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Understanding the RFID Deployment at Sacred Heart Medical Center: Using Technology-Organization-Environment Framework Lenses

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Abstract

This qualitative study based on a single case features the radio frequency identification (RFID)-based real-time location system (RTLS) system to track intravenous (IV) pumps deployed by the Sacred Heart Medical Center (SHMC), Eugene, Oregon --- one unit of the PeaceHealth network based in western U.S.A. Asset tracking management, followed by the tracking of medical staff and patients continue to be leading applications for RFID in the healthcare industry in north America. This case study uses Tornatzky's technology-organization-environment framework in interpreting and understanding the RFID deployment at SHMC/Eugene, Oregon.

Keywords: radio frequency identification (RFID); asset tracking; real-time location tracking; hospital inventory systems

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1. Introduction

This case study features the radio frequency identification (RFID)-based real-time location system (RTLS) system to track intravenous (IV) pumps deployed by the Sacred Heart Medical Center (SHMC), Eugene, Oregon --- one unit of the PeaceHealth network based in western U.S. There are multiple drivers for RFID adoption in the healthcare industry: high customer demand for higher quality care with "personalized" medicine; demographic pressures created by an aging society and the need to care for a growing number of seniors; the economic pressures within the industry itself to cut costs while expecting greater workflow efficiencies in the management of hospitals; emerging technologies pointing towards "connected, intelligent, and smart" health institutions; declining costs of RFID technology; and compliance with government regulations such as Health Insurance Portability and Accountability Act (HIPAA) in the USA and General Data Protection Regulation (GDPR) in Europe (Frost & Sullivan, 2021, 2019, 2016).

Asset tracking management, followed by the tracking of medical staff and patients continue to be leading applications for RFID in the healthcare industry (Frost & Sullivan, 2021, 2019, 2016). This was true before the COVID19 pandemic that started in March 2020. After the pandemic, hospitals are now faced with greater budgetary constraints in purchasing or renting medical assets as their budgetary priorities have shifted significantly towards the care of infected COVID19 patients (Frost & Sullivan, 2021).

Although RFID technology has been around now for a number of decades, it is interesting to note that the adoption uptake in the healthcare industry in North America is still considered low, considering the potential benefits of the technology (Frost & Sullivan, 2021, 2019, 2016).

This case study uses Tornatzky's technology-organization-environment (TOE) framework in interpreting and understanding the RFID deployment at SHMC/Eugene, Oregon.

2. Literature Review

2.1. Technology-Organization-Environment Framework

This study will use the technology-organization- environment (TOE) framework introduced by Tornatzky and Fleischer (1990) that uses three elements that influence technological adoption --- the environmental context, the organization context, and the technological context.

2.1.1. Environmental Context

The environmental context is the arena surrounding a firm, consisting of multiple stakeholders such as industry members, competitors, suppliers, customers, the government, the community, etc. They can influence how a firm interprets the need for innovation, its ability to acquire the resources for pursuing innovation, and its changing market and competitive conditions that prod firms to use various forms of innovation. Government regulation is also another powerful tool for constraining a firm's operational activities, increasing costs of production, and instigating an investigation of technologies that must meet specified mandatory criteria. Finally, dominant customer firms could exert their power to shift their suppliers' production activities and/or business processes to comply with their requirements.

2.1.2. Organizational Context

These descriptive measures characterize the "organizational context": firm size; the centralization, formalization, and complexity of its managerial structure; the quality of its human resources; the amount of slack resources available internally; formal and informal linkages within and outside the firm; decision making and internal communication methods; and boundary spanning mechanisms to communicate with the external environment. The concept of the "organic" versus the "mechanistic" organizational system is also relevant here. Frequent lateral communication, decentralization of leadership and control, and active networking both within and outside the firm are hallmarks of the "organic" system. Building interorganizational collaboration mechanisms is fundamental in meeting the needs of electronic coordination linkages enabling supply chain partnerships. Top executives can energize major organizational changes by: (1) developing and communicating a clear image of the firm's strategy, core values, and role of technology in meeting this strategy; (2) sending consistent signals both within and outside the firm about the value of the innovation; and (3) creating a team responsible for crafting a vision relevant to the innovation (Tushman & Nadler, 1986).

2.1.3. Technological Context

Tornatzky and Fleischer (1990) presented their "systems design perspective," which is a synthesis of the following approaches: technocentric, sociocentric, conflict/bargaining, systems life cycle, and socio-technical systems.

