Selecting the Right RTLS in Hospitals

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1. INTRODUCTION

As hospitals around the globe are increasing their adoption of information systems, they are also reconsidering the use of Automatic Identification and Data Capture (AIDC) technologies such as barcodes, and more recently Radio Frequency Identification (RFID) technologies. Today, the most prevalent RFID enabled application in hospitals involve active RFID technologies, which support Real Time Location Systems (RTLS) applications used to automatically identify and track critical "objects" such as mobile assets (e.g., infusion pumps, beds) or persons (e.g., medical staff and patients). These systems are increasingly used in hospitals as enabler of process improvement for established applications such as mobile asset management, patient and staff security and access control, or for innovative applications such as staff workflow management or hygiene compliance management.

Despite the fact that RFID technologies offer a unique potential to manage mobile assets and improve patient workflow over existing AIDC technologies, some questions remain since there is no clear benchmark analysis on the technological options available on the market. In this context, hospital managers are aware of the challenges involved in having to decide among the many technology and application platforms on the market. Should they choose an active RTLS that leverage on the hospital's existing Wi-Fi infrastructure? A proprietary RFID system? A RTLS that leverages on passive ultrahigh-frequency (UHF) technology? While each option has its distinct advantages and limitations, these competing technologies seem to offer similar benefits, as do the various RTLS middleware platforms used for data management and decision making (Bendavid and Boeck, 2015). Although some information is already available for years in the professional literature (e.g., Gardner, 2013; Maliff, 2013; O'Connor, 2009), many of what is published is also proposed by vendors, resulting in some confusion for potential adopters facing contradictory information.

Since different technological designs can be envisioned for a single application there is a need for practitioners to develop a better understanding of the technological options available on the market and determine which RTLS technologies are best suited for their needs. In order to address this gap, the main objective of the paper is therefore to discuss RTLS competing technological options and propose a benchmarking framework in order to help managers for rapidly assessing the performance of RTLS against their specific application requirements.

The paper is organized as follows. The next section (2) presents different technological options for a RTLS. In section 3, some RTLS applications in hospitals are briefly presented. Since RTLS solutions can be based on various technological designs, in section 4 we propose a set of key question managers should ask before selecting a RTLS. A benchmarking analysis using selected comparison variables is then proposed to highlight the key differences between various RFID-enabled RTLS that hospitals are currently deploying around the world. Finally, in sections 5, a discussion and future research directions are proposed.

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2. RTLS SYSTEMS: A TECHNOLOGICAL PERSPECTIVE

A RTLS can be represented as a three-level system (Bendavid, 2013a). As presented in Figure 1, at the first level "objects" are identified by using various types of tags/identifiers such as

1. Active RFID technologies (i.e., Wi-Fi, Zigbee, active UHF 433 MHz and 860-925MHz, Ultra Wide Band (UWB) or hybrid tags equipped with different technologies such as RFID and infrared (IR) sensors),
2. Passive UHF RFID,
3. Semi passive RFID tags equipped with a battery to activate embedded sensors,
4. Ultra Sound Identification technologies (USID), and
5. Even portable electronic devices (e.g., smart phone) used for Indoor Positioning Systems (IPS).

At the second level, the (tag ID) data is captured and communicated to the RTLS Middleware through a wired and a wireless infrastructure. Upon the choice of a technology, various devices can be used to build a reading infrastructure, such as fixed RFID readers/antennas, UWB or Wi-Fi antennas and access points, USID microphones, or Bluetooth low energy (BLE) beacons to communicate with smartphones. Today, since numerous active tags are equipped with hybrid technologies, the reading infrastructure can also be composed of location beacons (IR or BLE), LF exciters or USID transmitters for increased precision and immediacy.

At the third level, the data is communicated to a RTLS middleware where the object location is determined (in a localization engine for active tags) and specific transactions are performed accordingly. Today, many RTLS middleware are competing in the market, namely

Figure 1. RTLS: a technological perspective