

Introducing Identification Technology in Manufacturing Companies and Their Impact on Business Economics

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Abstract: *Automatic identification (AI) is a new type of communication, which uses passive components through the logistics chain for marking, transmission and automatically identifying information with these related elements. Product identification in manufacturing firms is helping to specify what material is a composite product, who the supplier or other properties of the product. Identification of the product also prevents the possible confusion. The product could be included in the information flow have to be alert for its movement (income, output, transfer). One of the most effective ways of acquiring data becomes the use of automatic identification. Bar codes are the cheapest and most common way labeling passive elements and allowing automatic identification on optical principle. Using of the bar code is secured transfer of data to a superior computing system. The aim of this article is to determine how much engineering manufacturing companies in The Czech Republic uses identification technology in the manufacture and design methodology for introducing identification technology into the manufacturing process for the synthesis of acquired secondary and primary data. It will thus provide a simple and easily applicable methodology that can be easily used manufacturing companies that are still not benefiting identification technology. In selected manufacturing companies the production process will be examined, with and without the use of identification technology. On the basis of this examination, the introduction of these technologies into production with an impact in business economics and cost savings will be analyzed.*

Keywords: *Automatic identification, manufactory, manufacturing company, manufacturing process, bar code.*

1. Introduction

In the competitive and dynamic environment of manufacturing companies, logistics is an important strategic factor for maintaining the competitiveness of companies. The use of identification technologies in the manufacturing process of companies contributes to increasing the logistics performance. Identification technology used in manufacturing allows management employees to have an almost immediate overview of all ongoing production processes in manufacturing. The use of identification technology ensures smooth logistics processes taking place in manufacturing. Using identification technology saves time in the manufacturing processes, brings about cost savings, and thus has a major direct impact on earnings.

Manufacturing companies, particularly in the field of engineering, food, pharmaceutical supplies, or the chemical industry, are users of the GS1 system¹ both on the global and local level. These companies are also involved in the formation and development of GS1 standards and are key players in terms of their implementation into business practices. GS1 is a global, non-profit association, dedicated to the creation and implementation of global standards for the use of identification technologies and solutions focused on improving the efficiency of the supply chain globally and across sectors. The GS1 system is the most widely

¹ The Organization of EAN Czech Republic was internationally renamed GS1 in 2006. In the Czech Republic, the designation GS1 Czech Republic is thus used.

used standard for supply chains in the world. It enables the use of automatic data collection means in all the important points of the supply chain. Thanks to the standards for electronic communication, the physical flow of goods can be effectively supplemented with the sharing of structured master and transactional data between business partners (GS1, 2017).

The use of identification technologies in manufacturing companies not only helps to identify the product and to specify what material the product is made of, it also provides information on who its supplier is or other properties of the product. Identification of the product also prevents possible confusion. In order for the product to be included in the information flow, a record of its movement must be made (receipt, issue, transfer). The use of automatic identification is becoming one of the most effective methods of acquiring data.

In a system where most of the information is processed by computers, great demands are placed on those parts of the system where the collection, creation and transmission of data occurs. In order for the efficiency of these systems to be further increased, it is precisely this problem that must be solved in an effective way (Beňadiková and Mada and Weinlich, 1994).

A large amount of individual data and information that does not have too much self-explanatory value arises every day from the manufacturing process, sales, purchasing, logistics flows or any economic operations. The purpose for collecting such an amount of data in each firm is primarily the need for the future use of this information. The future use of information primarily means gaining a competitive advantage and hence economic benefit for the company. Therefore, in order to use the information gathered, it is necessary to put it into context and especially store it in a way so that you can quickly manage to find it again.

Automatic identification (AI) is a new type of communication, which uses passive components passing through the logistics chain for the marking, transmission and following automatic identification of information related to these components (Freedom and Latýn, 2003). Automatic identification systems are used where the automation of processes in the manufacturing and non-manufacturing sector is required. While AI was previously used mainly in retailing, it is currently also used in the area of manufacturing and the management of production processes, monitoring manufacturing operations and material flow, the receipt of goods, storage, handling, and others. (Mačát and Sixta, 2005, Svoboda and Latýn, 2003).

