

USE OF DIGITAL TOOLS IN LOGISTIC AND PRODUCTION FACILITY MANAGEMENT FOR EFFECTIVE INFORMATION FLOW

Peter Ignáč

Technical University of Kosice, Faculty of Mining, Ecology, Process Control and Geotechnologies, Letna 9, 042 00 Kosice, Slovakia, EU, peter.ignacz@tuke.sk

Keywords: data, data collection, digital forms, information flow, paperless

Abstract: The article deals with the use of digital forms in the manufacturing environment to reduce the amount of printed paper and streamline the flow of information of production and logistic processes. The aim of this article is to point out the possibility of using simple and commonly available solutions to collect the necessary data. The problem is the need for higher computer skills of ordinary users. It can be used in both logistics and production environments. In a medium-sized company, the amount of paper printed using a printer may be approximately 19000 pcs per year, which consider checklists, forms, diaries of processes or maintenance. This quantity amounts to approximately 1140 EUR. The article focuses on the tools, which are commonly available software to smaller and larger companies in the manufacturing industry, and of course in other industries.

1 Introduction

What is digitization? Jarvis, A. with Morales, L. and Jose, J. said that: “*Digitization is the process of converting information into a digital format*” [1]. Correa da Silva, F. S. and Augusti-Cullell, J. defined, that information is: “*built by an intelligent entity, who constructs and organization for data in order to make sense of it*” [2]. Data digitization represents a huge potential for removing paper from processes in the information flow. Van Eijck, J. and Visser, A. described information flow as: “*metaphor of information exchanges as a kind of liquid flow. After all, we speak of information transfer, flow, and extraction*” [3]. Ultimately, digitization can also has a positive impact on the environment, as companies can spend substantially less paper on their information capture needs. Oláh, J. with Sadaf, R. and Máté, D. and Popp, J. think that: “*the success factors of the business, we have found that trust is the first, sector-specific IT development the second*” [4]. According Weller, S. and Romney, K.: “*the gathering of data is only the first step in the quest for understanding; data must then be analyzed and interpreted*” [5]. Paper forms as a means of recording and transmitting information are therefore slightly declining in industry today. In addition to a variety of internal corporate and corporate software that enables the creation of a digital information stream and, of course, in addition to the extended SAP, Microsoft has also launched Office 365 in 2011. Greve, D. and Strand, L. wrote that: “*for enterprises Office 365 allows them to move operationally important systems such as e-mail out to the cloud with Exchange Online – to be maintained and optimized by Microsoft*” [6].

This article is focused in more detail on how forms applications can be used, along with specific examples of how applications can be used in industry, whether to collect the data needed to manage production or logistics using electronic forms.

2 Methodology

Stack, F.C together with Marmor, M. and Jackson, L.L. have an opinion that: “*Electronic forms are non-paper, machine-readable forms created by forms analysts with the aid of forms design software*” [7]. The range and spectrum of data that can be collected using digital forms is wide. It is certainly interesting for manufacturing companies where is no need to be programmatically skilled to work with a useful everyday data collection tool. O’day, James said interesting idea that: “*Quality of the data depends at least on the performance of the police investigators and of those reviewing the data and entering them into computers*” [8]. Of course, in production aren’t police investigators, but we can find there people responsible for data validation. Systems for continuous data collection automatically at machines are usually based on integrated own PLC - programmable logic controller. Hansen, D.H. describe the principle of PLC in following way: “*A PLC operates, in principle, in the same way as a PC. This means that a PLC must programmed in order for it to perform its tasks*” [9]. For easier way in collection of data manually there is an option as digital form. It is common to use digital forms to collect data using quizzes and various surveys. Therefore, the use of digital forms is more widespread in areas:

- Marketing.
- Research agencies.
- Conference venue.

In the field of logistics and especially at micrologistics, the principle of data collection is the same, but the data will be different. Exact definition of micrologistics according Straka, M. is that: “*micrologistics it is possible to understand distinctive logistics at the level of an industrial concern or another company, the elements of which are the basic and supporting subsystems of the*

USE OF DIGITAL TOOLS IN LOGISTIC AND PRODUCTION FACILITY MANAGEMENT FOR EFFECTIVE INFORMATION FLOW

Peter Ignácz

business” [10]. If we are considering collecting the data needed for logistics, then we can focus on all parts of the internal logistics of the company. Above all, however:

- Material receipt in small plants.
- Order material from production lines.
- Records of material picking.

