

MASTER

Accepting and engaging with a real-time location system in a hospital context

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Accepting and engaging with a real-time location system in a hospital context

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Abstract

Overcrowding of emergency departments (ED) is a serious problem all over the world, which has widespread consequences for healthcare such as, increased mortality rates and prolonged hospital stay. Real-time location systems (RTLS) might offer a solution for this problem by gathering information about the workflow of hospital staff.

Staff's acceptance of and engagement with RTLS are important determinants for a successful RTLS project in a hospital environment. Neglecting these determinants can lead to RTLS rejection or even sabotage of the RTLS. Earlier research identified the perception of security, privacy and trust, culture, and education as variables which influenced the acceptance of RTLS. Earlier research suggested RTLS vendors should play a role in increasing staff's acceptance and engagement with RTLS. However, it remains unclear how these variables can be applied by RTLS vendors to increase acceptance and engagement. This study investigates how RTLS consultants can increase hospital staff's acceptance and engagement with RTLS.

To answer this question, this study first identified determinants which influence RTLS acceptance and engagement through a literature study. Six RTLS consultants were interviewed about their experiences with acceptance and engagement of hospital staff in two RTLS projects, using semi-structured interviews. The interviews were analyzed using thematic analysis to identify themes and subthemes and ordered on the chronological stages they were encountered in. Furthermore, findings of the literature and interview studies were compared and discussed. Finally, findings in this study were used to construct a requirement document.

The literature research showed that, perceived security and perceived privacy, culture, and education about RTLS, are variables which have an impact on the acceptance and engagement of hospital staff with RTLS.

[CONFIDENTIAL PARAGRAPHS]

In sum, this study investigated the role of RTLS consultants in increasing hospital staff's acceptance and engagement of RTLS. Based on a qualitative study, this research provided information about the acceptance and engagement in two RTLS projects. Next steps would be to implement these recommendations during an actual RTLS project. Future studies could use quantitative methods to verify and specify the effect of determinants found in this study, on hospital staff's acceptance of and engagement with RTLS.

Table of Contents

| | | |
|-------|--|----|
| 1 | Introduction..... | 2 |
| 1.1 | RTLS in healthcare | 3 |
| 1.2 | RTLS vendors | 3 |
| 1.3 | Research goals..... | 4 |
| 2 | Literature Research | 5 |
| 2.1 | Models measuring technology acceptance..... | 5 |
| 2.2 | RTLS in healthcare | 7 |
| 2.3 | Successful RTLS implementations | 8 |
| 2.4 | Technical determinants..... | 8 |
| 2.5 | Social determinants..... | 9 |
| 2.5.1 | The perception of security, privacy, and trust | 9 |
| 2.5.2 | Culture | 11 |
| 2.5.3 | Education..... | 11 |
| 2.6 | Conclusion | 11 |

1 Introduction

Over the last ten years, there has been an increase in emergency department (ED) visits all over the world, which in some instances leads to overcrowding (Lowthian et al., 2012). Overcrowding is a serious problem in hospitals (Affleck, Parks, Drummond, Rowe, & Ovens, 2013; Derlet, Richards, & Kravitz, 2001; Lowthian et al., 2012). Overcrowding has a wide range of effects on the functionality of an ED (Richardson & Mountain, 2009). The most severe of these effects is an increased mortality rate. It was found that patient's hospital admittance through an overcrowded ED was associated with a 34% higher mortality rate after ten days (Richardson, 2006). Other problems associated with overcrowding include, but are not limited to, increased severity of medical errors, prolonged length of stay in the hospital, and delayed time-critical interventions (Bernstein et al., 2009; Richardson, Mountain, 2009). Reducing overcrowding in EDs can decrease these negative effects and thus improve hospital's health care.

The development of real time location systems (RTLS) might offer a solution for problems such as overcrowding, as an RTLS can increase hospital workflow and efficiency (Ohashi, Ota, Ohno-Machado, & Tanaka, 2010). RTLS are systems that are able to detect, identify and localize objects or people automatically in a predetermined vicinity (Malik, 2009). An RTLS generally consists of tags and multiple beacons, which are connected to a network hub (Malik, 2009). The network hub functions as the network through which data is saved into a database. Beacons send communication signals, which are received by tags. Tags are small devices that can be worn by people or be attached to an object. When a tag receives the communication signal from the beacon, the tag returns a signal to the network hub. The network hub then detects the tag and logs its location including a timestamp through the network into the database. A layout of the RTLS system is shown in Figure 1.



