

Concept of Resistant to Electromagnetic Disturbances Prototype of Measuring Points System Located in Production Cells Based on RFID Selective Gate Technology

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Abstract: - The aim of paper is to present the concept of prototype called 'Resistant to electromagnetic disturbances integrated system of measurement points located in production cells using RFID selective gate'.

Keywords: RFID technology, RFID selective gate, integrated supply chain management

1. Introduction

Solutions supporting logistics and supply chain management using RFID (Radio Frequency Identification) are in a phase of dynamic growth. RFID technology is still evolving and giving new opportunities for an automatic data collection, called ADC (Automatic Data

Capture), also in the supply chain management. The aim of RFID is to provide data encoded in tags and then their reading in time and place required by organizational solutions implemented in an enterprise in a logistics area. A typical implementation of RFID system is a set of antennas connected to a controller and

attached to a structure tailored to user's needs, called "RFID gate". The analysis made by the authors shows that today most of RFID gates have limitations in their work. They operate in a non-selective way. This means that during the elements' identification can be read not only the tags that pass through the gate's light, but also those that are next or even behind it. These results the faulty objects' identification [14].

A literature review also confirms that. In the Polish literature, the issue of using RFID gates in a production logistics take a few authors [4,9, 10, 11,12, 13, 14], as well as, foreign authors [1, 2, 3, 5, 6, 7, 8, 15]. This is also supported by the participation of DataConsult Ltd. management board and scientists from the Institute of Logistics and Warehousing in Poznan (ILiM) in national and international conferences, as: IEEE EMC Society International Symposium on Electromagnetic Compatibility in USA, International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility - EMC in Zurich, International Symposium on

EMC in Wroclaw, International Conference on Electromagnetic Disturbances in Bialystok, National Workshops of Electromagnetic Compatibility in Wroclaw, Conference on EMC in Electro-technics & Electronic in Lodz.

The research conducted by DataConsult Ltd., Krakow, Poland that is the company operated in a high-tech specializing in a production of integrated logistics IT systems, industrial automation systems integrated with logistics management systems, selling periphery devices supporting a warehouse service and implementing of logistics systems for enterprises – shows that the main needs in this area have manufacturing companies that require solutions for a logistics processes optimization, resistant to the electromagnetic disturbances. It is known that the trend of cost optimization of logistic processes operated in innovative systems using automation (gates, readers), mobile solutions (terminals and data collectors) and software (database management, optimization) is growing up in the global scale. Main requirements for

these systems are an operational reliability in difficult production environment and integration for automated data exchange, so that each of the users involved in the logistics process works on real data.

The aim of this paper is to present the concept of prototype, called ‘Resistant to electromagnetic disturbances integrated system of measurement points located in production cells using RFID selective gate’ which will be the result of R&D conducted by DataConsult Ltd. in collaboration with The Institute of Logistics and Warehousing from Poznan (ILiM).

The designed system will enable to manage the logistics processes (internal supply chain) in an integrated way in enterprises that have no possibility to implement such systems due to electromagnetic disturbances. The system, which is going to be made as a result of R&D, will be resistant to the disturbances caused by different production devices and it will be based on the RFID selective gate technology allowing unambiguous details’ identification.

The research issues have determined the structure of the article which consists of two parts: the presentation of research results that allowed to identify problems and needs related to the improvement of data transmission in a production logistics and the presentation of the prototype concept of the resistant to electromagnetic disturbances integrated system of measurement points located by production cells using selective RFID gate’, as a result of R&D.

2. Related Efforts

2.1. Research Methodology

At the first step of research, it was defined an area which has been bordered to Poland and then the number of potential customers due to the size of their business was studied. Taking into account the experience of board members of DataConsult Ltd. and generally available information, it is assumed to the analysis that this type of solution is most frequently used by small, medium or large enterprises. The size of

potential target group has been determined because of the company's size, based on data collected from Statistical Center Office of Poland (GUS) in January 2011, according to which 91 893 enterprises were registered at the domestic market including: 73 675 small enterprises (from 10 to 49 employees), 15 032 medium-sized companies (from 50 to 249 employees) and 3 040 large enterprises (employing at least 250 employees). According to GUS data presented in the report [16], 29 090 enterprises were defined as "manufacturing" that run their activity on the domestic market. Companies in this sector are systematically developing their business activity including foreign markets that from the point of view of the proposed solution is a good 'omen' for the future.

