400	-,01243		,53959**	,33434*
	Management	-,34559	-,55202**	-,53959**		-,20525
	Healthcare Administration	-,14034	-,34677**	-,33434**	,20525	
Impact	Nurses		,36869**	-,32595**	,02542	,32038**
	Physicians	-,36869**		-,69464**	-,34327	-,04831
	Para- and Perimedics	,32595**	,69464**		,35137	,64633**
	Management	-,02542	,34327	-,35137		,29496
	Healthcare Administration	-,32038**	,04831	-,64633**	-,29496	
Support	Nurses		-,06295	-,55158**	,80842**	-,03899
	Physicians	,06295		-,48863**	,87137**	,02397
	Para- and Perimedics	,55158**	,48863**		1,36**	,51259**
	Management	-,80842**	-,87137**	-,1,36**		-,84741**
	Healthcare Administration	,03899	-,02397	-,51259**	,84741**	
Facilitating Conditions	Nurses		-,12168	-,02877	,48138**	,18575
	Physicians	,12168		,09291	,60306**	,30743**
	Para- and Perimedics	,02877	-,09291		,51016**	,21453
	Management	-,48138**	-,60306**	-,51016**		-,29563
	Healthcare Administration	-,18575	-,30743**	-,21453	,29563	
Acceptance	Nurses		,11788	-,53205**	,18974	,07712
	Physicians	-,11788		-,64993**	,07187	-,04076
	Para- and Perimedics	,53205**	,64993**		,72179**	,60917**
	Management	-,18974	-,07187	-,72179**		-,11263
	Healthcare Administration	-,07712	,04076	-,60917**	,11263	

* Significant at the 0.1 level

** Significant at the 0.05 level

APPENDIX VI - IN-DEPTH ANALYSIS

Subject Category		Department A	Department B	Department C	Department D
Attitude	Acceptance	<p>Do not have much information on process and EHR. Are positive, but still have a doubts</p> <p>Example: Arts: <i>'Scholing voor alle groepen. Dat je weet hoe het werkt. Dat er echt gebruik van wordt gemaakt.'</i></p>	<p>It is a good-behaving department, when they are told to use the EHR, they will. Still some have doubts about their abilities to work with the EHR.</p> <p>Examples: Arts: <i>'Er komt een [EHR]. Mensen gaan dat wel gebruiken. Wij zijn een brave afdeling.'</i></p> <p>Verpleegkundige: <i>'Mijn collega's daar zijn twee groepen: (jongeren) hartstikke goed om mee te gaan werken, (ouderen) ik zie nog wel een aantal hobbels, lukt het mij wel om die omslag te maken?'</i></p>	<p>Think problems will arise when connecting the EHR to their equipment, which are currently used on paper-base.</p> <p>Example: Verpleegkundige: <i>'...de eerste reactie hakken in het zand en zeggen: dat kan helemaal niet met al onze apparatuur.'</i></p>	<p>Most will immediately use the system when it is available, few will postpone the use of the EHR until they really have to.</p> <p>Example: Manager (over artsen): <i>'Ik denk dat sommigen blijven zitten totdat het echt moet. Het is een minderheid. Papieren notities die mogen niet meer, dat kan niet het dossier.'</i></p>