Figure 1: Graphical overview of RTLS hardware connectivity

1.1 RTLS in healthcare

The implementation of RTLS in hospitals can help resolve problems such as overcrowding by identifying underlying complications of ED processes. The most important process is staff's workflow (Potisek et al., 2007). RTLS gather data about staff's movement, from this data staff's workflow and bottlenecks on a department floor can be derived (Potisek et al., 2007). This data can be gathered by having staff wear a tag or attach the tag to hospital equipment. This tag will then record the movement of staff and assets throughout an ED (Vilamovska et al., 2009). By using an RTLS for a workflow analysis, inefficient routes can be identified. Additionally, an RTLS can have additional beneficial effects on an ED such as improved asset management, which can prevent hospital assets from getting lost or stolen, and patient management, which can reduce patient waiting times and improve quality of care (Wamba, Anand & Carter, 2013).

Several case studies implemented RTLS and found promising results (Janz, Pitts, & Otondo, 2005; Wang, Chen, Ong, Liu, & Chuang, 2006). For example, investigating workflow processes (Janz et al., 2005), improve medical services, and increase patient safety (Wang et al., 2006).

However, an RTLS project in a hospital context is not simple, because the RTLS has a broad influence on managerial, organizational, technical, and social aspects of a hospital (Lorenzi, 2008). Yao, Wang and Li (2012) recommended to consider many strategic and tactical determinants during an RTLS project. The most important of these strategic determinants according to Monahan and Fisher (2011) when using RTLS to analyze movement of staff, is the communication with staff. Earlier research found that staff's acceptance of the RTLS can determine an RTLS project to be successful or unsuccessful (Janz, 2005; Monahan & Fisher, 2008). For example, Monahan and Fisher (2008) showed that an RTLS was sabotaged due to bad communication with the hospital staff.

1.2 RTLS vendors

To improve the acceptance of RTLS, it has been stated that RTLS vendors should play a key role (Fisher & Monahan, 2012). In 80 qualitative interviews over three years, in 23 hospitals, Fisher and Monahan (2012) investigated how the implementation of an RTLS affects an ED. They identified several methods how the hospital staff's acceptance can be increased. One of these methods for vendors was to support the implementation of an RTLS in the designated hospital, by customizing an RTLS to the specific needs of a hospital instead of seeing the RTLS as a one-size-fits-all product. Fisher and Monahan (2012) call out to RTLS vendors to play an active role in RTLS projects and suggest that their involvement could increase the chance of a successful RTLS project. Vendors should deploy consultants at the hospitals, which are about to install an RTLS. These consultants can then use their RTLS expertise to guide hospitals in different stages of the RTLS process. They could for example, explain how RTLS hardware can best be installed, make sure that the RTLS is used correctly, or educate hospital staff about the purpose of the RTLS and answer questions (Fisher & Monahan, 2008). By guiding hospitals in RTLS project, consultants can increase the staff acceptance of and engagement with RTLS which in turn will lead to a more positive RTLS experience (Fisher & Monahan, 2008, 2012). If consultants are to be responsible for the acceptance and engagement of RTLS, it is important to investigate how they can improve staff's acceptance and engagement.

1.3 Research goals

The goal of this study is to identify determinants which influence healthcare staff's acceptance of and engagement with RTLS. To find support for this goal, the following main research question is proposed.

Main research question: *Which determinants influence hospital staff's acceptance of and engagement with an RTLS?*

To answer the main research question, three smaller research questions are formulated. First, we will identify the variables which influence RTLS acceptance and engagement by two studies: (1) a literature research and (2) an empirical study using semi-structured interviews with experts. The final research goal will combine the information found in the literature research and interview study. Recommendations will be extracted from these results for RTLS experts to improve the acceptance and engagement of an RTLS in a hospital environment.