In the next step DataConsult Ltd. made the research from May to August 2011 on a group of 90 randomly selected companies from the industrial sector in Poland, of which 10% were small companies, 71.2% medium-sized and

18.8% large enterprises. The survey included decision-makers on the technical, production and management level like: chairman of the board - 33 people (36.7%), production manager - 45 people (50.0%), technical director - 12 people (13.3%). As a research tool was used a questionnaire.

2.2. Research Results

The results of research showed that 53.3% of manufacturing companies used in their production halls devices that disturbed the data transmission. 22.2% were not able to implement effectively information systems due to the high number of electromagnetic disturbances (Fig.1).

During the study respondents (69%) pointed to the problem that the use of other technologies than RFID technology to identify products or elements is often not possible in their production plants because of the difficult working conditions. The main obstacles are: a potential high degree of dust, the possibility of code contamination causing great difficulties in

optical identification, a high temperature resulting the label's destruction and irregular or

small shapes of parts that prevent an attachment of bar code.

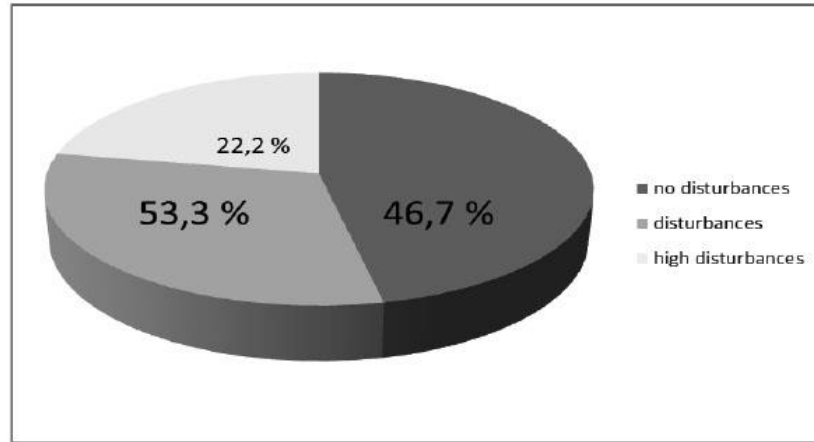


Fig. 1: Impact of electromagnetic disturbances on data transmission

The respondents also have identified that the use of RFID technology in their production activity is difficult because of electromagnetic disturbances (81%). Main requirements indicated by respondents are:

- ✓ An increased reliability of unambiguous goods' identification (80%),
- ✓ An improved resistance to electromagnetic disturbances (81%),

- ✓ Higher concentration of measurement points within the production line (57%),
- ✓ Reducing the distance between the production lines without the risk of reading the element from the next line (65%),
- ✓ The ability to integrate with external IT systems and automation devices (77%),

- ✓ The ability to adapt to existing solutions in the manufacturing plant (79%),
- ✓ A scalability of the solution (71%).

In response to the identified problems DataConsult Ltd. has decided to create a solution – ‘Resistant to electromagnetic disturbances integrated system of measurement points located in production cells using RFID selective gate technology. This system will be completely the innovative solution in the area of materials management and it will support logistics processes in the enterprise, enabling their full automation.

3. The Concept of Prototype the Resistant to Electromagnetic

The concept of prototype of the resistant to electromagnetic disturbances integrated system of measurement points located in production cells using RFID selective gate technology. The designed prototype will be dedicated for use in manufacturing plants that have a high ratio of

electromagnetic disturbances. Its main functions are:

- ✓ Identification of parts based on RFID,
- ✓ Pointing physical parameters of the element,
- ✓ Production accounting,
- ✓ Providing the ability to track the flow of raw materials and products (Traceability),
- ✓ Business process modeling in the designation of the correct flow of raw materials and products,
- ✓ Indication of errors based on the collected data,
- ✓ Data collection, data processing and advanced reporting services,
- ✓ Making different kind of analysis.

The main part of the prototype will be the measuring point and RFID selective gate that provides the ability to identify specific units of raw materials, semi-finished or final products with the possibility of traceability. Management, collection, processing and presentation of information from these modules will be

implemented using the measuring points management system.

For unambiguous identification of specific product units was chosen RFID technology. This choice was determined by the insensitivity of this technology in the hard working conditions in production halls, such as high temperatures, a high ratio of dust, the presence of highly reactive chemicals, irregular shapes or small product sizes that make it impossible to use the bar codes. The prototype, besides the reading, will also have the opportunity to move data to the RFID transponder in EPC Gen2 standard. Consequently, the system will get the functionality of labeling of new products and defective items provided to the re-control and others configurable by the user.