<p>Due to the lack of information about the process and the outcome (EHR), they are not yet able to support the change fully. Still they are positive, and try to do what they can to prepare for the implementation.</p> <p>Examples: Manager: <i>'Je kunt wel in de weerstand gaan zitten, [...] maar [...] we moeten voort, flats, flats, flats, verder, klaar!'</i></p> <p>Arts: <i>'We zijn nog niet actief aan het denken [...] het heeft er misschien mee te maken dat [...] er nog moet worden gezocht of iedere afdeling bij de [afdeling A] een eigen inrichtingsboek gaat maken of toch meer gezamenlijk.'</i></p> <p>Verpleegkundige: <i>'Ik vind wel dat wij daarin achterlopen en dat het veel te lang duurt. Maar ik ben er wel heel positief over dat het er nu eindelijk gaat komen.'</i></p>	<p>Department-based EHR-team is involved, others are less involved. Others do not feel they can influence the change as an individual or as department. While they have much doubts about the process, they have a positive adoption intentions.</p> <p>Examples: Manager: <i>'Ik zit in het EHR team. [...] Ik denk dat we allemaal verantwoordelijk zijn voor de voortgang.'</i></p> <p>Arts: <i>'Ik ben dus niet bij het EHR project betrokken. [...] Je kunt van alles formuleren, maar wij hebben natuurlijk geen invloed op wat aangeschaft wordt. We will see.'</i></p> <p>Verpleegkundige: <i>'Het EHR is belangrijk voor ons allemaal. Ik bedoel afgezien van de hobbels, de digitale hobbels. Misschien is iedereen er eigenlijk wel van overtuigd dat het een goede zaak is om tot het EHR te komen.'</i></p>	<p>Intentionally resistance, later more supportive. They do not feel they can influence the change as an individual or as department. They see positive as well as negative sides.</p> <p>Examples: Manager (over eerste reactie afdeling): <i>'Afhoudend [...] omdat men er nog niet echt in geloofde. [...] Jullie kunnen nu niet enthousiast zijn, maar we gaan het wel doen.'</i></p> <p>Arts: <i>'[...] dat we nu nog zo weinig informatie hebben over het programma [...] dat ik het gevoel heb dat we iets in het luchtledige aan het bedenken zijn.'</i></p> <p>Verpleegkundige: <i>'Er is heel veel winst in een EHR te halen. Maar er zitten ook heel veel risico's in.'</i></p>	<p>EHR-team is involved, they do not share all information with others outside EHR team. Therefore division in supportiveness.</p> <p>Examples: Manager: <i>'Ik vind het belangrijk dat het EHR binnen [Afdeling D] goed geïmplementeerd kan worden, het zou vervelend zijn om met een opgelegd systeem te moeten werken.'</i></p> <p>Arts: <i>'Op stafniveau kijken sommigen er naar uit, anderen zeggen: dat is oude wijn in een nieuwe zak.'</i></p> <p>Verpleegkundige: <i>'Eigenlijk is het tot zo ver alleen, op de werkgroep en de afdelingsgroep na, naar het team toe in zoverre niet gecommuniceerd wat er gaat gebeuren.'</i></p>
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In the last few years the department is further digitalized, therefore they do not expect a large impact, except for the nurses. Most nurses work paper-based as well as digital; they currently do their work in twofold.

Examples:

Manager: *'Maar we werken al 5 jaar digitaal, zonder papier.'* [...] *'Dus voor ons lijkt het niet zo heel veel anders te zijn. Maar of dat zo is dat weten we niet. We weten niet wat we gaan krijgen'*

Arts: *'Hier is het meer van: we gaan van elektronisch naar elektronisch en het wordt hopelijk alleen maar beter.'* [...] *'Het EHR is een patiëntendossier. Je wordt daar niet door gedwongen processen anders te doen.'*

Verpleegkundige: *'Verpleegkundigen zijn veel meer gewend om te schrijven of in hun dossier, en niet bijv. in [ziekenhuis informatiesysteem]'* [...] *'Zij (artsen) maken veel meer gebruik van automatisering. Artsen doen dat veel meer dan verpleegkundigen.'*

This department is digitalized, except for the nurses. Manager expects a little impact, physician expects more administrative work, and nurse expects a large impact on work methods.

Examples:

Manager: *'Deze afdeling is al ver met digitaliseren'* [...] *'Voor mijn werkzaamheden verwacht ik dat er niet heel veel zal veranderen.'*

Arts: *'Het is geen EHR maar we gebruiken het wel als EHR. Dus wij werken redelijk papierloos.'* [...] *'Veel administratieve handelingen die door dokters gedaan worden, nog meer.'*

Verpleegkundige: *'Ons verpleegkundig dossier is een papieren dossier. En sommige elementen zijn dan wel digitaal.'* [...] *'Als je van papier naar elektronisch dossier gaat dat is natuurlijk een enorme stap.'*

This department is almost completely paper-based, still they are eager to learn and develop. Surprisingly, they do not expect that digitalization will affect their work methods much.

Examples:

Manager: *'Het is niet meer van de tijd [...] op een papiertje allemaal afdrukken en dan laten we 300 statussen per dag uit het archief komen.'*

Arts: *'Ik denk je doet meer met een computer, daar zal het in zitten. Ik denk niet dat het [speciaal] werk zelf heel erg zal veranderen.'*

Verpleegkundige: *'Dus de logistieke efficiëntieslag hebben wij al gemaakt. Die hebben we gemaakt op papier. Dus het stukje logistiek werken op papier zal ingevuld worden door het EHR.'*

While the outpatient clinic is digitalized, most expect a large impact on current work methods. Also here, the nurses work paper-based.

