

Guest Editorial for the Special Issue on RFID-enabled Healthcare: Applications, Issues and Benefits

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About the Guest Editor

Dr. Samuel Fosso Wamba is a Senior lecturer at the School of Information Systems & Technology (SISAT), University of Wollongong, Australia, and Invited Associate Professor at the Rouen Business School, France. He earned an M.Sc. in Mathematics, from the University of Sherbrooke in Canada, an M.Sc. in E-commerce from HEC Montreal, Canada, and a Ph.D. in Industrial Engineering for his work on RFID-enabled supply chain optimization, from the Polytechnic School of Montreal, Canada.

His current research focuses on business value of IT, inter-organizational system (e.g., RFID technology) adoption and use, supply chain management, electronic commerce and mobile commerce. He has published papers in a number of international-conferences proceedings and journals, including: *European Journal of Information Systems*, *International Journal of Production Economics*, *Information Systems Frontiers*, *Business Process Management Journal*, *Journal of Theoretical and Applied Electronic Commerce Research*, *Proceedings of the IEEE*, *Hawaii International Conference on Systems Science (HICSS)*, *Pacific Asia Conference on Information Systems (PACIS)* and *Americas Conference on Information Systems (AMCIS)*.

Dr Wamba is also responsible for organizing/co-organizing special issues on RFID for the *Business Process Management Journal*, the *Pacific Asia Journal of*

the Association for Information Systems, and the *Journal of Medical Systems*. He has been serving as mini-track organizer and chair on the same topic for the 15th *Americas Conference on Information Systems (AMCIS)*, the 6th, 7th, 8th and 10th *Workshops on e-Business*, a Pre-ICIS Workshop Sponsored by AIS SIGeBIZ.

On the other hand, he is a CompTIA RFID+ Certified Professional, Academic Co-Founder of RFID Academia, Founder and CEO of e-m-RFID.biz. He is the current Deputy Director of the Centre for Business Service Science (CBSS), Wollongong University, Australia. More information is available online, at: www.samueLFossoWamba.com

RFID-enabled healthcare: Applications, issues and benefits

Information technology (IT)-enabled healthcare is an area of interest for scholars from various fields of research [1]. Lately, radio frequency identification (RFID) technology emerged as a new multidimensional IT innovation [2] with a tremendous research potential in the healthcare sector. However, the current level of articles published on RFID-enabled healthcare is still fairly low. For example, a review of articles on RFID technology by [3] showed that only 3.6% of articles were concerned with applications, issues and benefits related to the healthcare sector. The main objective of this special issue was to attempt to bridge this knowledge gap, by seeking recent articles dealing with applications, issues and benefits related to RFID-enabled healthcare. All articles submitted to the special issue went through three rounds of double-blind review process, with a minimum of four reviewers per article. The review of the introductory article was handled by the journal's editor-in-chief to avoid any conflict of interest.

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Synopsis of contributions

The section below is dedicated to the synopsis of all articles included in this special issue.

In the paper “RFID-enabled healthcare applications, issues and benefits: an archival analysis (1997–2011)”, by Samuel Fosso Wamba, a comprehensive review of articles published between 1997 and 2011 in the *Journal of Medical Systems (JMS)* on RFID technology is presented. A total of 22 papers are analyzed using a classification framework that has three dimensions: RFID-enabled healthcare applications, RFID-enabled healthcare issues, and RFID-enabled healthcare benefits. In addition, all authors of the papers accepted for the special issue on RFID for the *JMS* are invited to position their various papers within the classification framework. Finally, a list of future research directions in the area of RFID-enabled healthcare is presented.

The authors of the paper “Applied patent RFID systems for building reacting HEPA air ventilation system in hospital operation rooms”, Jesun Lin, Jar-Yuan Pai and Chih-Cheng Chen, apply the RFID technology to (a) offer a unique medical staff and patient identification, (b) activate the HEPA air ventilation system to reduce the cost, and (c) save energy and prevent the prevalence of hospital-acquired infections. The HEPA air ventilation system contains RFID tags (for medical staffs and patients), a sensor and a reacting system which receives the information regarding the number of medical staff and the status of the surgery, and accordingly controls the volume of air in the HEPA air ventilation system. A pilot program was carried out in an operating unit of a medical centre located in central Taiwan. The results revealed that the air ventilation system was able to function much more efficiently with less energy consumed. Furthermore, the indoor air quality could be maintained, thus helping to prevent hospital-acquired infection or other occupational diseases.

In the paper “Increasing the reliability of production schedules in a pharmaceutical packaging department”, Dario Pacciarelli and Andrea D’Ariano study quantitative methods for evaluating the potential benefits of introducing new advanced tracking technologies in the pharmaceutical industry. Specifically, RFID technology is an effective way for increasing the quality of the data that are used to generate production schedules, but scientific research data are lacking to quantify the return on investment that can be achieved in practice. In this work, the authors propose a systematic method for assessing the impact of data estimation errors and discuss its implementation in a packaging department of a pharmaceutical plant. The computational results confirm that more reliable data combined with effective scheduling algorithms should significantly improve productivity.

In the paper “Deployment of RFID in healthcare facilities – Experimental design in MRI department”, the authors Chen-Yang Cheng and Jyh-Wen Chai discuss the RFID deployment issues and implementation benefits in the MRI department. The paper presents an experimental design of reading performance considering various notable factors in the MRI department. In addition to the readability experiment, the efficiency and reliability of RFID implementation in the MRI department is measured using a simulation approach, and such measured outcomes are beneficial to hospitals. The study can serve as an example and indicator of RFID installation in hospital settings. In terms of future research, the authors suggest that these experiments should be conducted in other departments of medical or healthcare institutes, such as the department of tomography so as to ascertain improvements in medical management quality, patient’s information management, and information transmission speed.