Research question 1: *What determinants influence the acceptance and engagement of hospital staff with RTLS according to the current scientific literature?*

Research question 2: *What determinants influence the acceptance and engagement of hospital staff with RTLS according to RTLS experts?*

Research question 3: *What recommendations can be drawn from the literature research and interview study to support RTLS vendors and consultants to increase the acceptance and engagement of hospital staff with RTLS?*

2 Literature Research

RTLS is of broad interest in the current literature as can be seen by the increasing amount of publications about the topic (Wamba, 2012; Wamba, Anand & Carter, 2013). Although RTLS is used in a variety of branches such as the supply chain, pharmacy, and healthcare (Vilamovska et al., 2009), a large part of the current literature focuses on the application of RTLS in healthcare and investigates the management of assets, patients and staff in a medical context (Wamba, 2012; Wamba et al., 2013). First, we define the scope of this literature review. Thereafter, the literature on RTLS in healthcare is discussed by first providing two case studies and investigating the technical and social issues. Finally, conclusions of this literature review are discussed.

To gather literature, this study uses the same method as used by Wamba, Anand and Carter (2013). A comprehensive literature search using combinations of multiple descriptors was performed. This literature search used the following keywords; “RTLS”, “RFID”, “healthcare”, “acceptance”, and “engagement”. Multiple searches were performed with a combination of keywords, leading to combinations which were unique per literature search. These searches were performed using the following search engines: Google Scholar, PubMed, Vlink, and Elsevier (SCOPUS). Articles which were related to the acceptance of and engagement with RTLS were selected and their abstract was screened to assess its fit with the research objective of the current study. Based on this process 50 articles about the acceptance of and engagement with RTLS were selected and thoroughly analyzed by the author. This analysis classified 15 articles as inappropriate for this literature study as the content of these studies was not relevant to the research goal of this study. The remaining 35 articles were used to identify determinants influencing RTLS acceptance and engagement.

2.1 Models measuring technology acceptance

Before we investigate RTLS acceptance in detail, it is important to consider general models which are used for measuring technology acceptance. The technology acceptance model (TAM) is the most commonly used model to assess technology acceptance (Davis, Bagozzi, & Warshaw, 1989; Chen, Li, & Li, 2011; Holden & Karsh, 2010). Additionally, the unified theory of acceptance and use of technology (UTAUT) is discussed as it is an extensive revision of the original TAM and other acceptance models which were based on the TAM (Venkatesh, Morris, Davis, & Davis, 2003).

The TAM (Figure 2) is based on two variables (Davis et al., 1989): perceived usefulness and perceived ease of use. Perceived usefulness is defined as the degree to which a prospective user believes that the technology would enhance the user’s performance. Perceived ease of use refers to the degree to which the prospective user believes the technology to be free of effort.

External variables, such as personal differences or situational constraints impact perceived ease of use and perceived usefulness (Davis et al., 1989). Perceived ease of use positively affects perceived usefulness. Perceived ease of use and perceived usefulness together influence the user’s attitude towards using the technology. Perceived usefulness together with the user’s attitude towards using the technology affect the user’s behavioral intention to use the technology. This behavioral intention in turn predicts the actual use of the technology.

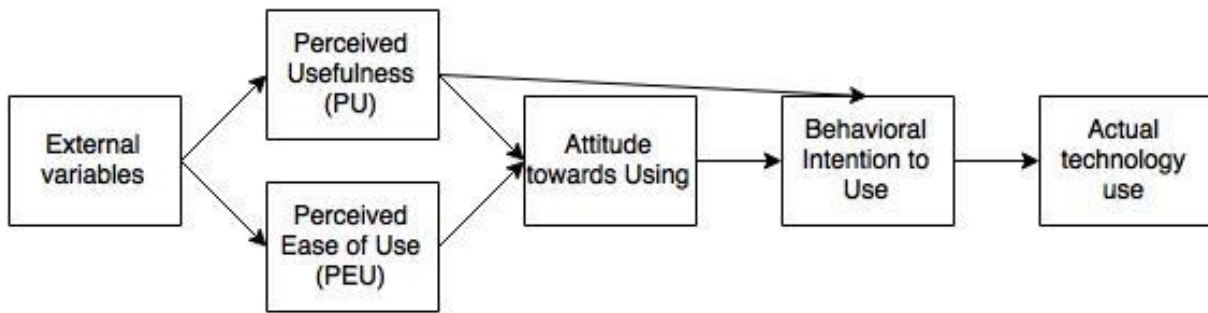


Figure 2: The technology acceptance model (TAM)