Examples:

Manager: *'Wij werken al heel erg digitaal, als een van de eerste afdelingen. Ook klinisch zouden we graag papierloos willen werken.'* [...] *'Huisbrede uniformiteit van processen en systemen betekent wel dat sommigen hun oude werkwijze moeten loslaten.'*

Arts (over polikliniek): *'Consulteren doen we nog op papier, verder is eigenlijk alles digitaal.'* [...] *'We zijn al een paar jaar digitaal, dus gewend aan typen en computeren.'*

Verpleegkundige: *'We hebben het natuurlijk al zo lang op papier gedaan, en het is natuurlijk ook best wel een grote verandering.'*

Usefulness	Expectations				
		<p>Manager: + <i>Betere overzichtelijkheid gegevens</i> - <i>EHR wordt mogelijk ziekte-georiënteerd ingedeeld, afdeling is patiënt-georiënteerd</i> +/- <i>Al digitaal, niet minder papierwerk door EHR</i> +/- <i>Minder tijd kwijt aan administratie, maar meer administratief werk voor dokters</i></p> <p>Arts: + <i>Inzichtigheid behandeling patiënt in ziekenhuis en op afdeling</i> + <i>Efficientie/snelheid</i> - <i>EHR heeft risico om net als [ziekenhuis informatiesysteem] veredeld Word-vel te worden</i> - <i>Artsen moeten veel en snel typen: weloverwogenheid brieven kan verdwijnen en het kost extra tijd</i> - <i>Kwetsbaar bij stroomuitval</i> +/- <i>Weet niet of EHR voor uniformiteit zorgt</i></p> <p>Verpleegkundige: + <i>Kennis ontwikkeling</i> + <i>Kwaliteit van zorg verbeterd</i> + <i>Gerichter zorg verlenen</i> + <i>Gerichter evalueren</i> + <i>Data verzameling verbeterd</i> - <i>Uniformiteit kan leiden tot starheid</i> +/- <i>Standaardsdisatie: 'saai' lijstjes invullen, EHR kan wel helpen door systematiek er in te brengen</i></p>	<p>Manager: + <i>Nu meerdere systemen naast elkaar, dan gekoppeld</i> + <i>Betere patiëntveiligheid</i> + <i>Betere informatie</i> + <i>Efficiëntie</i> - <i>Geen goede koppeling tussen programma's kan leiden tot slechte bedrijfsvoering</i></p> <p>Arts: - <i>Geen koppeling externe partijen</i> - <i>Arts moet meer administratief werk doen</i> → <i>minder tijd voor patiënt</i> → <i>Kans op fraude</i> +/- <i>Leesbaarheid bij schrijven, typefouten bij typen.</i></p> <p>Verpleegkundige: + <i>Gebruiksgemak</i> + <i>Minder fragmentatie qua programmatuur</i> + <i>Uniformiteit</i> + <i>Snelheid</i> - <i>Gevangene worden van systeem: geen ontspanningsmogelijkheid zoals papier</i></p>	<p>Manager: + <i>Inzichtigheid van gegevens</i> + <i>bewaking van het proces</i> - <i>Meer administratieve handelingen artsen</i> → <i>minder patiënten per spreekuur</i></p> <p>Arts: + <i>Inzichtigheid</i> + <i>Leesbaarheid</i> + <i>Beschikbaarheid</i></p> <p>Verpleegkundige: + <i>Gebruiksgemak</i> + <i>Integratie</i> - <i>Traagheid computers</i> - <i>standaardisatie vs. Personalisatie</i> - <i>Overkill aan informatie</i> - <i>Afhankelijkheid systeem</i> - <i>Geen constante feedback zoals nu bij eigen KWR-lijst</i> - <i>Minder veiligheid patiëntgegevens</i></p>	<p>Manager: + <i>Consistentie</i> + <i>Autorisatie</i> + <i>Leesbaarheid</i> + <i>minder dingen dubbel doen</i></p> <p>Arts: + <i>Één systeem</i> → <i>geen dubbel werk doen</i> - <i>Hogere administratieve last artsen</i></p> <p>Verpleegkundige: + <i>Gebruiksgemak</i> + <i>Efficientie</i> + <i>Inzichtigheid</i> + <i>Uniformiteit</i> - <i>Afhankelijkheid van het systeem</i> - <i>'kinderziektes' EHR</i></p>