(1) Understand the Characteristics of the Innovation

The technocentric approach espouses the notion that technological factors dominate the implementation experience, thus, leading to the following consequences: (a) there should be a detailed technical plan for implementation; (b) methods engineering should help in the redesign of business processes and jobs; (c) the innovation should be able to be integrated with the existing technical system; and (d) technical criteria should be used in measuring implementation effectiveness (Rousseau, 1988; Lawson et al., 1983; Gunn, 1982). The "systems design perspective" used also calls for a technology-organization match. The technology innovation could also influence how different parts of a firm need to coordinate. Implementation of information systems supporting environmental goals extends the level of coordination needed from internal integration to interorganizational integration within the supply chain context.

(1) Develop Measures of Implementation Effectiveness

A wholistic approach to measuring implementation effectiveness would include metrics that are relevant to the technocentric, systems development life cycle, sociocentric, and conflict/bargaining approaches.

(2) Plan and Pace Implementation

Pacing technology implementation refers to the speed at which changes are unfolded, which could range anywhere from gradual to radical (Roitman, Liker, & Roskies, 1987).

(3) Design or Redesign the Organization

The sociocentric approach focuses on making the organization more flexible, humanistic, and open to changes brought about by the innovation (Tornatzky & Fleischer, 1990; Zaltman, Duncan, & Holbek, 1973; Hage, 1980).

(4) Modify Human Resources Policies

Human resource policies involving employee selection, compensation, appraisal, and training --- all of which have important implications for innovation implementation have to be modified to fit the innovation (Ettlie, 1988; Majchrzak, 1988).

(5) Design or Redesign Jobs

The design and/or redesign of jobs are needed to ensure that the affected workers and the work system required by the innovation are linked (Tornatzky & Flesicher, 1990).

(6) Install the Innovation and Integrate with the Existing System

The systems design approach prescribes the following: (a) incorporating end user needs into the requirements definition phase; (b) designing the new system so that it can integrate with the larger IT system that encompasses the firm; and (c) ensuring the provision of resources for reliable system maintenance and providing for both incremental and radical system changes if called for.

3. Research Methodology

This study uses the case study approach in aligning the concepts and guidelines prescribed by the TOE framework to the case facts of SHMC, Eugene, Oregon. The case study approach is an appropriate methodology in testing the application of a conceptual framework to a real organization.

Primary data was gathered from the transcript of the presentation given by Kaspar Christian Bucksteiner, Healthcare Improvement Engineer, SHMC/Eugene, Oregon during the RFID Journal Live! Annual Conference in April 3-5, 2012, Walt Disney's World, Orlando, Florida (Bucksteiner, 2012). Secondary data using articles were used as well. All of these materials were content analyzed using key concepts embodied in the TOE framework. The following are accepted definitions of the content analysis method:

"Content analysis is any research technique for making inferences by systematically and objectively identifying specified characteristics within text." (Stone, 1966, p. 5)

"Content analysis is a research technique for making replicable and valid inferences from data to their context." (Krippendorff, 1980, p. 21)

"Content analysis is a research method that uses a set of procedures to make valid inferences from text." (Weber, 1990, p. 9). In this study, the concepts used for conducting content analysis were derived from the TOE framework. These form the "context" of the content analysis method as applied to the RFID project of SHMC.

"A context is always someone's construction, the conceptual environment of a text, the situation in which it plays a role. In a content analysis, the context explains what the analyst does with the texts; it could be considered the analyst's best hypothesis for how the texts came to be, what they mean, what they can tell or do. In the course of a content analysis, the context embraces all the knowledge that the analyst applies to given texts, whether in the form of scientific theories, plausibly argued propositions, empirical evidence, grounded intuitions, or knowledge of reading habits…. The context specifies the world in which texts can be related to the analyst's research questions." (Krippendorff, 2004, p. 33).

TOE concepts were used in analyzing the secondary materials within the context provided by the different theoretical frameworks or "prior theory." "Analytical constructs operationalize what the content analyst knows about the context, specifically the network of correlations that are assumed to explain how available text are connected to the possible answers to the analyst's questions and the conditions under which these correlations could change….analytical constructs ensure that an analysis of given texts models the texts' context of use…" (Krippendorff, 2004, p. 34).