The UTAUT is an extensive revision of the original TAM and other acceptance models which arose to predict user acceptance more accurately (Venkatesh et al., 2003). Due to the many different technology acceptance models (Venkatesh & Bala, 2008; Vijayarathay, 2004), the UTAUT was constructed after analyzing eight models which predict technology acceptance (Venkatesh et al., 2003). The UTAUT uses the variables: performance expectancy, effort expectancy, social influence, and facilitating conditions (see Figure 3). Performance expectancy is explained by Venkatesh et al. (2003) as the degree to which a user expects the system to deliver support to his or her job performance. Effort expectancy is defined as the ease which is associated with the use of the system. Social influence is explained by the measurement to which a user expects relevant others to think he or she should use the new system. Finally, facilitating conditions is defined as the degree to which the user experiences technical and organizational infrastructure exists to support the use of the new system. The moderators, gender, age, experience, and the voluntariness of use influence the effect of the predictors on the behavioral intention and use behavior of the user.

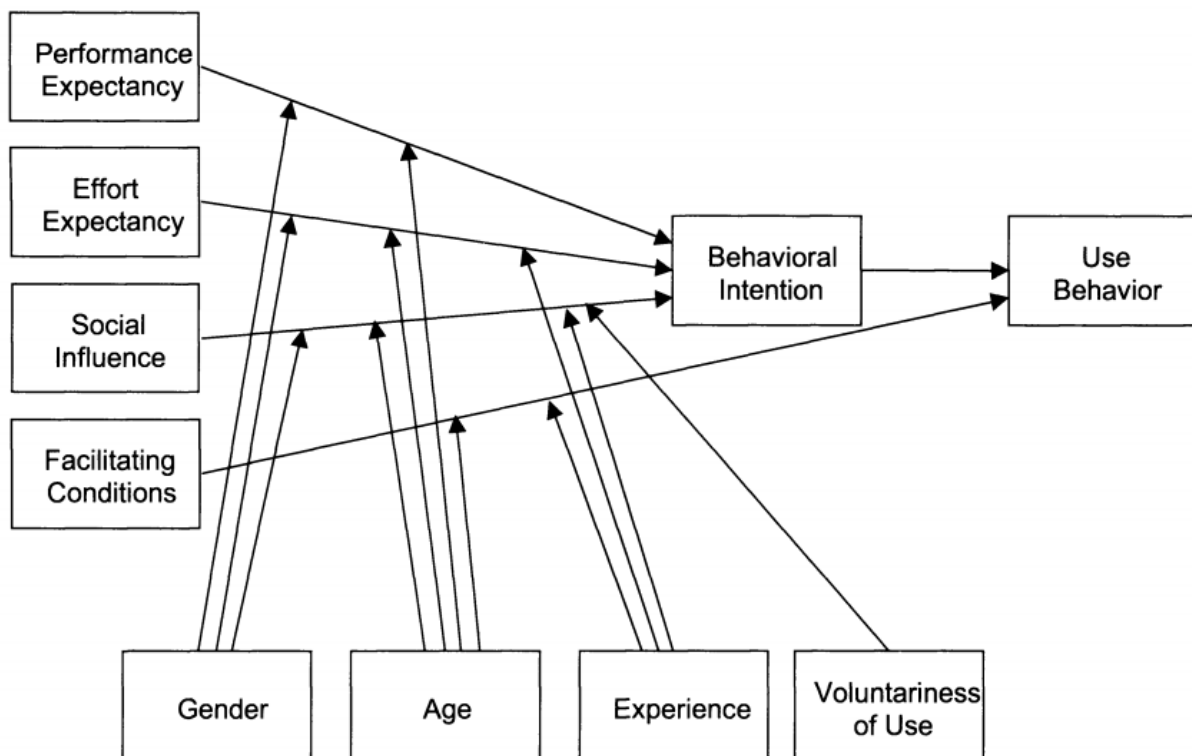


Figure 3: The unified theory of acceptance and use of technology (UTAUT)

