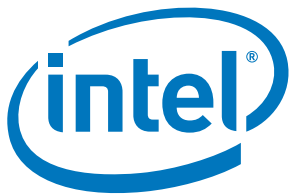




# Gaining Solid Results with RFID in Healthcare



**Modern society forces healthcare into innovation beyond medical innovation. Can Radio Frequency Identification (RFID) deliver the required results?**



Radio Frequency Identification (RFID) is well on its way to becoming a mainstream technology in a number of industries. For instance, retail and aviation are actively investing in large-scale applications of RFID technology. Their main motivations lie in automatic identification, tracking and tracing, and safety improvements. Similar motivations apply to healthcare. Automatic identification of materials, tracking and tracing of blood products, and increasing patient safety through monitoring of patients and personnel, inspired the definition of a combination of three pilot implementations of RFID. These pilots have been carried out in a highly complex high-tech environment within the AMC

University Hospital: the operating rooms, intensive care, and transfusion laboratory. The results are very promising. Technological barriers have been overcome through careful analysis and creative organizational solutions. The benefits to the organization are confirmed in various areas. Also, the actual use of RFID has inspired the professionals to come up with new applications of the technology. This demonstrates our ability to implement RFID solutions in healthcare that are technologically sound, organizationally profitable, and socially inspiring.



### The Drivers

Healthcare is increasingly confronted with demands on patient safety. These demands range from government regulations on recording storage conditions for blood products to tracking and tracing of surgical materials and implants per patient. Also, critical procedures are specified in detail to minimize patient health risks. In case of medical misfortune it is up to the healthcare provider to prove that these procedures have been followed. With an increase in liability suits, hospitals are spending more time and resources on minutely recording critical activities. In the meantime, efficiency and cost-effectiveness are a major concern to all healthcare providers, and payers alike. This requires detailed insight into process performance and opportunities for increased productivity and cost cutting. All these requirements can be met, in theory, by the application of RFID. We took it upon us to demonstrate the extent to which these requirements could be met in actual practice.

### RFID in Healthcare

During the first five years of the 21st century, a number of applications of RFID in healthcare have been published. Interest in the application is demonstrated by the number of specialized conferences that have been organized on the topic. Typical applications include: identification of patients (especially newborns), identification and authentication of medication, tracing of patient-patient and patient-professional contacts related to infectious diseases (e.g. SARS), localization of medical equipment, and wander prevention for inpatients. The published applications are almost all unique instances, triggered by innovative hospitals and businesses, eager to try out new technologies. The reported benefits are often not quantified. This is known as the innovation paradox: organizations that need innovation to turn around dire results are not the ones to implement an innovation and

“This technology definitely has potential in the areas of patient safety and monitoring of critical processes. However, clearly more research needs to be done and more experience has to be gained to make RFID in healthcare a commodity. RFID most certainly has added value over more traditional IT solutions.”

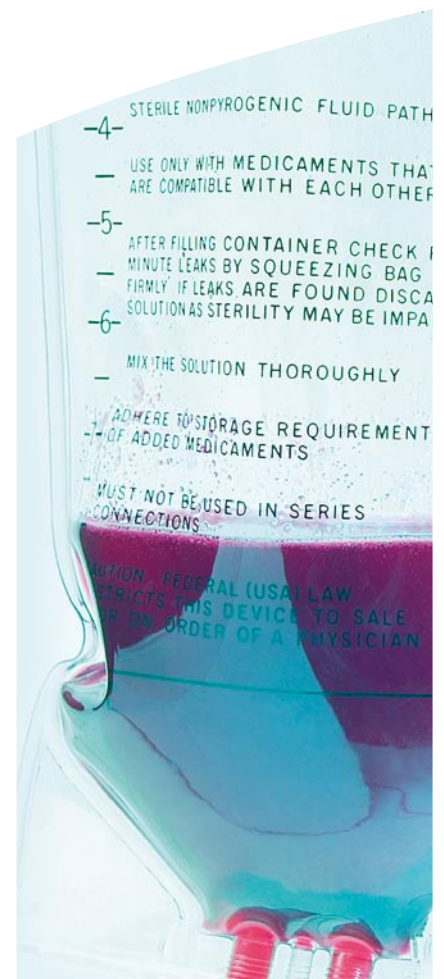
**Dr. P.J.M. Bakker**

Oncologist and RFID project executive

### The RFID in Healthcare Project

A consortium of partners, consisting of the Academic Medical Centre (AMC) at the University of Amsterdam, Capgemini, Geodan mobile solutions, Intel, and Oracle, have defined and completed a study on the application of RFID in Healthcare. The project was carried out at the request of the Dutch Ministry of Health, Welfare and Sport, and was financed in part by the Ministry of Economic Affairs as coordinator of the Statewide IT Agenda. Matching funds and resources have been provided by the consortium partners themselves.

reap its rewards. We have developed a clear and realistic business case for the application of RFID to help overcome this paradox.



