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Contributions to Radio Frequency Identification (RFID) research: An assessment of SCI-, SSCI-indexed papers from 2004 to 2008

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ABSTRACT

The research literature on Radio Frequency Identification (RFID) has grown exponentially in recent years. In a domain where new concepts and techniques are constantly being introduced, it is of interest to analyze recent trends in this literature. Although some attempts have been made in the past to review this stream of research, there has been no attempt to assess the contributions to this literature by individuals and institutions. This study assesses the contributions of individual researchers and institutions from 2004 to 2008, based on their publications in SCI- or SSCI-indexed journals. The findings of this study offer researchers a unique view of this field and some directions for future research.

1. Introduction

Radio frequency identification (RFID) is a small tag containing an integrated circuit chip and an antenna, and has the ability to respond to radio waves transmitted from the RFID reader in order to send, process, and store information [40]. The advantage of RFID tags is that they use a memory storage device to store a certain amount of data such as the product identification number, price, cost, manufacture date, location, and inventory on hand [7]. As technologies continue to advance forward in antenna technology, microchip fabrication and radio spread spectrum, RFID is rapidly pushed to the existing markets with diversified applications, such as automatic tariffs payment in public transport, animal identification and tracking, and automated manufacturing and logistics control [39]. RFID has the potential to change the way we do business all around the world [32]. Many business enterprises are applying the advantages of RFID to experimental projects to improve operational efficiency and to gain a competitive advantage [4]. RFID has become a hot topic in the fields of manufacturing and logistics [25]. Given the emerging significance of RFID over the past few decades, it is hardly surprising that RFID technology and its application have attracted much attention from academics and practitioners in recent years [23].

As a field of academic inquiry, RFID has attracted numerous researchers during the last few years. In the past, there have been several attempts to review and synthesize the RFID literature, and/or to offer suggestions for other researchers (e.g., [7,23,25,32,33]). These efforts significantly consolidated the knowledge of RFID and pointed out a number of very important research directions for RFID researchers. Yet there has been no attempt to assess the contributions of individual researchers and institutions to this field of inquiry, nor has there been any attempt to assess the impact of various publications in this field. Researchers and readers of this literature are left wondering what has been researched recently, which outlets are most appropriate for publishing RFID research, who the major contributors are, and which articles have had the greatest impact on the field in recent years. Given that RFID is a well-established field, it is important to address these unanswered questions because such knowledge could give researchers a more complete view of their field, a clear idea about their potential impact on the literature, a guide in selecting their research topics and target journals, and motivation to continue making contributions to this field.

The purpose of this study is threefold. First, the primary issues of recent RFID research and the major outlets for RFID research are investigated. Specifically, the Science Citation Index (SCI)-indexed and Social Science Citation Index (SSCI)-indexed journals are ranked by the number of articles that they have published on RFID topics; the frequency of publications focusing on various topics is also reported. Second, the productivity of individual researchers and institutions in RFID research between 2004 and 2008 is assessed. This is done by tabulating the credited publications of individual researchers and institutions in SCI-indexed and SSCI-indexed journals. Third, the impact of individual publications and individual researchers on the RFID literature is assessed based on a citation analysis. In the remainder of this paper, the methodology adopted for this investigation will be described. This will be followed by a presentation of the

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results of the assessment. The paper will conclude with a discussion of the outcomes of the investigation.

2. Method

2.1. Protocol used for selecting the journal articles

The protocol for journal selection and analysis is illustrated in Fig. 1.

2.1.1. Scope of the study

As RFID research itself, this paper focuses on RFID articles published in SCI- or SSCI-indexed journals from 2004 to 2008. The rationale for a focus on SCI- or SSCI-indexed journals is that publications in such journals are likely to have the largest exposure to RFID researchers and to reflect state-of-the-art RFID research that generates a significant number of citations in the literature. While RFID research has been around for the past few decades, and many early contributions have had a major impact on the literature, the current interest is in assessing recent contributions to the RFID literature. This is because contributions between 2004 and 2008 reflect the changes in the RFID environment more closely, including but not limited to the rapid globalization of world markets and substantially increased cross-border business. It is important to keep in mind that the current study's focus on recent publications by no means implies a lack of impact of publications appearing before 2004. Rather, focusing on the contributions between 2004 and 2008 should render the results of this study more relevant to current RFID researchers.