When we speak about manufacturing, it was described by Todd, R.H, Allen, R,H, and Alting, L. as: “an interdisciplinary activity” [11]. In the area of production, the application is interesting for collecting data on both regular and irregular activities. In particular, however, for capturing data on inspections carried out on production facilities such as:

- Technical inspection of the machine before start of production.
- Check that the machine is lubricated.
- Check the tightening of screws or nuts.
- Traceability of machine cleaning data.
- Check replacement of seals.

In this case, production is slightly data specific, as the data must be easily traceable. For better understanding, traceability is according Coff, C. and Barling, D. with Korthals, M. and Nielsen, T.: “system refers to how far back or forward the system is able to track and item” [12]. It is very common to find these data about the process and the performed check in the case of delivery of the complaint and its back clarification, eventually finding a corrective solution, to avoid repeating the error and so on. The data collected in electronic forms have a huge advantage over the paper version because they are:

- Permanent.
- Available.
- Traceable.

The application works on the principle of quiz questions, to which one can answer by choosing from the options or by filling in the text box. Entering responses is manual as it visible in Figure 1.

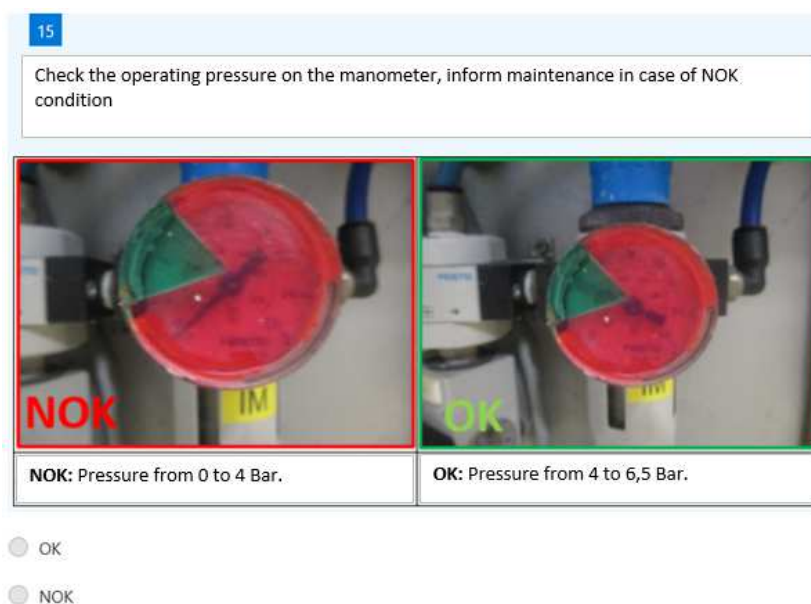


Figure 1 Example of question in forms formular for check the “OK” or “NOT OK” state at facility

Responses or written texts to the application are automatically saved to the collection point, respectively the cloud. Cloud is described by Rajsingh, E.B. and Veerasamy, J. with Alavi A.H. and Peter, J.D. as: “efficient, on-demand, and scalable environment for the benefit of end users” [13]. At the collection point it is possible to view and filter the data eg. using Microsoft Excel. It is possible to display the forms as well as the collection point using both a computer and a mobile phone or tablet.

The electronic form can be opened in 2 ways:

- Click the hyperlink;
- Scanning QR codes.

Firstly is needed to say, what hyperlink or hypertext is. Mcknight, C. and Dillon, A. with Richardson, J. wrote that: “simply stated, hypertext consist of nodes (or ‘chunks’) of information and links between them” [14]. Clicking a link can be used primarily in areas where computer access is possible, otherwise a mobile phone or tablet can open the form. After click on the link, you will be automatically connect to the electronic form.