### The Pilots

The pilot implementation in the AMC University Hospital consisted of three parts:

- Person and patient logistics in the operating rooms;
- Tracking and tracing of operating room materials;
- Tracking and tracing of blood products.

Tracing the movement of patients and professionals enables an active positive identification of the patient. In addition, it allows for detailed automated registration of parts of the process, otherwise requiring manual activities which are cumbersome and error prone. In terms of patient safety we can now investigate the correlation between staff movement and post-operative infections, caused by bacteria carried on increased airflows through the OR.

Both in terms of patient safety and to enable more detailed activity based costing of surgical procedures, tracking and tracing of operating room materials provides the necessary detailed information. However, as item-level tagging is not commonplace even in the retail industry, this pilot has shown only the ability to do this and the mechanisms necessary to use the information. The fact that standard retail technology could not be used in the proximity of high-tech medical equipment has led to a creative organizational setup for monitoring the material flows coming in and out of the OR. The actual usage of materials per patient is then derived from that information.

For the tracking and tracing of blood products we used temperature sensitive tags. These tags keep track of the environmental temperature during storage and transport of the blood products. Blood products are tagged and identified at the transfusion laboratory, before transport to the OR. Within the OR the blood products are identified once more. Used blood products are identified directly,

### Considerations for Blood Products

Special care has been taken with respect to the use of adhesives when attaching RFID tags to blood bags, in order not to impact the quality of the blood products. Also, laboratory tests have been carried out to study the behavior of the tags during sudden changes in temperature. More research is needed to relate the lag in temperature reading to the actual (core) temperature of the blood product itself. Only then can safe judgment be made on the quality of the blood product and whether it can be (re)used.

thus thus increasing the accuracy and the swiftness of the transfusion registration.

The combination of pilots enables a number of additional possibilities with respect to patient safety. Direct feedback is provided to the professionals when a mismatch is detected between patient and blood products. Also, the materials used are linked explicitly to the patient, rather than through the roster of the OR (in which last-minute changes are often not recorded). In theory, the usage rate of materials per professional or team can be monitored as well. However, due to privacy issues and obvious resistance from staff, we decided to monitor professionals by role only and not as individuals.

### The Technology

We have used a layered approach to designing the technology part. In the physical layer we used both active and passive RFID-tags with three different frequencies. The active RFID-tags, at 868 MHz and a 125 kHz wake-up frequency, were used for both persons and blood products. For blood products we also used passive, temperature sensitive tags, operating at 13,56 kHz. Passive RFID-tags, conforming to EPCglobal Gen2 standards at 868 MHz, were used for materials. This technology is already widely used in retail. On the virtual level we have used Oracle technology, running on a standard Intel platform, to capture and represent all events that are registered by the RFID infrastructure. On the business level this information is used by the Movida



platform, provided by Geodan mobile solutions, to represent locations of persons and blood products and to provide the alerts on blood/patient mismatches. We have created interfaces with the hospital's blood bank and OR management systems to provide integration with the regular information flows.

### The Business Case

The design and realization of the three pilots made it possible to formulate an initial business case for a full-scale implementation of RFID in and around the operating rooms. With respect to patients and personnel, we expect that better monitoring of complex processes can lead to increased efficiency in patient logistics. However, the benefits in terms of patient safety are expected to outweigh the efficiency gains. In the area of materials we expect substantive decreases in materials consumption and stock levels. In addition, due to the use of activity based costing, more accurate budgets can be set when the mix of operations changes. Tracking and tracing of blood products not only enables compliance with government regulations. The elimination of administrative work and the increased efficiency in returns of blood products contribute to a positive business case. Overall the business case turns out to

### Project Management and Communication

Sharp project management has proved invaluable during the course of the project. Keeping technology, functionality, procedures, and progress in line required much effort and dedication from both internal and external project management. Furthermore, anticipating possible consequences and early but well-dosed communications about the project were indispensable factors in the project's success. This has helped to moderate initial hesitations and ensure active cooperation of all people involved.

be positive in a generic case. However, every individual project will need to analyze its own situation and muster organizational support for the benefits to be realized. A lot depends also on the combined use of, for example, a wireless network infrastructure. Such synergies are a certain boost to the business case.

### Lessons Learned

The application of RFID in Healthcare has definite potential. Both in the literature and in our projects we have demonstrated its added value in a number of different processes and environments. Key success factors lie in the technological design in relation to medical technology and in the process design for both information capture and information usage. Involving professionals from the very beginning in the process design is vital, as processes in healthcare are usually not as clear-cut as in, for instance, retail or manufacturing. Moreover, the possible negative impacts of RFID on patient safety have to be assessed by healthcare professionals, as they hold the final responsibility in this crucial area. We were blessed with strong hospital sponsorship and a dedicated internal project manager who knows the organization and the people well. In the end, people need to adopt new ways of working with new technologies, and no technology can adopt itself. However, as professionals are experiencing the possibilities of RFID in real life, they are inspired to come up with new applications that will help advance the hospital in both quality and efficiency of care.



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