Although the TAM and the UTAUT are often used to assess the acceptance of technology, these models do not identify how the predictor variables can be influenced to increase the acceptance of and engagement with certain technologies. As the goal of this study is to influence these predictor variables to increase acceptance and engagement, we take an explorative approach to identify the variables which underlie the predictors used in the UTAUT. To gain more insight into how RTLS consultants can increase hospital staff's acceptance and engagement with RTLS, we take a closer look at RTLS in healthcare by investigating the current literature on the acceptance of RTLS in healthcare contexts and by interviewing RTLS consultants.

2.2 RTLS in healthcare

RTLS is a topic of interest among hospital management as shown by a questionnaire study with 81 health operation directors (Yazici, 2014). This study showed that hospital operating directors see RTLS as a method which can have many benefits to a hospital, which in turn leads to an improved functionality of the hospital's departments. Especially improved efficiency and shorter response times to critical events are reasons why hospital operating directors are enthusiastic about RTLS (Yazici, 2014).

Although the amount of publications about RTLS rose exponentially the last years (Wamba et al., 2013) and hospital management was enthusiastic (Yazici, 2014), the implementation of RTLS did not increase. RTLS is not new on the market, as in 2004 already 20% of the respondents to a healthcare survey in the United States, reported that they had tested or experimented with RTLS (Wicks, Visich, & Li, 2006). In a study from 2009 in the United States, 18% of the hospital administrator respondents reported that they were implementing RTLS and 48% was considering to implement it (Mogre, Gadh & Chattopadhyay, 2009). Later on in 2012, a new survey found that 15% of hospitals in the United States used RTLS and 43% of the respondents were planning to use RTLS in the next two years (Fisher & Monahan, 2012).

RTLS tags are small and can be attached to anything (Malik, 2009). Because of this, RTLS can be used for several functions (Wamba, 2012; Wamba et al., 2013; Yao et al., 2012; Yazici, 2014). For example, RTLS tags can be attached to surgical tools to check, whether the tools have been in contact with patients, and thus might be unhygienic or whether they are not left inside a patient after surgery. Hospital assets can be tracked to prevent them from getting lost or stolen which saves the hospital expenditures and the staff's time looking for the assets. Patients can be tracked to investigate patient flow.

The stages of RTLS implementation is a researched in multiple studies (Kumar, Livermont, & Mckewan, 2010; Matta, Koonce, & Jeyaraj, 2012). Matta et al., (2012) identified three stages of implementation; initiation, experimentation and implementation. Initiation describes the awareness and preparation of the RTLS. Experimentation is defined as the activities leading to adoption. Finally, implementation explains the adoption implementation. To reach a successful adoption Matta et al., (2012) suggested these three stages should be walked through in a successive order.

This study focuses mainly on the localization of hospital staff on an ED as an ED is a stressful environment which might benefit the most from the functionalities an RTLS has to offer. To investigate the discrepancy found between the attitude towards RTLS and the actual implementation, it is

important to understand how RTLS can be implemented in a hospital. First, we look at two successful RTLS implementations.

2.3 Successful RTLS implementations

Across the world hospitals are experimenting with RTLS (Vilamovska et al., 2009). However, currently only two successful RTLS projects have been well documented and published (Janz et al., 2005; Wang et al., 2006). These two case studies report about the successful implementation of RTLS in Taiwan and in the United States. These studies indicate that RTLS can be an important contribution to the quality and efficiency of healthcare.

The first project used RTLS in Taiwan during the outbreak of a dangerous and contagious disease called SARS (Wang et al., 2006). In this project patients were tracked and their temperature was measured by an RTLS, which reduced the workload of staff. Additionally, visitors and staff were tracked in the hospital environment to reduce contact time with infected patients, which reduced the risk of contamination. Because the added value of the RTLS was clear patients, visitors and staff, all groups accepted the technology easily. It was concluded that a successful RTLS project requires team effort and that RTLS vendors and consultants should be included in this process.