Use of the QR code is possible in areas where the computer is not stable, or if the purpose of the form is to force a person who has scanned the QR code to confirm that he has personally visited and checked the site. This indisputable advantage is not offered by the paper form of

USE OF DIGITAL TOOLS IN LOGISTIC AND PRODUCTION FACILITY MANAGEMENT FOR EFFECTIVE INFORMATION FLOW

Peter Ignáčz

the forms. This creates a new dimension of control in time, but also in place. Authors Szewczyk, R. with Zielinski, C. and Kaliczynska, M. agreed that QR codes: “*may also carry useful information that can be easily read by means of a low-cost camera.*” In industry it can be read by mobile phones, tablets or scanners [15]. The QR code is a two-dimensional barcode developed by the Japanese company Denso-Wave in 1994. The term “QR” comes from the English designation Quick Response, as the code is designed with a view to quick decoding. After scan of QR code there can be automatic connection for specific digital form - checklist with quiz questions for control of process quality for example as it visible at Figure 2. Advantage is that there is possibility to set also information flow for specific email addresses. For example, for all “OK” replies it has just informative character, but in case of “NOK” reply digital form can show additive questions and after

fullfill of form specific informations can be send to specific email addresses. Example is shown at Figure 3.

Everything is designed to make it easier for people to work. Kovács, G. and Kot, S. said that: „*The growing market globalization, increasing global competition*“ [16]. About effectivity of work wrote Hackett, P. that: “*Within most work organizations the task of bringing people to the desired standard of efficiency*“ [17]. It is important for reason to be a competitively due to large amount of competitors. Kotler, P. and Armstrong, G. described it as: “*an advantage over competitors gained by offering consumers greater value than competitors do*” [18]. Effective work must be standard. Pekarčíková, M. with Trebuňa, P. and Kliment, M. wrote about standardization that: “*The goal of standardization is to stabilize processes, thereby improving productivity, quality and efficiency*“ [19].



Figure 2 Representative visualisation of forms at mobile. Author: Ing. Peter Ignáčz

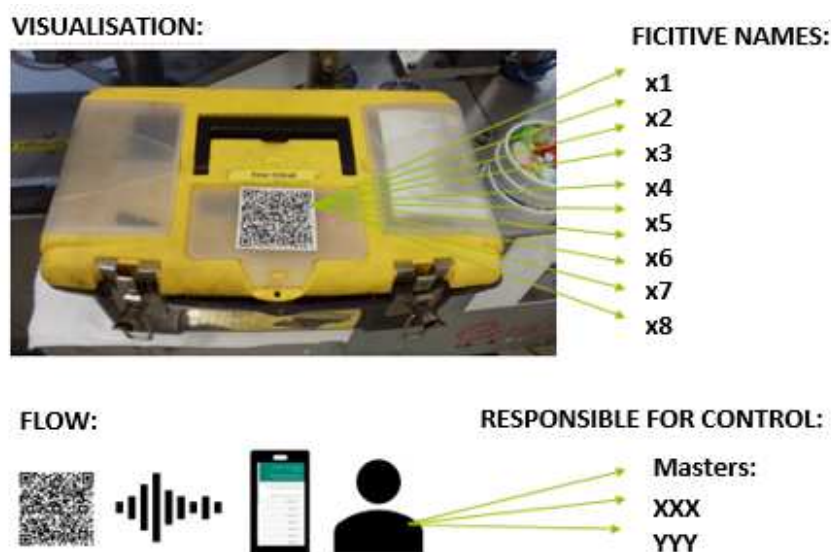


Figure 3 Representative visualisation of forms information flow about tool box cleaning. Author: Peter Ignáčz

USE OF DIGITAL TOOLS IN LOGISTIC AND PRODUCTION FACILITY MANAGEMENT FOR EFFECTIVE INFORMATION FLOW

Peter Ignácz

3 Result and discussion

Data digitization brings with it a great advantage, namely the possible reduction, respectively. the absolute removal of the paper from the production or supply process. According Dimopoulos, G. it means that: *“To become paperless means, essentially, that the traditional paper-based practices such as writing, note-taking, reading, editing, communicating and even drawing are implemented electronically”* [20]. It means that during change of system from manual writing on paper to digital collection of data there need to be as change of system so change of people and their training. Good opinion have Drucker, D.J. and Bruckstein, J.P.: *“To create a truly paperless office, you will need to adopt a paperless mentality”* [21]. From the legislative point of view, however, it is necessary to ensure that there is still traceability of individual processes and their parameters in

case of complaints. In the food industry, these are particularly points CCP – Critical control points. Pierson, M.D. and Corlett jr., D.A. see a CCP as: *“A step in a process at which control can be exercised and a food safety hazard can be minimized”* [22]. In the event of a power failure, computer network failure, or overall application failure through which data is collected and written, it is always necessary to keep paper records of the process.