The following key conceptual elements of the content analysis method as stipulated by Krippendorf (2004) were used in this study: (1) body of text selected for the analysis; (2) research question that needed to be addressed; (3) a context of analysis within which interpretations will be made; (4) analytical constructs that operationalize what the analyst knows about the context; and (5) inferences that will be arrived at to address the research question.

4. The Sacred Heart Medical Center Real-Time Location System

As part of the Peace Health Network, SHMC serves eight counties as a level II trauma center. As such, it oversees the use of a wide variety of expensive medical assets whose usage has mostly been mismanaged among medical care workers who often expressed frustration over the lack of units for their use. This experience was allowed to go on for years until top management no longer tolerated the monthly purchase of additional units subject to the whims and demands of care takers. It was at this point when top management spearheaded the first ever RFID-based asset management system considered for SHMC. In 2010, the designated real-time location system project decided to keep things simple and focused on one asset only --- the IV pump as its use was in high demand at SHMC. After having been informed of the project, the nurses' initial response was lack of enthusiasm and skepticism.

The asset management project underwent two phases of development. In the first phase, the focus was to facilitate finding the location of the IV pumps following their use throughout the hospital. Versus RFID tags were attached to 700 IV pumps that enabled health workers to track them. The end user side of the system required nurses, though, to log into the Versus system to find the IV pump and then, physically go to the discovered location to pick it up. This aspect of the system annoyed the health care workers who thought that their job was no easier nor was time really saved, even if they could locate the pumps. This led the RTLS project team to transition to phase 2: to eliminate the need for health workers to fetch IV pumps from identified locations, a PAR level system of maintaining inventory levels had to be developed. Data was gathered on IV pump usage and movements in different hospital facilities and was used as the basis of the PAR-based inventory management system supported by the Versus Technology RFID-based RTLS system. The PAR system indicates the minimum allowable count of IV pumps per location and generates alerts when the number goes below the minimum threshold.

This system also depends on the participation of the engineering staff whose members collected the IV pumps and brought them to a centralized location of a unit, where healthcare workers can pick them up. Thus, healthcare workers no longer have to prowl the hospital units to fetch the IV pumps --- a major improvement in their view.

5. Research Findings

5.1. Environmental Context

The use of radio frequency identification (RFID) in the healthcare sector in tracking expensive assets, medical staff, and patients has been driven by a number of factors. Hospitals and other healthcare organizations continually seek to improve their business process flows, asset utilization, and optimize their procurement processes (Frost & Sullivan, March 2016). Regulatory efforts of governments and healthcare-related agencies as expressed through initiatives like HIPAA have also paved the way for further RFID adoption. Despite the promise of benefits from RFID deployment and the declining costs of the technology, the penetration level of RFID in the healthcare industry in North America is still not as high as one might expect (Frost & Sullivan, March 2016).

This case study featuring the deployment of RFID in tracking inventory assets at SHMC is, therefore, considered one of the "middle-of-the-road" experiences in an industry that is lagging in RFID adoption despite its demonstrated benefits. While insufficient financial resources have been cited as a major reason for the slow RFID adoption, it has been just as strongly noted that medical staffs' lack of education, if not outright ignorance about the technology and its benefits, and simple unwillingness to try it have been powerful deterrents to its use (Frost & Sullivan, March 2016). Medical personnel's fear of being monitored is also another demotivator.

Another environmental factor was the availability of an RFID vendor, in this case, Versus Technology, now called Midmark Technology, that shepherded SHMC's journey in RTLS system deployment. This same vendor was used in the other SHMC units within the PeaceHealth network. Loyalty to this vendor and long-term relationship and collaboration are significant contributors to the successful RTLS system deployed at the Eugene, Oregon medical center.

5.2. Organizational Context

SHMC at the University District, Eugene, Oregon, USA, is part of the PeaceHealth network based in Vancouver, Washington, USA (PeaceHealth, 2021a, 2021b). This network consists of 10 medical centers spread throughout the rural and urban communities in the northwest USA covering Washington, Oregon, and Alaska. The SHMC in Eugene, Oregon is one of the centers of the network that sponsor groundbreaking medical programs. It works together with the Oregon Health & Science University, and manages the largest inpatient behavioral health unit in central and southern Oregon (PeaceHealth, 2021b).