Manufacturing companies, purchasing material for production, always try to have enough material, therefore the planning in the system must correctly indicate to the buyer what, when and in what quantity and quality they should order (Gros, 1996). The role of the systems lies in optimizing the amount of material across orders and the dynamic timing of the issuance of the order. More specifics can be found in communication with suppliers. The automotive industry uses supply schedules which transmit information systems among themselves through EDI electronic communication (Tvrdíková, 2008). In engineering, online purchasing portals are increasingly being used in the projects, through which the information system indicates to the supplier what to add, prints barcode labels and visualizes the material en route. When deploying barcode technology, it is therefore clear that they must take into account the impact of the specifics of each sector.

The barcode is existing automatic identification technology in the field of logistics and has become part of the supply chain. The introduction of barcode technology has had an impact on the supply chain in practice like few other previous technologies (Suraj, and Singh, 2009). The use of barcode technology significantly simplifies the registration of materials and goods in stock. After reading the barcode, information about the type of material or goods is displayed which is automatically subtracted or added at the warehouse. The transmission of information relates to inventory, the status of goods on the move, the location of stocks, input and output supplies, customers, staff and the utilization of warehouse space (Drahotský and Řezníček, 2003).

The use of barcodes significantly expanded in the 1970s. In the Czech Republic it was rather late. The development of bar codes in our country did not occur until the early 1990s, mainly due to the expansion of supermarkets and hypermarkets (Ježek, 1996). According to Mačáta and Sixty (2005) and Vaněčka (2006), barcodes are one of the cheaper and more widespread methods of labeling passive components and allowing automatic identification on the optical principle. By using the bar code, the transmission of data is ensured to the superior computing system. This greatly increases control over products, materials, and the circulation of documents etc. Barcode technology has a wide application in many areas, such as the identification of industrial products, daily consumer goods, during inventory management, etc. (Youssef and Salem, 2007). This technology provides numerous benefits to industry.

All may generally be divided into three main categories:

- The decline of entering incorrect data,
- shortening the time needed for control
- and increasing traceability.

GS1 is a nonprofit group that deals with the implementation of global standards throughout the supply chain. GS1 states that an experienced operator makes 1 error for every 300 keystrokes when entering data into the system. Entering data using barcode technology reduces the entering of erroneous data to 1 error per 1 million keystrokes (Hayat, 2012). With the advancement of mobile technology, many mobile phones are equipped with cameras that enable the function of scanning 2D barcodes. If software for reading a 2D barcode is installed in a telephone, the user can quickly find out information about the scanned product (Lin and Cheung and Siao, 2014). Barcode technology enables the tracking of the supply chain from the beginning to the end customer, as well as helping to trace back the history of the product up until its composition. Tracking the movement of the product is a complementary activity, aimed at enhancing product safety, streamlining and optimizing production planning and distribution systems and processes. It helps to locate the source of problems (defects, contamination) and effectively manage their removal (Musa and Gunasekaran and Yusuf, 2014).

For the successful reading of a bar code, direct visibility by the sensor is needed. However, in some areas this is impossible to secure - for example, in paint shops or in environments with high dust levels. In these cases, the principle of radio frequency identification (RFID) finds its use. RFID codes were first used in World War II (Štědroň and Budiš, 2009). RFID can be imagined as a unique wireless communication technology, which is used to identify the selected objects or persons (Hunt and Puglia and Puglia, 2007). RFID codes are expected to increase supply chain efficiency and transparency (Gaukler, and Seifert, 2007). RFID technology has a number of important beneficial aspects, compared to barcode technology, for example:

- long distance readability
- resistance to changing environmental conditions, for storing information,
- processing and acquisition of capacity, etc.

However, it has some serious drawbacks in the implementation to supply chains, such as read error, or safety problems (Kapoor and Piramithu and Zhou, 2009). This technology complements barcodes in areas where they cannot be used, or their deployment is ineffective. RFID has its limitations given by the physical principles of the dissemination of radio frequency waves. Unlike bar codes, RFID allows bulk reading and does not require direct visibility for the identification of objects. Thanks to these properties, RFID is regarded as a potential successor to the barcode and can complement or replace the barcode (McCathie and Michael, 2005).