For a simple example of possible cost saving through digitization of forms and also simple calculation of it, the below table of the necessary forms in paper form is operated by a fictitious company based on change, daily and weekly with irregular usage days. It can have impact on fixed cost which are according Bentley, T.J.: *“any cost which does not change in a direct relationship with output”* [23]. Consider production facilities distributed on two floors:

Table 1 Quantity of paper form documents use at production part - A

Per shift:							
Machine:	Document	Pcs/machine	Nb of machines	Pcs/Shift	Pcs / Day		
Banding machines	register of control	1	3	3	9		
	acceptance protocol	1	3	3	9		
Welding machine	temperature control protocol	1	1	1	3		
					TOTAL	21	pcs of paper per shift
Daily:							
-	Paper form of sampling			1	1		
					22	pcs per day - ground floor:	
Irregular							
Weekly:							
-	Paper form production startup	1			1	approx. 3 per week	
					150	pcs per 50 workweeks	

Formula for calculation (1):

$$Pcs\ of\ paper\ per\ day \times Days\ in\ workweek \times Workweeks\ per\ year + Pcs\ of\ irregular\ paper\ forms\ per\ yer = Total\ quantity\ of\ used\ paper \quad (1)$$

Table 2 Total quantity of used paper at production part - A

Pcs of paper per day	22	
Days in workweek	5	
Workweeks per year	50	
Pcs of irregular paper forms per year	150	
TOTAL	5650	pcs of paper per year

Analysis of the quantity of paper forms used in the production part - B of the fictitious operation.

USE OF DIGITAL TOOLS IN LOGISTIC AND PRODUCTION FACILITY MANAGEMENT FOR EFFECTIVE INFORMATION FLOW

Peter Ignácz

Table 3 Quantity of paper form documents use at production part - B

Per shift:						
Machine:	Document	Pcs/machine	Nb of machines	Pcs/Shift	Pcs / Day	
Fillers	shift report	1	6	6	18	
IMIG	shift report	1	1	1	3	
	register of control	1	1	1	3	
PO-CLIP	register of control	1	1	1	3	
	Paper form of sampling	1	1	1	3	
THU	report	1	1	1	3	
Grinders	report	1	1	3	9	
Graphs	viscosity	2	1	2	6	
TOTAL					48	pcs of paper per shift
Daily:						
-	CCP graphs				3	
					51	pcs per day - first floor:
Irregular						
Weekly:						
-	Paper form production startup	1	12	1	2	approx. 12 pcs / week
TOTAL					600	pcs per 50 workweeks

Formula for calculation (2):

$$Pcs\ of\ paper\ per\ day \times Days\ in\ workweek \times Workweeks\ per\ year + Pcs\ of\ irregular\ paper\ forms\ per\ yer = Total\ quantity\ of\ used\ paper \quad (2)$$

Table 4 Total quantity of used paper at production part - B

Pcs of paper per day	51	
Days in workweek	5	
Workweeks per year	50	
Pcs of irregular paper forms per year	600	
TOTAL		13350
		pcs of paper per year

Calculation of savings by reduction of paper forms (3):

$$\begin{aligned} & Total\ quantity\ production\ part\ (A) + \\ & Total\ quantity\ production\ part\ (B) = \\ & \quad \quad \quad Total\ quantity \quad (3) \\ & 5650\ pcs + 13\ 350\ pcs \\ & \quad \quad \quad = 19\ 000\ pcs\ of\ paper\ per\ year \end{aligned}$$

For a unit price of EUR 0.06 per 1 piece of paper. The price also includes the cost of operating the printer (toner and energy). Representative calculation of the final form digitization savings per year:

$$19\ 000\ pcs \times 0,06\ EUR = 1140\ EUR.$$

4 Conclusions

By digitizing data, it is ultimately possible to save financial resources that are tied to paper and the costs associated with operating the printer. This is also visible by calculating the paper that has been saved in a fictitious operation. With an average paper consumption of 19,000 pieces per year in the production process, this allowed a potential saving of 1140 €. If we looked at the company as a whole and not just the production part, this would be even

higher. It should be noted that the amount of paper is multiplying in operations where 2 or 3 work changes are being made. This change brings higher demands on the computer skills of people who will come into contact with e-forms and also manage the system. Training personnel to operate and work with these tools is therefore one of the key factors for successful implementation.