In the paper “RFID sensor-tags feeding a context-aware rule-based healthcare monitoring system”, by Luca Catarinucci, Riccardo Colella, Alessandra Esposito, Luciano Tarricone, and Marco Zappatore, the authors propose an ontology-based context-aware infrastructure fed through a new RFID-based device—the Enhanced Sensor-Tag—connected to proper sensors. The proposed system was designed for monitoring purposes, and yet it suits the healthcare domain, where it provides an easy and cost-effective remote monitoring of patients through sensor data storage and alert management. Moreover, it follows an easy-to-configure architecture based on the integration of ontology representation with multi-agent paradigm and rule-based logic. The system is very efficient, versatile, and its effectiveness is demonstrated by both the customization effort and the performance results obtained from validation in two different real-life healthcare monitoring contexts.

In the paper “Enhanced UHF RFID tags for drug tracing”, Luca Catarinucci, Riccardo Colella, Mario De Blasi, Luigi Patrono and Luciano Tarricone demonstrate that RFID-based high performance item level tracing systems can actually be implemented also in a very critical scenario within the pharmaceutical sector. The presence of liquids and metals in drugs and packages negatively affects the performance of RFID tags with UHF commercial label. To overcome such limits, the authors deeply investigated the electromagnetic aspects of the phenomenon and set out a guideline for an ad-hoc design of relevant, passive UHF RFID tags. They then used the same guideline to achieve a novel label-type enhanced tag that is specifically tailored for the pharmaceutical supply chain. The results that are presented come from several experimental campaigns carried out in a controlled test environment which can faithfully reproduce the main steps of the pharmaceutical

supply chain; such findings undoubtedly demonstrate the appropriateness of the proposed approach.

In the paper “Implement the RFID position based system of automatic tablets packaging machine for patient safety”, by Ching-Hsiang Chang, Yeong-Lin Lai, Chih-Cheng Chen, the authors discuss the application of RFID technology and its potential from a pharmacist viewpoint. They indicate how RFID should be integrated into the automatic tablets packaging machine (ATPM) applications in the pharmacy department. Another point is the definition of passive HF RFID technology on position-based system (PBS), hardware devices architecture, and software function interfaces. The research findings should definitely be important to researchers and practitioners. For researchers, introduces a new tool is introduced in hospital management, which can reduce human errors in dispensing medication. After implementation, the PBS will assure human error rate from 0.83% to zero. The PBS of ATPM is currently being used only for doses requirements of inpatients; this is why our research team is planning to investigate the doses requirements for outpatients whose quantity of prescriptions is the triple of that of inpatients. This need for outpatients is more urgent and complex, so we will pay more attention to the high stability and reliability in our future research. On the other hand, the hardware cost was higher, and there is a need to ponder on how to reduce the number of readers and multiple antennas installed, which is the next issue we are going to focus on.

The paper “RFID-enabled traceability system for consignment and high value products: a case study in the healthcare sector” is written by Ygal Bendavid, Harold Boeck and Richard Philippe. These authors present results from a 6 month-study during which data were collected through numerous qualitative and quantitative techniques. It is a case study of a hospital operating room which evaluated a RFID-enabled traceability system for the management of consignments and high value products requiring item level traceability. The study indicates that the system facilitates item level traceability, improves financial controls and case costing, upgrades service levels, and reduces inventory shrinkage and other non-value-added activities that can be transferred to patient care activities. From a research perspective, the paper provides an approach to assess qualitatively and quantitatively the potential impact of RFID in the healthcare supply chain and concludes on the need to conduct further research on RFID SCM applications in the healthcare sector, as this area holds great potential for healthcare performance improvements.

In their paper titled “Security risks associated with radio frequency identification in medical environments”, Peter J. Hawrylak, Nakeisha Schimke, John Hale and Mauricio Papa provide an overview of the potential security threats to

the use of RFID in healthcare. They investigate both passive and active RFID systems. Threats investigated include interception, interruption, modification, and fabrication. Instances of specific attacks in each category are presented. The majority of these threats are related to the release of personal or medical information. Other areas included are attacks against inventory control systems and access control systems. Countermeasures for each threat are presented along with an analysis of the impact of the threat and countermeasure on healthcare. The overview and discussion about the countermeasures provide the developer, the systems integrator and the user with a roadmap to securely deploying RFID system in healthcare.

In the paper “The adoption and implementation of RFID technologies in healthcare: a literature review”, the authors Wen Yao, Chao-Hsien Chu, and Zang Li present a literature review of the use of RFID technologies in healthcare following an innovation-decision framework. On the one hand, the paper first surveys current challenges faced by healthcare and the opportunities offered by the use RFID technologies. On the other hand, it reviews common RFID applications in different areas, and then analyses the perceived benefits and barriers. A critical success factor framework for RFID implementation in hospitals is proposed based on reviewed case studies. The survey concludes that: (1) many adopters in healthcare found RFID to be functional and useful in asset tracking and patient identification; (2) major barriers to adoption include technological limitations, interference concerns, prohibitive costs, lack of global standards and privacy concerns; and (3) better designed RFID systems with low cost and privacy issues addressed are needed to increase acceptance of RFID in healthcare. This study enables a quick assessment of the technology and provides guidance for researchers and practitioners in the adoption of RFID applications in medical arenas.

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