The prototype will consist of the following elements:

- ✓ RFID selective gate - a device that reads the information from the RFID tags passing only by the gate's light (the space inside the device).

- ✓ Measuring point (detection of disturbances, color measurement, weight) - a set of industrial sensors. Ultimately, it will be possible to use any measuring devices. In the prototype it will be used sensors detecting an element presence, a color measurement and the element weight.
- ✓ Industrial Computer with a touch screen and mobile checkpoints transferred to the data collectors - devices used to the prototype service by the operator.
- ✓ RFID programmer - a device used to record data in RFID transponders.
- ✓ Electromagnetic shields absorbing electromagnetic waves emitted by the production equipment.
- ✓ Measuring points service system in the production cell - IT system for the measuring points management and modeling of business processes related to production cells.

✓ Network infrastructure providing communication between system modules. The scheme of resistant to electromagnetic disturbances integrated system of measurement points located in production cells using RFID selective gate technology is presented below (Fig.2)

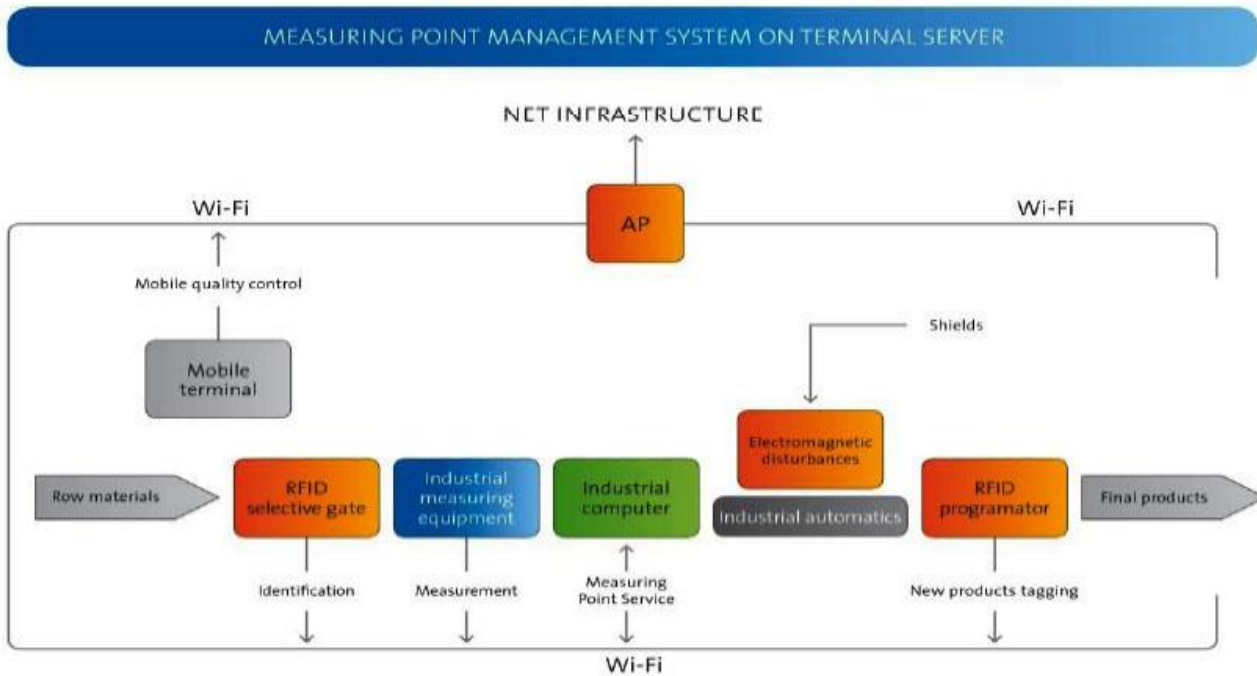


Fig. 2: The concept of 'Resistant to electromagnetic disturbances integrated system of measurement points located in production cells using RFID selective gate technology'

The necessity to use the RFID selective gate technology (tag reading is only possible in the light of the gate) is due to the need of ensuring error-free operation of the system. As a result, it is not possible to register the sliding element next to the gate. The project of RFID selective gate developed by the Institute of Logistics and

Warehousing [19] is currently under a patent application. The system's prototype is a pioneering use of this device in the manufacturing industry and the second in the world. Additional advantages of RFID selective gate are:

- ✓ High resistance to electromagnetic disturbances,
- ✓ Measuring points concentration without increasing the risk of read the redundant tags,
- ✓ Scalability (the ability to customize the dimensions of the gate to meet the requirements of implementation).