Outcome	<p>Manager: 'Wat meer inhoudelijker informatie heb ik gemist. Over de mogelijkheden.'</p> <ul style="list-style-type: none"> • Multi-disciplinair gebruik • Customized EHR: deel ligt vast, met vrijheidsgraden • Gegevens anoniem versleutelen voor onderzoek <p>Arts: 'Ik hoop dat het een werkbaar EHR wordt.'</p> <ul style="list-style-type: none"> • Spraakherkenning • Voor iedereen inzichtelijk <p>Verpleegkundige: 'Ik ben een voorstander van pop-ups.'</p> <ul style="list-style-type: none"> • Gebruiksvriendelijkheid • Overzicht patient gegevens • Pop-ups 	<p>Manager: 'Waarschijnlijk gaan ze (huidige programmatuur) gekoppeld worden maar eigenlijk willen wij 1 systeem.'</p> <ul style="list-style-type: none"> • Echo-beelden digitaal in dossier • Koppeling moet goed gaan, of andere oplossing nodig • Kwaliteit van zorg en veiligheid patiënt <p>2</p> <p>Arts: 'Je hoopt toch dat je die ook voor een deel automatisch zou kunnen invullen vanuit het EHR'</p> <ul style="list-style-type: none"> • Inzichtelijkheid • Automatisch brieven versturen • Betere onderzoeksmogelijkheden • Minder computerprogramma's door koppeling • Gebruiksvriendelijkheid • Voldoende beeldschermen & snelle computers <p>Verpleegkundige : 'Ik hoop dat je pasje, dat je dat over een sensor haalt en meteen in het systeem zit.'</p> <ul style="list-style-type: none"> • Snelheid • Patientveiligheid • Aanwezigheid van hardware 	<p>Manager:</p> <ul style="list-style-type: none"> • Het digitaal beschikbaar maken van gegevens • Flexibiliteit EHR → customization • Protocollair EHR • Klein stukje algemeen, veel specifiek <p>Arts:</p> <ul style="list-style-type: none"> • Patientenvolgsysteem • Uniformiteit vs. specificiteit • Informatiefiltering • Inzichtelijkheid • Autorisatie • Snel en up-to-date EHR • Werkplek op maat <p>Verpleegkundige:</p> <ul style="list-style-type: none"> • Gegevens uit apparatuur moet digital • Aantasting huidige efficiëntie-niveau: Patientenvolgsysteem • Administratieve last arts • Tekenen en foto's bewerken • Informatie overload 	<p>Manager:</p> <ul style="list-style-type: none"> • Efficiëntie • Gebruiksvriendelijkheid in lay-out en handelingen • Simulatiemogelijkheden voor onderwijs • Autorisatie in onderwijs • Inzichtelijkheid • Uniformiteit, niet specificiteit • Snelle en kwalitatieve hardware • Beschikbaarheid van ICT-ers <p>Arts:</p> <ul style="list-style-type: none"> • Efficiëntie • Standaardisatie • Dataverzameling • Gebruiksgemak → ondersteuning zorgproces • Multidisciplinair samenwerken <p>Verpleegkundige:</p> <ul style="list-style-type: none"> • Duurzaamheid EHR • Efficiëntie • Uniformiteit en specificiteit • Uitval system • Patientveiligheid
Other	<p>Verpleegkundige: EHR-ontwikkeling door [een bedrijf voor ICT-apparatuur]</p>	<p>Manager: aansluiten bij programma Sector.</p> <p>Verpleegkundige: indicatorenprotocol ontwikkelen</p>	<p>Manager: Op initiatief afdeling begonnen met digitalisering.</p> <p>Arts: Processen zijn al in kaart gebracht.</p>	<p>Arts: alvast gebruik van tablets ingevoerd.</p>