2. Objectives

This article aims to analyze the management of processing large amounts of information in the manufacturing process using barcode technology. The analysis will be based on the findings of the identification requirements of specific businesses that operate on the Czech market in the field of engineering. Subsequently, the introduction of these technologies into the manufacturing process and the comparison of the manufacturing process with and without the use of identification technology will be analyzed. The article deals with an area that is not scientifically mapped out in the Czech Republic. This issue touches on several areas such as manufacturing management, business economics and logistics, which are topical and interesting both in terms of practical use and academic research. The outcome of the article will be the strengthening of management skills in the field of mechanical engineering in companies that manage business processes via barcode technology. This article should provide findings that will be useful for the companies themselves and experts.

3. Material and methods

The analysis of the management of processing large amounts of information in the manufacturing process using bar codes will take place based on the identification requirements of individual companies. Specific companies doing business in the Czech Republic in the field of engineering. The introduction of bar code technology in the manufacturing process of companies and the comparison of the manufacturing process with and without the use of barcodes will be analyzed. Information on engineering companies were obtained through structured interviews with knowledgeable individuals through the monitoring of the manufacturing process using barcode technology and a look into internal documents. These engineering firms have bar code technology established in manufacturing processes. The article is based on in-house company data, which, however, was relatively difficult to obtain. It is sensitive data used by company management for operational and strategic decisions and is not freely accessible.

In the course of working with the analysed companies, however, the selected range of data was promised, with whose use it will be possible to analyse the use of the impact of the introduction of identification technology on the economy of the company. The present article is the first of a series of articles analysing the introduction of bar codes in the selected Czech engineering companies.

The first analyzed company (A) is engaged in the manufacturing of rail, underground and tram lines. The company was founded in 1995. It is now a monopoly producer in the area of technology for railway and underground lines in the Czech Republic and a major manufacturer of technologies for tramway tracks in the Czech Republic and abroad. It also produces a complete range of spare parts for switches, it provides service activities for newly delivered products, performs the regenerating of used switches from tracks and their re-use, provides services related to the maintenance of the railway superstructure of the track such as welding frogs, grinding switches, straightening tongues and track material after accidents, the replacement of spare parts etc. In 2016, the company had 580 employees. The revenue of the company in 2016 amounted to EUR 58.6 mil. For the conversion of sales from CZK to EUR the exchange rate of the CNB of 27 CZK / EUR was used.

Another analyzed company (B) is engaged in the manufacturing of laser cut parts. The **company** is a solely Czech company, which was founded in 2008. **The main focus of the company is the custom and serial production of precision burnouts through laser burning.** Since 2010, the company has significantly strengthened the machinery equipment and gradually, with the increase in production volume, expanded to also focus on other sectors, namely on bending on CNC presses and a machine shop, where the material cutting, grinding, welding, manual plasma cutting, assembly, product assembly and other processes are carried out. In 2016, the company had 188 employees and the turnover of the company amounted to EUR 5.8 mil.

4. Results

The presented companies implemented barcode technology several years ago. The first company, engaged in the manufacture of crossings, has the entire production process connected by a system that supports barcodes. This system is built by linking a barcode system with an in-house information system. Each employee working according to the production plan hands over the finished work by registration in the in-house information system. The employee performs this operation using the terminal, which is located directly at individual workplaces. This terminal is equipped with a bar code reader in the form of a ballpoint pen. The employee need only log into the system using the personal number and read by swiping the barcode along the production plan sheet. This operation is performed with all the production plan sheets thereby entering the finished work into the system. All employees on all shifts enter this data in the same way. At one in the morning, the entire production plan in all contracts is automatically recalculated and the timeliness of information about the production process is thus ensured. The introduction of barcode technology in manufacturing has provided many advantages such as the sharp decline of entering incorrect data, reducing the time for checking, increasing traceability, drastically reducing the time required to enter data into the system, awareness about the status of orders in production, etc. The introduction of barcode technology in this company caused the easing of work for three workers, who previously had to enter all performed operations into the system manually. Now they can focus on other administrative duties. The company's management also stated that these three experienced operators, who were responsible for manually entering data into the in-house information system, made on average one mistake for every twenty registered operations. Managers now indicate that the error rate after the introduction of barcode technology decreased by more than 87%.

