

USING RFID FOR REAL-TIME PRODUCTION MANAGEMENT IN THE DIGITAL ENTERPRISE

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ABSTRACT

In an increasingly digital world, manufacturing enterprises are coping with a complex, dynamic and competitive environment due to globalization and a rapid development of information and communication technologies. Enterprises must improve their competitiveness by quickly responding to the changing market/customer demand, increase product quality and improve service and production efficiency. Real-time information, dynamic control and management of the manufacturing process flow are essential for real-time enterprise and business intelligence. This paper provides an overview a proposed conceptual framework of a Radio Frequency Identification (RFID) based production management system. The system will enhance information visibility in an internal as well as an external supply chain integration. Thus a more effective and efficient business processes and real-time information for management support in digital enterprise will be attained.

Keywords: RFID, digital enterprise, management

1. INTRODUCTION

In the modern world of increasing globalisation and digitalisation, Croatia, as a small country with a small economy, cannot isolate itself from the changes in the environment. EU Initiative i2010 promotes an open and competitive digital economy and emphasises Information and Communication Technologies (ICT) as a driver of inclusion and quality of life. Since Croatia is preparing for membership of EU, goals of Programme e-Croatia 2007 mostly correspond with Initiative i2010 goals. Particularly, within the current economic and financial crisis, modernising economy and increasing productivity are crucial to future growth prospects for Croatia. The fast development ICT, such as the Radio Frequency Identification (RFID), is one of the important factors to improve competitive advantage of enterprises. Because of the need for more effective and efficient production management, we are proposing a conceptual framework of integration RFID with Enterprise Resource Planning (ERP) system in digital enterprise.

2. PROBLEM DESCRIPTION

A real-time information is crucial for effective production management and effective decisions that responds promptly to a signal or request to satisfy a specific requirement. Production management should provide environment that sustain product customization and decreases disturbance in production. Without accurate real-time work-in-process information the current shop floor control and tracking process can not be efficient [1]. Variation in production affects downstream member of supply chain (e.g. supply of parts to assembly line) and their planning and scheduling. The status and related information about each component in production must be monitoring individually through its internal and external supply chain. Coordination, integration and particularly sharing information in real-time about resource constraints, plans and schedules with other supply chain members is very important [2]. The most of Croatian enterprises still use labor-intensive methods (enter data manually and using bar-code systems) for products-related data acquisition. Due to limitations in data acquisition and data interchange between shop floor and ERP system, data is often unreliable and incomplete and needed production status information are unavailable at the right place and at the right time to make effective decisions. As a consequences of problems in existing methods of identifying and tracking parts and products, mislay of parts and products, schedule delay and late deliveries occurs and costs increase. To solve this production management problem, automated data acquisition is necessary to enable the required information timely and to everyone whose need them through integrated enterprise system and supply chain.

3. RFID TECHNOLOGY

Various automated identification technologies (e.g. barcodes, two dimensional barcodes, RFID and optical character recognition) are available for acquisition data in different areas [3,4,5]. RFID is automatic identification technology that uses radiowaves to capture and transmit data of any item with attached tag (chip) and thus automatically identify items that are within given range (Fig. 1). RFID

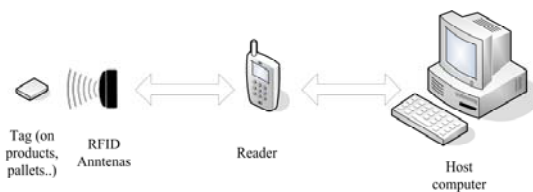


Figure 1. Simplified description of RFID system components

have advantages compared with others automatic identification technology: long reading ranges that enable automatic identification at varying distances, real-time read/write capabilities, data storage on the component, do not require line-of-sight for reading, enduring in harsh environment [2,3,6]. The most of available literature about RFID technology is focused to application of RFID technology for warehouse management and supply chain,

e.g. [7,8]. Our paper is more oriented to production and presents RFID integration with ERP system for production management purpose in digital enterprise. According to the Croatian Bureau of