Facilitating conditions	Process	Department has need for more information about EHR-format to develop department-specific requirements. Past experiences cause them to be a bit concerned.	Need for more information, they have concerns about transition period. Based on past experience they show concerns.	Mostly positive about process, many concerns based on may bad past experiences with digitalization.	Very clear view on process. The do not feel the urge to have more influence. Bad experience with current system, hope for better.
<p>Examples: Manager: <i>'Energijds word je geacht vorm te geven aan de inhoud, maar als je helemaal niets over de vorm weet, dan is dat best complex'. [...] 'dat we maar matig geïnformeerd worden over het hoe en het wat.'</i></p>	<p>Arts (werkzaam op twee afdelingen): <i>'Hierdoor zie ik hoe de introductie van het EHR verschillend verloopt per afdeling'. [...] 'Men ziet op tegen de overgangperiode. Je moet je voorstellen dat als je poli doet en je kunt niet bij je gegevens. Dat is de meest gênante en slechte situatie.'</i></p>	<p>Examples: Manager: <i>'Ik weet niet wie uiteindelijk verantwoorde-lijk is. [...] 'Ook ben ik wel bang voor de overgangsperiode.' [...] (over EHR team) 'Actief begeleiden' [...] 'Het draagvlak is altijd communicatie. En laten zien wat je zegt' [...] 'Vertrouwen is er maar het blijft spannend.'</i></p>	<p>Arts: <i>'Er wordt veel voorwerk gedaan, waarvan je je dan afvraagt of dat een papieren tijger is of dat echt zinnig is' [...] 'als je nog geen opdrachtgever hebt, dan weet ik niet wat we aan het implementeren zijn.' [...] (over EHR implementatie) 'en is dat in de praktijk net als een nieuw ziekenhuis bouwen. Dat valt toch altijd tegen als je er intrekt.'</i></p>	<p>Examples: Manager: (over EHR team): <i>'Er is een onge-looflijke boel opgetuigd,' [...] 'Maar daar zit een beetje iets scheefs. Het is net of wat ze daar be-denken, nou dat is dan allemaal heel belangrijk.' [...] 'maar dan nog... hier moet het wel gebeuren.' [...] 'Ik durf geen adverte-entie te zetten want we hebben een heel hoge taakstelling voor de be-zuinigen van de zorgad-ministratie gekregen. Waar die taakstelling op gebaseerd is, weet ook niemand.'</i></p>	<p>Manager: (over eigen rol) <i>'Je kunt de mensen voor-bereiden, en helpen met het inrichten van het sys-teem.' [...] (over rol EHR team) 'Ik denk dat zij er-voor moeten zorgen dat ze zoveel mogelijk onder-steunen.'</i></p>
<p>Verpleegkundige (over invoering EHR): <i>'ik vind ook wel dat wij daar in achterlopen en veel te lang duurt.' [...] 'ik denk dat er ten eerste meer informatie moet komen, van hoe zit het nou met het EHR.'</i></p>	<p>Verpleegkundige: <i>'Wij zullen informatie moeten krijgen van nou ja goed, wat wil jij graag en wij zullen zeggen van dit hebben wij graag, wat kunnen jullie bieden?'</i></p>	<p>Arts: <i>'Ik denk ziekenhuis-breed dat het heel goed is dat men denkt er over na, en dat is in andere ziekenhuizen waarschijnlijk minder.' [...] 'Dan weten we in ieder geval wat we eventueel zou-den willen.' [...] 'Je be-denkt wel iets, maar je weet niet of het ook uit-gevoerd kan worden..'</i></p>	<p>Verpleegkundige: <i>'De communicatie is prima.' [...] 'Hoe lang gaat de periode duren dat nog niet alle wensen en eisen in het systeem zitten op het moment dat het is ingevoerd? Dat is een stuk dat mij dan wat zor-gen baart..'</i></p>	<p>Arts: <i>'Als afdeling heb je nu niet het idee dat je een hele grote rol kan spelen bij het ontwikkelen' [...] (Het EHR team moet...) 'Heel veel met gebruikers om tafel.' [...] (over EHR proces) 'Ik denk dat dat heel professioneel gema-naged wordt' [...] (over project stimulatie) 'Ik heb het idee dat daar volop aandacht voor is en dat iedereen het wel onder-steund.'</i></p>	<p>Verpleegkundige: <i>'Het is wel een traag proces [zie-kenhuis]-breed.' [...] 'Dus ja betrokkenheid is wel erg belangrijk.' [...] (over eigen rol) 'zo gauw het systeem allemaal wat duidelijker wordt dan moet je meer zeggen, de afdeling moet dan ook wat meer duide-lijkheid krijgen.'</i></p>

Manager: 'Er is ooit een pilot geweest binnen [afdeling A] over een digitale temperatuurlijst, waarin een aantal afdelingen veel tijd in hebben geïnvesteerd en wat vervolgens werd afgeblazen. Door dit soort ervaringen is men voorzichtig.'