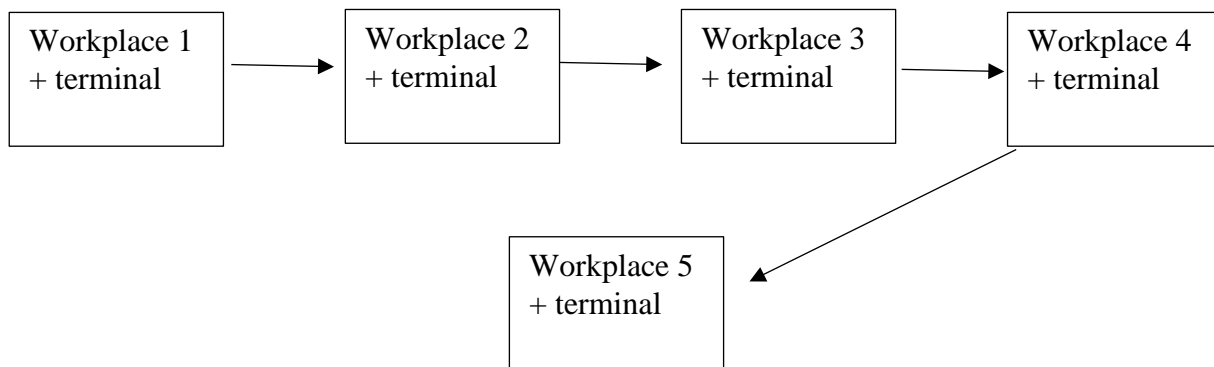
Table 1: Comparison of the advantages and disadvantages of barcode technology in company A Source: Own processing

Company A	
Advantages	Disadvantages
Sharp decline in entering incorrect data	Time required to implement
Reduction in the time required for data	Demanding for IT administration
Shortening the time for checking	Employee training
Enhancing traceability during production	Financial demands on acquisition
Information on the status of orders in manufacturing	
Easing of administrative work	
Finding out the repeatability of orders	

Source: own processing

Table 1 shows a comparison of the advantages and disadvantages connected to the introduction of barcode technology. The management of the company acknowledges that the introduction of technology paid off for the company not only in terms of personnel, but also from the perspective of the entire management of production. The benefits that this technology has brought them are much more beneficial than any system used before the introduction of bar codes.

Diagram 1. The manufacturing process of company A with the designating of the terminals



Source: own processing

Diagram 1 shows the location of the individual workstations with terminals. Workers in the individual workplaces have access to terminals with reading devices and can thus seamlessly send off work results without unnecessary movement.

The second company, which is engaged in laser burning, introduced bar code technology in 2015. The company has an in-house system connected with bar code technology the same as the previous company. The company also uses bar code technology in the storage of material and also has it linked with several suppliers of material. This fact facilitates many activities such as taking over material from a supplier, speeding up the discovery of the current status of stocks of materials in the warehouse and information about its use. The advantages of the introduction of barcode technology in this engineering company are almost the same as in the previous company. Determining the repeatability of orders is one of the specific advantages for this company, as the main activity of the company is custom manufacturing. This finding helps management to identify the most common types of recurring projects and modify the manufacturing process according to this. Furthermore, the company's management states that after the introduction of barcode technology into the manufacturing process, the error rate when entering data into the system has been reduced compared to manual entry by almost 93%.