The rather sizeable medical network appears to support a culture of sharing best IT practices and frequent lateral communication among counterpart staff members in the medical centers. Whatever slack resources (financial or otherwise) were available to the PeaceHealth network were applied in medical centers that needed IT innovations to improve their operations. This is apparent when observing the use of tracking technologies for different specific applications. At SHMC/Eugene, the entire hospital had sensors installed in 2008, using RTLS only in selected areas: emergency department, anaesthesia clinic; selected medical staffers were tracked as well as selected expensive medical equipment (Bucksteiner, 2012). In 2009, nurses in the operating room were tracked also. Also in 2009, another SHMC unit in River Bend, Springfield, Oregon adopted patient tracking in the emergency section of the newly built hospital using both infrared and RFID technologies (Swedberg, 2009). Those SHMC units used Versus Technology for technology support.

SHMC's top management has been always involved in sponsoring high priority technology innovations in support of the network's mission. In the case of SHMC/Eugene, top management's attention was captured by what to them was an unreasonable expenditure of at least US$45,000 monthly for the purchase IV pumps, in addition to rentals. This very quickly spurred the investigation of IV pump use and inventory count --- the prelude to the formal launching of what was to become the PAR Level Management Module system (Bucksteiner, 2012). The project team under the leadership of Kaspar Christian Buchsteiner, Healthcare Improvement Engineer, was immediately empowered to deploy the IV pump tracking project (Bucksteiner, 2012).

5.3. Technological Context

(1) Understand the Characteristics of the Innovation

The SHMC in Eugene, Oregon started their journey with using sensors to track assets and people in 2008. Sensors were used in selected areas only: emergency department and the anaesthesia clinic to track physicians, medical staff, patients, and very expensive equipment like the ones used in the operating room, including ultrasound machines and radiology equipment. It took two years for SHMC to learn how to optimize the use of RTLS technology for asset management in spite of the spotty deployments with tracking experienced previously. The multiplicity of costly medical equipment used throughout SHMC created an overwhelming challenge, though. To cut down this challenge into a manageable size, the project team decided to focus on just one asset that was used most frequently by caregivers in dealing with patients. The formal effort that jumpstarted the development of an organized asset tracking system was the need to identify the hospital's IV pumps on account of a recall (Bucksteiner, 2012).

Once the formal decision was made to rationalize the tracking of IV pumps, the project team followed a methodical approach and technical plan for implementation guided by the systems development life cycle (SDLC) methodology (Valacich & Schneider, 2017). The other sections on the technological context describe the pacing of the deployment experience, integration of the resulting PAR level management module with the existing technical system, and the measurement of the implementation effectiveness using certain metrics.

(2)Plan and Pace Implementation

SHMC followed the SDLC phases in the deployment of what was to be the Versus PAR Level Management Module for tracking their IV pumps (Bucksteiner, 2012).Valacich and Schneider (2017) designate the following four phases of the SDLC: systems planning; systems analysis; systems design; and systems implementation and operation.The systems planning phase was instigated by problems SHMC was facing with respect to the lack of availability of enough infusion pumps needed by caregivers in tending to patients. The formal effort that jumpstarted the development of an organized asset tracking system was the need to identify the hospital's IV pumps on account of a recall (Bucksteiner, 2012).For a long time, the hospital tolerated the purchase of more IV pumps whenever caregivers complained about short supply, but when expenses reached about US$45,000 monthly, top management noticed and questioned the practice of purchasing and renting more IV pumps (Bucksteiner, 2012).

The early version of the deployment required the nurses (i.e., caregivers) to log into what was then called the Versus system (now called the Midmark system) to find an IV pump and then, once the location was found, he/she had to go to that location and retrieve the pump. This process proved onerous for the caregivers, and so, in the next iteration, the project team created a central storage area where all IV pumps had to be stored and picked up when needed. The PAR level is reflected in the appropriate user interface which shows a screen that indicates both overstocked or understocked items in one glance (Bucksteiner, 2012).

In an intermediate move, the project team attempted to suggest the use to another web-based application screen based on a floor plan to locate the IV pumps. With this solution, not only do caregivers have to use another web-based screen, they also still needed to go to the specific locations of IV pumps. This may not even really work because the system did not indicate if the pumps are still in use by the patients. Thus, caregivers rejected this idea.

In the next iteration, the project team improved the system and added a central storage location where all IV pumps had to be stored. This way, caregivers needed to go to only one place to pick up IV pumps they needed. Based on a "just-in-time" model, the central hub location was managed by the PAR minimum and maximum thresholds set for each location in the medical center (Bucksteiner, 2012).