In addition to the RFID selective gate, each of the measuring points will be able to be equipped with a range of industrial gauges that read information about the physical characteristics of a part working in a production cell. The data recorded by the readers will be integrated with the product identifier and stored in a database to be used in future analyzes, as well as, the input to the alerts' system.

The use of wireless terminals as mobile points of management and control will be possible thanks to the screening of the production devices what reduces the impact of electromagnetic disturbances in IT networks. Their use reduces the costs of implementation - one terminal will

be able to work in the production hall and not just in the one production cell. This gives the opportunity to introduce mobile quality control mechanisms. With a constant access to the wireless network, terminals will be able to work online (to be constantly connected to the network). The effect is that the data on which the operator works will be updated in any time. In addition, it solves the problem of conflicts when two users refer to the same resources.

Data terminals will be able to work with the modern wireless Wi-Fi standards (including IEEE 802.11g and IEEE 802.11n) and to communicate with peripherals devices (e.g. mobile label prints) using Bluetooth (IEEE 802.15.1).

The system will also have the ability to model business processes. It will be implemented by defining paths in the system which are able to follow the raw materials / semi-finished products to make the final product. The system is going to prompt the operator the next working point of the element. If it achieves the wrong measuring

point, the system will inform the user sending a message. The operator will also have the opportunity to check the history of the part (the points in which it was processed so far). The designed measuring points management system is going to be fully scalable. Such solution allows for the interaction of a number of measuring points over a wide range - from providing the comprehensive traceability in the production hall and the production line, as well as, the possibility of communication between the points and alarming in case of incorrect actions, to the analysis of the work in all measuring points. The analysis can be related to:

- ✓ The effectiveness of separate measuring points and entire production lines,
- ✓ Time of operators real work,
- ✓ The operator effectiveness,
- ✓ The identification of bottlenecks during the element processing (optimization analysis),
- ✓ The calculation of error rate (the percentage of defective units),

- ✓ Others defined by the user.

Precise minimum hardware and software requirements for the measurement points management system could be determined after the completion of the prototype. At present, it can predict that these requirements will be linearly dependent on a number of operators and simultaneous measurement points. A characteristic feature of the prototype will open interfaces. This allows to integrate with any automation devices, sensors, readers, etc. The measurement points management system will also have interfaces to communicate with external systems, enabling the exchange of data.

4. Conclusions

The research conducted by DataConsult Ltd. showed that so far there is no company that offers the measurement points integrated system dedicated to production cells. The use of RFID selective gates in production lines is an innovation in the world [17]. The designed

prototype compared to similar solutions in the world will have the following advantages:

- ✓ It will use RFID selective gate (the pioneer solution) which allows to increase the reliability of unambiguous goods identification. It means that there will be registered goods only sliding by the gate's light. The goods to be moved next to the gate will not be identified that is the great benefit with a respect to classical RFID gates. Moreover, the solution will have the improved resistance to electromagnetic disturbances, the possibility of doing any concentration of measurement points within the production line, the ability to reduce the gap between production lines without the risk of recording element from the nearby line:
- ✓ It will have the ability to automatically record information to the RFID tags

with a service from a measuring points management level;

- ✓ It will be highly resistant to electromagnetic disturbances generated by certain industrial automation tools and devices;
- ✓ It will be equipped with open interfaces that allow to integrate with external systems and automation devices;
- ✓ The system will be flexible to adapt it to existing solutions. In other words, it will not require to make a new design of the production line;
- ✓ The integration of modules into one product, that is the measurement point, is going to be created a consistent solution that implicates the following advantages: lower costs and shorter time of implementation, the ability to support implementation by the partners;

- ✓ It will be equipped with mechanisms for modeling business processes and quality control;
- ✓ It will have the opportunity to derive user interfaces for mobile terminals;
- ✓ It will be fully scalable.

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Doctor of Economics, engineer. For several years, she has been associated with the IT industry as the consultant, expert and scientific project manager in the area of ICT in business management, especially integrated management systems and platforms. Currently she is the scientific project manager of the project entitled "Resistant to electromagnetic interference prototype of measuring points system in production cells based on selective gate of RFID technology" in DataConsult Ltd. Since 2003 she

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