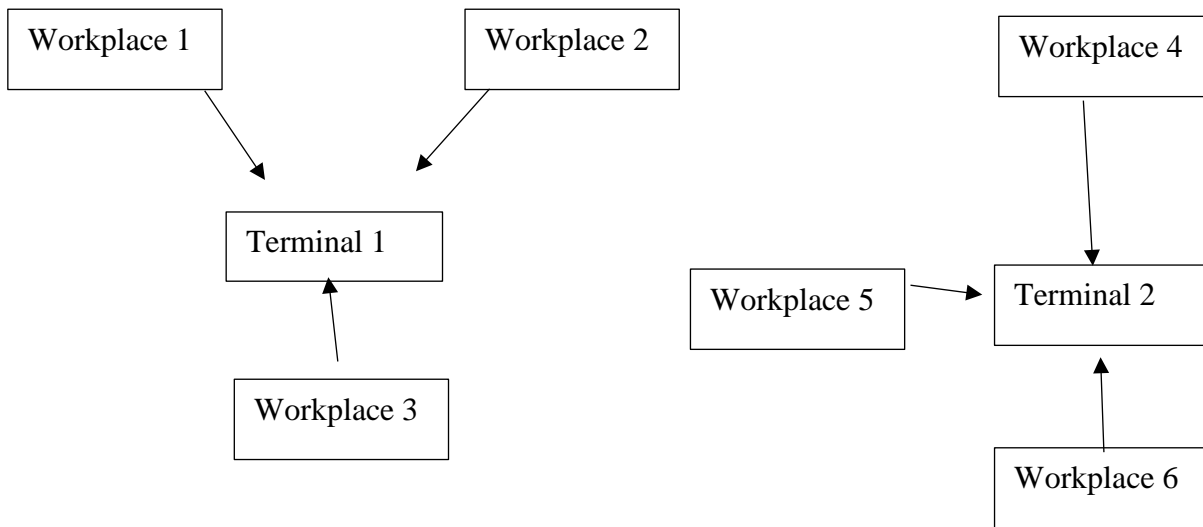
Table 2: Advantages and disadvantages of barcode technology in company B

Company B	
Advantages	Disadvantages
Sharp decline in entering incorrect data	Time required to implement
Reduction in the time required for data	Demanding for IT administration
Shortening the time for checking	Employee training
Enhancing traceability during production	Financial demands on acquisition
Information on the status of orders in manufacturing	
Easing of administrative work	
Finding out the repeatability of orders	
Supports optimal production plan	

Source: own processing

Table 2 shows the advantages and disadvantages of the introduction of barcode technology in company B. The company management stated that they see the benefits of the introduction of barcode technology for their company primarily in the possibility of optimizing the production plan and the almost immediate verifiability of the state of orders. In this company, it took a little longer to implement barcode technology, but only due to the poor selection of the supplier of this technology. Finally, the firm said that after replacing the contractor, the course of implementation was smooth.

Diagram 2: Illustration of the location of individual workplaces with the location of terminals in company B



Source: own processing

Diagram 2 shows the layout of workplaces and the location of two terminals that were built so that the personnel of each department have the best possible access to terminals. Company B has placed the terminals in cubicles to keep them in a clean environment and prevent them from being affected by dust. By building the cubicles, the management has achieved the reduction of the cleaning intervals of the terminals. Another benefit of these cubicles is seen by the company management in the reduction of entering incorrect data into the system caused by the pollution of the reading pen.

5. Conclusion

Entering data using barcode technology reduces the entering of erroneous data to 1 error per 1 million keystrokes according to Hayata (2012). The company, which is engaged in manufacturing switches, reported that these three experienced operators, who were responsible for manually entering data into the in-house information system, made on average one mistake for every twenty registered operations. Managers now

indicate that the error rate after the introduction of barcode technology decreased by more than 87%. The remaining percentage of the error rate is very hard to remove for this particular company. It is a problem with the purity of the reading pen, which gets dirty easily due to the environment in which it is used. Then there is a poor reading of codes.

Another advantage, which is indisputably being used by the employees in this company, is tracking the movement of the product. According to Musa (2014), tracking is a complementary activity aimed at enhancing product safety, streamlining and optimizing production planning and distribution systems and processes. It helps to locate the source of problems (defects, contamination) and effectively manage their removal. In the given company, this backtracking of individual work operations has already been utilized many times when searching for poorly manufactured parts. This backtracking has saved a lot of valuable time in the manufacturing of demanding constructions and saved a lot of money during the quick identification of the source of the problem.

The second company, which is engaged in laser burning, noted that after the introduction of barcode technology into the manufacturing process, the error rate when entering data into the system has been reduced compared to manual entry by almost 93%. In this company, the terminals are located in cubicles that prevent the soiling of the reading pen and thus help reduce the error rate when entering data into the system. The company has only two terminals that are close enough to all work sites. The introduction of barcode technology greatly helped this company with the optimization of the planning of production processes. According to Musa (2014), it is one of the complementary activities designed to facilitate production planning. This company has optimized production processes, thus ensuring their continuity using barcodes.

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