(3)Install the Innovation and Integrate with the Existing System

The earliest part of the deployment involved fielding about 20 RFID readers and infrared (IR) sensors in the hospital. The project team went through a number of iterations before getting the system developed into acceptable form. Initially, 700 infusion pumps were tagged with the Midmark (formerly Versus Technology) asset tags. These have an IR wavelength of 875 nm/455kHz (kilohertz) and a radio frequency of about 433 MHz (megahertz) (MidMark, 2021c). These asset tags are fairly small with the dimensions 1.38" in width, 0.56" in diameter, and 2.41" in height (MidMark, 2021c). The wired sensor network also used wired IR sensors which receive signals from the asset tags to room-, bed-, or chair-level locations as small as two feet in height (MidMark, 2021c). The sensor plus model includes a USB port to energize Bluetooth low energy (BLE) beacons (MidMark, 2021c). Other elements of the wired sensor network consist of the collector and the concentrator. The collector accepts data from up to about 24 sensors. The concentrator, on the other hand, get data from up to four collectors. Both items constitute the backbone of the RTLS sensory network and both measure about 5.25" wide, 1.625" in diameter, and 5.5" high (MidMark, 2021c).

The asset tags on the IV pumps transmit information to the Midmark asset tracking + management software which monitors the location of the IV pumps and manages inventory through the PAR method. The Periodic Automatic Replenishment (PAR) method is a standard practice in setting up inventory levels in healthcare environments (MidMark, 2021a, 2021b). PAR levels can be set up for minimum and maximum inventory levels for different medical equipment assets used in a medical facility. The SHMC distribution unit set the minimum and maximum levels for the PAR system. These minimum and maximum levels were set based on data collected on pump movements in each area of the hospital; specific thresholds were set per area --- one area may have a maximum level of eight pumps and another would have 15 pumps (Bucksteiner, 2012). PAR levels help ensure that caregivers have the IV pumps available when they need them. When the actual count of IV pumps falls below the minimum stipulated, the system generates automatic alerts to staff members who control the physical assets and act on replenishing the supply. The PAR level management and alerting system are features of the Midmark RTLS software housed in the back end database server of PeaceHealth (Bucksteiner, 2012). The PAR management system also interfaces with the mail exchange server of the IT network of SHMC. PAR levels can be adjusted periodically as staff needs change.

The asset tags on the IV pumps transmit their unique identification number to the infrared sensor within range (Swedberg, Feb 17, 2012). The RFID chip on the asset tags use a proprietary air-interface protocol in transmitting at 433 MHz in providing a signal with a broad read range, capable of penetrating walls (Swedberg, Feb 17, 2012). Notifications can be sent to mobile devices used by medical staff like smartphones, pagers, and tablets so that they can respond to inventory shortages promptly and move extra IV pump units from locations where they are not needed to the central hub location. Hourly emails are sent to designated individuals who need to act on IV pump inventory levels until the PAR levels are met. Pop-up messages in the user interface of a designated workstations and dashboards can also be sent hourly until inventory issues are resolved.

Under the centralized/JIT model of the system, the nurses/caregivers were asked to facilitate cleaning of used IV pumps and removal of unused pumps and depositing them in the central storage area. Earlier, the project team met with objections from nurses/caregivers who did not like to clean the pumps and thought that this was not part of their job description. Thus, the project team, then, had to resort to designating the environmental services department to clean used pumps and move unused ones to the central storage area (Bucksteiner, 2012). The final version of the PAR level management module was deployed in April 2011 (Bucksteiner, 2012).

(4)Design or redesign the Organization

One of the key problems SHMC had with respect to the use of IV pumps was the lack of onus of responsibility for the pumps because of the multiple stakeholders involved, each with its own kind of operational process ownership. The pharmacy had the financial ownership; the different users consisting of caregivers and nurses had the operational "day to day" use ownership; and the materials management department had the ownership over the distribution of the IV pumps throughout the SHMC facility (Bucksteiner, 2012). The project team for the RTLS project put the materials management department in the driver's seat in the pursuit of the project and determination of manner in which the IV pumps would be picked up and returned to a centralized storage location.

There was no redesign of the units necessary in the operational process ownership of the IV pump usage. A clarification of each stakeholder's operational process ownership and assertion of the responsibility of the materials management department to oversee IV pump usage was all that was required.