In the second project, RTLS was used to deal with overcrowding on a level 1 trauma unit in the United States (Janz et al., 2005). Staff received training on the RTLS, which increased staff's acceptance of the system, because the functionality of the system was framed in the context of problems staff encounters on a daily basis. The RTLS identified bottlenecks during patient's hospital flow-through and increased the accountability of patient stay from 25% to 80%. Exact performance measures are unknown as these measures were confidential. However, Janz et al. (2005) mentioned that "medical staff was generally pleased with the quality and value of the initial results" (p. 141).

These case studies show that RTLS were successful. However, this leaves the question why implementation of RTLS has not grown as much as expected. The lack of growth can be explained due to technical and social determinants (Fisher & Monahan, 2008, 2012; Wamba, 2012; Wamba et al., 2013), elaborated in the following sections.

2.4 Technical determinants

In their extensive literature review, Wamba, Anand and Carter (2013) identified two categories of technical issues which are specifically important for RTLS. The first category focuses on the integration of RTLS with hospital's information technologies (IT). The second category focuses on data management, security and privacy of the RTLS.

The first category of technical issues of RTLS, RTLS integration with IT, consists of smaller issues such as, data collection and data management (Janz et al., 2005; Li, Visich, Khumawala, & Zhang, 2006; Mogre et al., 2009). The data collected by RTLS is often corrupted by noise and can be erroneous. For example, when RTLS uses infrared to communicate, the infrared light might get reflected by a surface and ends up in the zone of a different beacon. This will cause the data to be collected by the wrong beacon. Because of this, the data collected needs to be filtered and checked for errors before using the data for analyses.

The second category of technical issues is data management, security and privacy issues related to data gathered by an RTLS (Monahan & Fisher, 2011; Wamba, 2012; Wamba et al., 2013). To specify,

the current RTLS literature does not define the difference between privacy and security clearly, resulting in the definitions used interchangeably. This study will address security and privacy issues as explained by Hawrylak, Schimke, Hale and Papa (2012) and will thus address both security and privacy issues as security threats. Security threats can be categorized into four topics: interception, interruption, modification, and fabrication (Hawrylak et al., 2012). An interception threat is present when a message is susceptible to unauthorized acquisition of the sent message (Ayoade, 2007; Wickboldt & Piramuthu, 2012). Interruption is the intervention of a third party to prevent the message from arriving at the destined location (Hawrylak et al., 2012). Modification is the alteration of a message's content (Ayoade, 2007). Fabrication means that a concocted message is entered into the RTLS (Chen, Huang, Tsai, & Jan, 2012).

It may be because potential RTLS users are afraid of these security threats that the implementation of RTLS has not grown as exponentially as expected. However, the mentioned threats assume that the data sent in an RTLS network contain privacy sensitive information, which might not actually be the case. Additionally, while previous studies state that these issues are unacceptable terms during the use of RTLS (Ayoade, 2007; Juels, 2006), hospital staff did not feel threatened by security and privacy issues (Janz et al., 2005) addressed by Hawrylak et al. (2012). This might imply that the technical determinants are not such a problem for RTLS acceptance and engagement. Fisher and Monahan (2008, 2012) suggested not the technical determinants to be the most important to consider for RTLS acceptance and engagement but social determinants.

2.5 Social determinants

Fisher and Monahan (2008, 2012) suggested social determinants to be of importance for a successful RTLS project. To identify these social determinants this study takes a closer look at how these determinants influence acceptance and engagement.

Many studies investigated the influence of social determinants on the acceptance and engagement of RTLS (Fisher & Monahan, 2008, 2012; Matta et al., 2012a). These studies often used the TAM (Hossain & Prybutok, 2008) or determinants were simply argued to have an influence (Junglas & Watson, 2008; Thiesse, 2007). The following summarizes these variables and looks at their influence on RTLS.