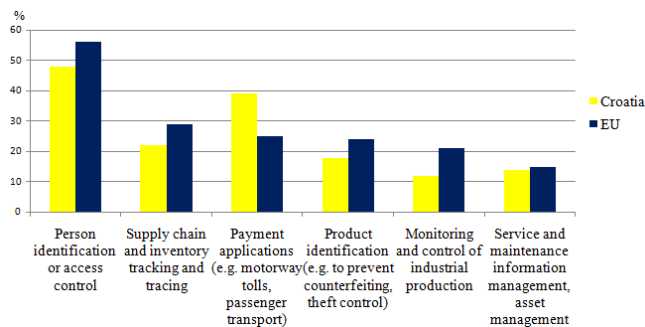


Figure 2. Applications of RFID usage in enterprises, first quarter 2009

Statistics for first quarter of 2009, there are 4% of all enterprises in the Republic of Croatia that use RFID technology (Fig. 2), and that corresponds to the EU average [9, 10]. According to [11], 41% of companies are using RFID for tracking products through manufacturing, assembly or other processes. Products with tags have a unique identity and a capability for storing key manufacturing information (e.g. material used, production status) which enables distributed data storage on the product, and can interchange data

with environment (transmission information between mobile devices and computer) [3].

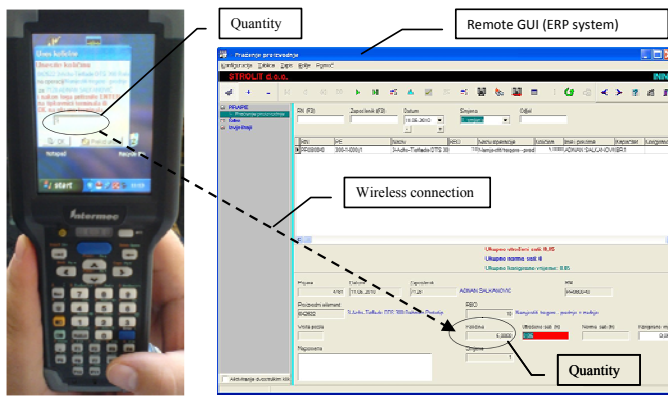


Figure 3. Real-time production status monitoring and update using RFID Handheld Reader/Writer

The presence of RFID tags on items (as a parts, products, pallet, or shipping container) enables effective tracking of items in the production process. So RFID technology enables fast capture of the needed information and transfers them to databases as parts flow through shop floor and also across whole internal as well as external supply chain. Example of RFID usage in production environment is shown on Fig. 3.

4. CONCEPTUAL FRAMEWORK OF RFID BASED PRODUCTION MANAGEMENT

There is a need to establish conceptual frameworks (Fig. 4) for real-time production management using RFID technology with ERP system that enables dynamic and real-time control of production.

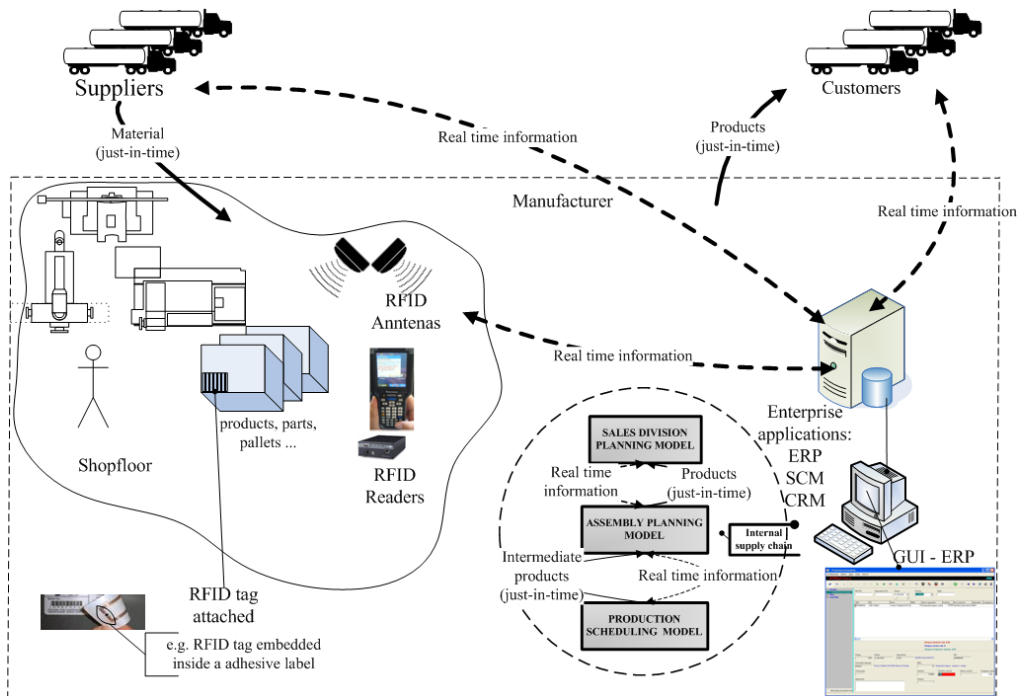


Figure 4. Conceptual framework for production management: Integration of the ERP system and RFID in the digital enterprise