2.1.2. Selection of papers

The RFID articles were selected through a combination of electronic and manual searches. The ABI/INFORM database was used to identify a pool of articles that might be relevant to RFID. Keywords such as “radio frequency identification” and “RFID” were used to identify electronically articles published in SCI- or SSCI-indexed journals. This method is being widely used in studies of other fields [36,41]. Although this restriction might have excluded certain papers, we can be sure that the papers identified are studies in the RFID field.

We included each paper after manual examination and confirmation of its relevance to RFID. We used the following guidelines in the confirmation process. First, as the purpose of this research was to evaluate the contribution of RFID studies, only academic research papers were considered, while journal editorials, comments on previous papers, book reviews, and magazine articles were excluded. Second, as this research was primarily concerned with research in the RFID field, studies that only mentioned the term RFID in passing were not considered to be exploring RFID-related issues and were excluded. Overall, 94 articles were identified from both searches in 44 journals between 2004 and 2008.

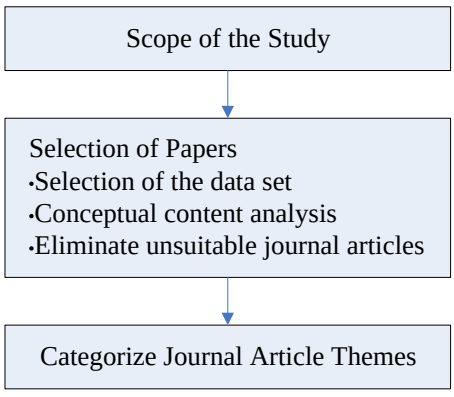

Fig. 1. Protocol used for selecting the journal articles.

2.1.3. Categorize journal article themes

According to the method proposed by Ngai et al. (2008) [25], RFID literature is classified into four main categories: technological issues, applications areas, policy and security issues, and other issues. Each of these categories is divided into several sub-categories. The 94 articles in the pool were content-analyzed to uncover the major topical areas of RFID research. Examined by title, abstract, and content, articles were then assigned to one of the following sub-categories. Each article was classified into one of these sub-categories on the basis of its primary topic. It should be recognized that some articles investigated multiple topics. Because this classification system does not allow an article to be classified into more than one topic area, it does not reflect the topical variations within an article. Rather, it is meant to capture the primary topics investigated in the 94 articles.

2.1.3.1. RFID technology. A typical RFID system consists of tags and readers, application software, computing hardware, and middleware. We focus our attention on the articles that pertain directly to the RFID system, including tags, readers, antennae, and communications infrastructure, but exclude the literature on computer software. We divide the technology category into the following sub-categories.

(1) Tags and antennae: An RFID tag consists of an integrated circuit with memory, which is essentially a microprocessor chip. The antennae are the conduits for the communication of data between the tag and the reader. This area focuses on RFID chips and tag antennae.
(2) Reader: An RFID reader is a device that can read data from and write data to compatible RFID tags. To ensure the compatibility of the communication, the tag and reader must work at the same specified working frequency and comply with specific regulations and protocols. Papers related to this section aimed at RFID readers design to ensure the compatibility of the communication.
(3) Communication infrastructure: This category includes articles on the relevant communication criteria and protocols, safeguards, and network connectivity issues.

2.1.3.2. RFID applications. RFID is an emerging technology that has been successfully applied in supply chain management, manufacturing, and logistics, but its range of application extends far beyond these areas. Based on the various industry areas that are featured in the reviewed literature, we sub-classify this category as follows.

(1) Animal detection
(2) Building management
(3) Enterprise feedback control
(4) Food safety warranties
(5) Health
(6) Library services
(7) Logistics and supply chain management
(8) Museums
(9) Retailing
(10) Manufacturing
(11) Casinos

2.1.3.3. Policy and security issues. The literature in this category is mainly divided into three broad sub-categories, namely, privacy, security, and standardization.

(1) Privacy: Studies of RFID privacy and protection issues, and especially those that examine RFID in relation to existing human rights policies, constitutional protection, and data protection law, are therefore included in this section.
(2) Security: Security concerns revolve around vulnerabilities and the protection of confidential data from unauthorized access and manipulation.