First, literature related to perceived security, privacy, and trust are examined, which distinguishes itself from technical issues by focusing on the subjective perception of users. After that, culture is discussed as a determinant, which could influence an RTLS project. Finally, the topic of training and education as an influential determinant in RTLS (Fisher & Monahan, 2008, 2012; Guédon et al., 2014; Ting, Kwok, Tsang, & Lee, 2009).

2.5.1 *The perception of security, privacy, and trust*

By investigating how people perceive the security of an RTLS, it will become clearer whether technical issues with security are in fact a problem during an RTLS project. It is important to note that people can perceive a technology as insecure while in fact it is secure. A previous study divided perceived security into two subcategories (Hossain & Prybutok, 2008): Importance of personal information and the unwillingness to sacrifice security. These variables were found to have a negative correlation with the intention to use RTLS (Hossain & Prybutok, 2008). This implies the higher users perceive the importance of personal information, and the less willing they are to risk this information, the lower their intention to use RTLS.

As with the technical determinants, also in social challenges security and privacy are closely related. While security is more often referring to the technology, which is protecting a user's information, privacy is more often used to define the degree in which the user has control over the distribution of their personal information. It was suggested that privacy also had a considerable impact on the acceptance and engagement with RTLS (Fisher & Monahan, 2008; Guédon et al., 2014; Hsi & Fait, 2005; Malik, 2009). This statement was supported by Pramatarı and Theotokis (2009), who showed that information privacy concerns were negatively correlated with the attitude towards RTLS. In addition, Cazier, Jensen, and Dave (2008) divided information privacy concerns into the perceived privacy risk likelihood and perceived privacy risk harm, thus, how likely participants rated the chance to have their privacy violated and the harm this violation could do. Both of these determinants showed a significant negative correlation with the intention to use RTLS. However, while this might indicate that privacy may play a significant role in the acceptance of RTLS, other studies found no significant correlation between perceived privacy and the acceptance of RTLS (Hossain & Prybutok, 2008). This might indicate that while privacy appears to have some influence on the acceptance of RTLS, it has yet to be determined how privacy is related to the acceptance of RTLS. It could also mean that a variable such as perceived privacy overlaps with other variables such as perceived security or trust. A possible explanation for this discrepancy in findings could be that different RTLS, methodologies, and variables were used in these studies (Cazier et al., 2008; Hossain & Prybutok, 2008; Pramatarı & Theotokis, 2009).

Trust was found as another influencing variable in the acceptance of RTLS (Thiesse, 2007). It was shown that risk security perception, and privacy perception predicted trust, which in turn predicted perceived risk (Pavlou, 2001). When taking a closer look at what role trust may play in the acceptance of RTLS, three different kinds of trust have to be distinguished. The first of these is institutional trust. Here the question can be asked; Do users trust the vendor which deploys the RTLS? Secondly, interpersonal trust is identified; Does the user trust the vendor's consultant, whose job it is to explain the RTLS to the users? Thirdly, technological trust; does the user trust the RTLS itself? For example, if a consultant is untrustworthy or even dishonest with the user, while the user initially trusts the vendor and the technology, the user may decide to not accept and engage with the RTLS promoted by the consultant.

The lack of trust may lead to technological anxiety where users are unable or unwilling to use RTLS (Pramatarı & Theotokis, 2009). In these situations, one of the main reasons for users not to engage with RTLS is because they do not know who has access to their data (Fisher & Monahan, 2008, 2012; Junglas & Watson, 2008). It was shown that people were especially sensitive about the leaking of information containing personal information (Katz & Rice, 2009; Ohkubo, Suzuki, & Kinoshita, 2005). In other words, it is essential for the acceptance and engagement of an RTLS to have transparency about what data is being collected, what it is used for and who has access to it. Also, to protect hospital staff against leaking of personal information, hospital staff can be anonymized by role (Stahl, Holt, & Gagliano, 2011). This would be a solution as users of the RTLS could only be identified as a nurse or a physician in the data collected by the RTLS. Another solution to prevent leaking personal information would be to not collect any personal information with the RTLS (Hsi & Fait, 2005). In an interview study, nurses reported that they did not find it a problem to be tracked but that it might be an issue when visitors or patients are tracked (Ohashi et al., 2010). Thus, while the leaking of personal information might not actually be as big of a problem as suggested, transparency and protection of personal information might enhance the acceptance and engagement of RTLS.