(5)Modify Human Resources Policies

A major change made as a result of the PAR Management Module system was that the formal procedure was created for tracking other valuable medical equipment assets used in SHMC. From then on, medical staff units involved in using other medical assets would have to rationalize their purchases and inventory management based on the prototype system created for the by IV pumps (Bucksteiner, 2012).

(6)Design/Redesign Jobs

Clear changes had to be made in terms of the responsibilities of the stakeholders involved: caregivers and nurses were asked to help out in cleaning IV pumps but the main responsibility for doing so rested with the environmental services department (Bucksteiner, 2012). Nurses clearly objected to being mainly responsible for cleaning the IV pumps as they did not see this as part of their job description as a nurse. With the deployment of the formal RTLS system, they acquiesced, nevertheless, and agreed to “help out” in cleaning the pumps. The responsibility of the materials management department was reinstated and reinforced as the steward of the centralized inventory repository of IV pumps (Bucksteiner, 2012).

(7)Develop Measures of Implementation Effectiveness

A two-year post implementation inventory count resulted in 99.7 percent availability of the IV pumps or 698 out of 700 pumps (Bucksteiner, 2012).With the PAR level management module, the number of IV pumps used was decreased from 923 to 700 (Bucksteiner, 2012). There was palpable relief experienced when complaints or calls for support to get the pumps from caregivers about the lack of IV pumps just disappeared “from day one” (Bucksteiner, 2012). Caregivers/nurses also stopped hoarding/hiding/hunting for IV pumps, which means that patients were properly cared for in a timely manner. The Midmark RTLS software accurately reported the location and utilization levels of IV pumps in the hospital and the resulting data captured from the asset tags was used to streamline inventory values (Bucksteiner, 2012).In terms of meeting overall goals, the new system allowed SHMC to stop IV pump rentals altogether and cut back on IV pump expenses by 26 percent, thus, avoiding a US$600,000 expense. Over a ten-year period, this savings amounted to US$2.7 million (Bucksteiner, 2012).

6. Conclusions

Tornatzky’s technology-organization-environment framework has been a useful tool in understanding the RFID RTLS deployment at SHMC. In terms of the *environmental context*, SHMC behaved consistently in response to the healthcare industry pressure to cut costs by seeking efficiencies in workflows by using tracking technologies such as RFID and infra-red (IR) sensors. Efficiencies gained through effective tracking has multiplicative effects and second order benefits resulting in benefits like medical staff job satisfaction and better patient care.

The study results have direct implications for practice for members of IT project teams who might consider RFID in their future asset/inventory tracking projects.

(1) Always ensure top management mandate and support behind major RFID initiatives.

This will give the project team a sense of authority when conducting project tasks, and even in the face of skepticism amongst targeted end users, can lend the project resilience. In terms of the *organizational context,* top management’s determination mattered to finally stop a pattern of impulsive IV pump purchases and rentals in response to caregiver complaints. The recall of the IV pump was the incident that instigated top management’s deep inquiry into the inventory and usage patterns governing the IV pumps. Investigations led by project team leader Kaspar Christian Buckheimer revealed unreasonable demands from caregivers for more pumps because the pumps were, indeed, in the hospital, but not to be found precisely because of lack of formal tracking and dysfunctional practices like “hoarding” and hiding of IV pumps by caregivers.

(2) Take advantage of available slack resources when responding to top management mandates.

Other *organizational context* factors that helped the RTLS project was the availability of slack resources such as personnel, time, and money to back up the development of the PAR Level Management Module system.

(3) Involve directly affected stakeholders/end users in the change management efforts that undergirds the project.

In terms of the *technological context* ---also helpful was the active involvement of the caregivers in the systems analysis phase of the SDLC that helped collect evidence that, indeed, revealed that there were more than enough IV pumps in the hospital --- the problem was they were in the wrong places and could not be found. The project team's initiative in demonstrating the benefits of storing and collecting the IV pumps in a centralized location and the guaranteed availability of units to caregivers "turned the tide" and made the caregivers warm up to the deployment of a formal RTLS system.

(4) Maintain and sustain long-term relationships with value IT and RFID vendors.

Another important factor contributing to SHMC/Eugene's success was the support of the RFID vendor, Versus Technology (now called Midmark Technology), which has served as the vendor for the entire PeaceHealth network through the years. The guaranteed service of Versus Technology ensured that the deployment experience would succeed and be well supported.

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