Arts: 'Sinds de invoering van [systeemnaam] is de efficiëntie op de OK enorm gedaald.' [...] 'ook een groot nadeel is vind ik de digitale EFS, medicatie aanvraag, met name digitale recepten. Want je typt nou een keer makkelijker fouten dan dat je ze schrijft.' [...] 'De digitale thermometer is het laatste debacle?'

Verpleegkundige: 'we hebben wel eens gehad dat die server het niet meer deed.' [...] 'We merken nu bij die indicatorenprotocol van: je moet gewoon doen.'

Manager: '[Ziekenhuis X] [...] die heeft een compact iets eerst aangekocht en die zeggen, dan bouwen we wel door, maar daar is bijvoorbeeld [ziekenhuis Y] aan failliet gegaan, zo'n beetje.' [...] 'We hebben zelf ook wel een keertje aan een pilot meegedaan, en nu, de laatste pilot is ook weer mislukt.'

Arts: 'dat men bang is door de innovaties die we in het verleden hebben gekregen.' [...] (over andere ziekenhuizen) 'Waar toch achteraf wat nadelige, of, hoe moet ik dat zeggen, financiële verrassingen naar voren kwamen toen het EHR er eenmaal was.' [...] 'Maar als men weet als er een probleem beneden is, met ons beeldensysteem, dan komt (ICT-er) direct naar beneden om dat op te lossen.'

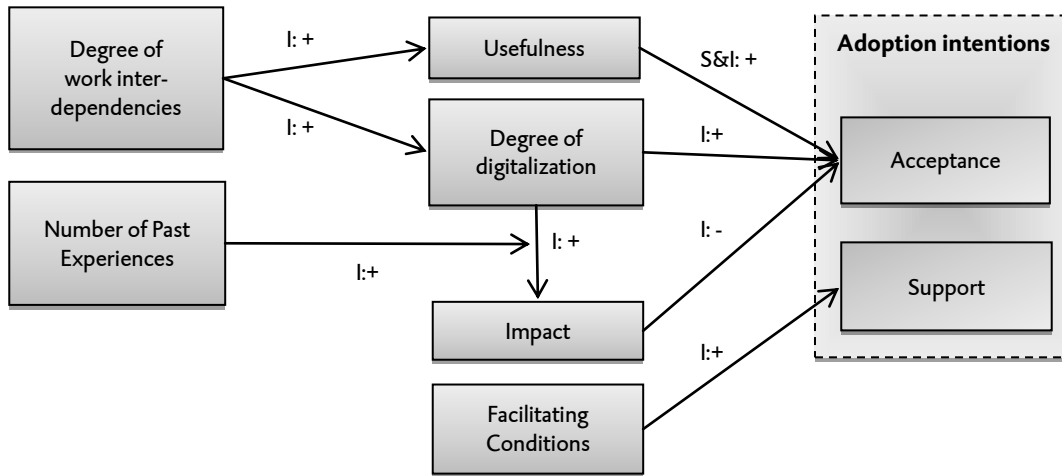
Verpleegkundige: 'We hebben al een aantal keer gehad dat [afdeling C] meeinging in een applicatie, zoals scannen, dat ging al grandioos mis.' [...] 'Er zijn dagen geweest dat het netwerk platlag en iedereen naar huis werd gestuurd. [Afdeling C] gelukkig niet, met het papieren dossier.' [...] 'De ervaring leert, met de aanschaf van bepaalde dingen, we doen er niks mee.'

Manager: 'Vanaf 2010, al langer, merken wij dat [ziekenhuis informatiesysteem] instabiel is. Iedere keer kwam er een nieuwe update, een paar keer hebben we een crash meegemaakt.' [...] 'Het hoeft ook niet te zijn dat het allemaal een desillusie wordt. Toen wij digitaal begonnen te werken, was de vraag ook "Hoe erg gaan we de röntgenfoto missen en het papieren dossier." In het begin bij oude patiënten werd altijd het papieren dossier er nog bijgehaald. Al heel snel werd de vraag, heb je dat nog nodig?'

Arts: 'Ik vind het tot nu toe niet heel goed, de automatisering' [...] 'Als je dan het initiatief neemt, wordt dat ook meteen de kop in gedrukt.'

Verpleegkundige: 'ik heb het afgelopen jaar wel 3 of 4 keer gehad dat het systeem uitviel en dat was storend gewoon.'

APPENDIX VII – THEORETICAL MODEL



Mechanisms influencing adoption intentions on group-level
I=Derived from Interview analysis,
S=Derived from Statistical analysis