2.5.2 Culture

Next to security, privacy, and trust, culture was found to affect the acceptance and engagement with RTLS (Hossain & Prybutok, 2008). Two categories of culture are identified; international and organizational (Monahan & Fisher, 2011). International culture plays a role in the acceptance and engagement of RTLS as international cultures may have a different attitude towards technology. A questionnaire about consumer acceptance of RTLS devices showed that participants from Greece scored higher on technological anxiety than participants from Ireland (Pramatari & Theotokis, 2009). While no other comparisons about the acceptance and engagement of RTLS has been made between other countries, it should be kept in mind that the deployment of an RTLS may differ from country to country.

Organizational culture also influences the acceptance and engagement with RTLS. Management influences the extent to which there is support for information technologies within an organization (Fisher & Monahan, 2012; Matta, Koonce, & Jeyaraj, 2012b). In addition, the size of an organization may also play a role as this influences the organizations resources, transaction volume and workforce size (Fisher & Monahan, 2012; Matta et al., 2012b). RTLS was more likely to be accepted and implemented successfully if the hospital staff experienced some external pressure. If external partners of the hospital wanted the hospital to use the RTLS, hospital staff was more likely to use it (Matta et al., 2012). This can also be supported by reinforcement from the management (Matta et al., 2012). If management supports staff during the implementation of an RTLS by for example, functioning as a role model, staff is more likely to accept and engage with the RTLS (Fisher & Monahan, 2008).

2.5.3 Education

Lastly, perhaps the most important variable to increase the acceptance and engagement with RTLS is the education about RTLS (Fisher & Monahan, 2008, 2012; Guédon et al., 2014; Ting, Kwok, Tsang, & Lee, 2009). RTLS education can be done in several manners. For example, giving presentations about RTLS, organizing walk-in hours, but also by selecting staff members who are included in the implementation phase at an early stage, so called champions (Guédon et al., 2014; Janz et al., 2005). Training staff has several advantages. First of all, it can increase staff's perceived convenience of the RTLS. By formulating the goals of the RTLS in problems which staff encounters in their daily work, staff will be able to identify themselves with the problems and see the use of the RTLS (Janz et al., 2005). It should be clear that the focus of the RTLS is to support staff (Junglas & Watson, 2008; Kindberg, Sellen, & Geelhoed, 2004), instead of increasing their workload (Hossain & Prybutok, 2008). This will also increase transparency as staff will gain more insight into the goal of the system and what is done with the collected data (Thiesse, 2007). Education is also a good moment for staff to ask questions or negotiate about how the RTLS should be used both from the staff's side, as from the vendor's side (Fisher & Monahan, 2008). In general, education about RTLS raises the expectations of RTLS, which in turn will increase the RTLS acceptance of the staff (Hossain & Prybutok, 2008).

2.6 Conclusion

Based on this literature research, several determinants, which influence acceptance and engagement, are identified. Literature stated technical determinants to stop users from using RTLS. However, it was found by Janz et al., (2005) that technical determinants do not influence acceptance

and engagement of hospital staff. It can be concluded that technical determinants are not as relevant for staff's acceptance and engagement as suggested by Hawrylak et al., (2012) and Mogre et al. (2009). When looking at social influences, several determinants are identified. These determinants are: perceived privacy, perceived security, perceived trust, culture, and education and training.

However, several remarks should be taken into account when looking at this literature research. As previously mentioned, not all variables in the current literature have been tested. This means that while it is suggested that the mentioned variables can influence the acceptance and engagement with RTLS, their effect still has to be proven. Secondly, it should be mentioned that the variables were measured using different RTLS. As Fisher and Monahan (2012) stated "Perceiving RTLS as an off-the shelf technology may serve vendors' goals but it undermines successful deployment." (p. 711). It is of importance that researchers do not make the same mistake by generalizing conclusions related to a specific RTLS.

To conclude, this interview study answered the first research question by identifying which determinants play a role in RTLS acceptance and engagement of hospital staff according to the current literature.

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