Real-time feature of production management is very important for control of deviation in production, whereas the efficiency of entire supply chain may be adversely influenced by deviation from the schedule [2]. Our framework is based on a hierarchical model of planning and scheduling that enables operation in accordance with just in time principle [12]. The main purpose of integration of RFID

and ERP systems is to use real-time production status directly from production (e.g. ensure accurate information about inventory levels, about start time and finish time of operation - then system calculates total real operation duration). That enables constantly adjustment of the production schedule to any disturbance. Thus, integration of ERP system and RFID technology, and also integration of ERP with others systems (SCM, CRM, etc.) increases speed of data interchange, and enables data accuracy, real-time tracking work orders, parts and products through internal, and external supply chain.

5. CONCLUSION

In this paper, authors propose a conceptual framework for integration of RFID technology as an important managerial tool with the ERP system for the digital enterprise. The objective is to enable real-time status information about material, products, workers and other resources needed for management decisions, in context of hierarchical planning and scheduling and just in time principles. The system should enhance the visibility of information and material flows in the internal as well as external supply chain integration. Thus a more effective and efficient business processes and real-time information for management support in digital enterprise should be attained. The future work should include the validation and verification of integration of our framework into an actual enterprise solution.

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6. REFERENCES

- [1] Chen, R.S., Tu, M. A.: Development of an agent-based system for manufacturing control and coordination with ontology and RFID technology, *Expert Systems with Applications*, 36(4), 2009, Pg. 7581-7593
- [2] Yin, X.F., Khoo, L.P.: A hierarchical model for e-supply chain coordination and optimisation, *Journal of Manufacturing Technology Management*, 18(1), 2007, Pg. 7-24
- [3] Ergen E., Akinci B., Sacks, R. Life-cycle_data management of engineered to-order components using radio frequency identification, *Advanced Engineering Informatics*, 21 (4), 2007, Pg 356-366
- [4] Garcia, A., Chang, Y.S., Valverde, R.: Impact of new identification and tracking technologies on a distribution center, *Computers & Industrial Engineering*, 51(3), 2006, Pg 542-552
- [5] Youssef S.M., Salem R.M. Automated barcode recognition for smart identification and inspection automation, *Expert Systems with Applications*, 33(4), 2007, Pg. 968-977
- [6] Ngai, E.W.T., Suk, F.F.C., Lo, S.Y.Y. Development of an RFID-based sushi management system: The case of a conveyor-belt sushi restaurant, *International Journal of Production Economics*, Volume 112, Issue 2, April 2008, Pages 630-645
- [7] Attaran, M. RFID: an enabler of supply chain operations, *Supply Chain Management: An International Journal*, 12(4), 2007, Pg. 249-257
- [8] Poon, T.C., Choy, K.L., Chow H.K.H., Lau H.C.W., Chan F.T.S., Ho, K.C. A RFID case-based logistics resource management system for managing order picking operations in warehouses, *Expert Systems with Applications*, 36(4), 2009, 8277-8301
- [9] Croatian Bureau of Statistics. Usage of Information and Communication Technologies (ICT) in enterprises, 2009, First Results, First Release. http://www.dzs.hr/Eng/Publication/2009/2-1-8_1e2009.htm
- [10] Eurostat Press Office. E-commerce accounted for 12% of enterprises' turnover in the EU27 in 2008. http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/4-19012010-BP/EN/4-19012010-BP-EN.PDF
- [11] Commission of the European Communities: Europe's Digital Competitiveness Report, Vol. 1: i2010 — Annual Information Society Report 2009. Benchmarking i2010: Trends and main achievements, Brussels, 2009. http://ec.europa.eu/information_society/europe/i2010/docs/annual_report/2009/sec_2009_1103.pdf
- [12] Matičević, G., Lovrić, T., Čičak, M. Using ERP system to improve internal supply chain coordination. *Tehnički vjesnik*, 14(3,4), 2007, Pg. 11-21