The number of forms created for each company is unlimited, as is their form. There are several possibilities of access to forms or other digital documents and it is necessary to set them according to the actual conditions of the workplace and the job description of the worker. It is also possible to open documents by clicking on the hyperlink or by scanning a QR code, which can force the worker to visit the site. However, digitized forms and documents carry another huge advantage, and that is traceability. The data is stored as a virtual storage - cloud, from where it can be accessed from any location and device, and is always fully accessible. There is no need to physically go to the archive if we need to locate the device a month ago at a specific time. These things can be very helpful, for example, in clarifying complaints. Today, these solutions are implemented in many organizations, but not every organization uses the tools in this suite to reduce its

USE OF DIGITAL TOOLS IN LOGISTIC AND PRODUCTION FACILITY MANAGEMENT FOR EFFECTIVE INFORMATION FLOW

Peter Ignácz

fixed costs. The use of instruments is wide-ranging and this article pointed to only one option.

Most companies do this improvements for reason of competitiveness. For large corporations, as well as smaller businesses, it is important to remain competitive. Data digitization is one of the steps to achieve this.

Acknowledgement

The submitted work is a part of the project VEGA 1/0317/19, "Research and development of new smart solutions based on principles of the Industry 4.0, logistics, 3D modelling and simulation for production streamline in the mining and building industry", funded by the Scientific Grant Agency of the Ministry of Education, science, research and sport of the Slovak Republic and the Slovak Academy of Sciences.

References

- [1] JARVIS, A., MORALES, L., JOSE, J.: *Quality Experience Telemetry. How to Effectively Use Telemetry for Improved Customer Success*, Milwaukee, ASQ Quality Press, 2018.
- [2] CORREA DA SILVA, F.S., AGUSTI-CULLELL, J.: *Information Flow and Knowledge Sharing*, Amsterdam, Elsevier, 2008.
- [3] VAN EIJCK, J., VISSER, A.: *Logic and Information Flow*, Cambridge, The MIT Press, 1994.
- [4] OLAH, J., SADAF, R., MATE, D., Popp, J.: The influence of the management success factors of logistics service providers on firms' competitiveness, *Polish Journal of Management Studies*, Vol. 17, No. 1, pp. 175-193, 2018. doi:10.17512/pjms.2018.17.1.15
- [5] WELLER, S.C., ROMNEY, A. K.: *Systematic Data Collection*, London, SAGE Publications Ltd., 1988.
- [6] GREVE, D., STRAND, L.: *Microsoft Office 365: Exchange Online Implementation and Migration*, Birmingham, Packt Publishing Ltd, 2012.
- [7] STACK, F.C., MARMOR, M., JACKSON, L.L.: *Electronic Forms Systems Analysis and Design*, Washington, IRM Reference Center, 1993.
- [8] O'DAY, J.: *Accident Data Quality*, Washington, National Academy Press, 1993.
- [9] HANSEN, D.H.: *Programmable Logic Controllers, A Practical Approach To IEC 61131-3 Using Codesys*, Chichester, John Wiley & Sons, Ltd., 2015.
- [10] STRAKA, M.: *Distribution and Supply Logistics*, Cambridge Scholars Publishing, Newcastle upon Tyne, 2019.
- [11] TODD, R.H., ALLEN, D.K., ALTING, L.: *Fundamental Principles of Manufacturing Processes*, New York, Industrial Press Inc., 1994.
- [12] COFF, CH., BARLING, D., KORTHALS, M., NIELSEN, T.: *Ethical Traceability and Communicating Food*, Springer Science + Business Media B.V., 2008.
- [13] RAJSINGH, E.B., VEERASAMY, J., ALAVI, A.H., PETER, J.D.: *Advances in Big Data and Cloud Computing*, Singapore, Springer Nature Singapore Pte Ltd., 2018.
- [14] MCKNIGHT, C., DILLON, A., RICHARDSON, J.: *Hypertext in context*, Cambridge, Cambridge University Press, 1991.
- [15] SZEWCZYK, R., ZIELINSKY, C., KALICZYNSKA, M.: *Progress in Automation Robotics and Measuring Techniques*, Volume 2 Robotics, Switzerland, Springer International Publishing Switzerland, 2015.
- [16] KOVACS, G., KOT, S. New logistics and production trends as the effect of global economy changes, *Polish Journal of Management Studies*, Vol. 14, No. 2, pp. 115-126, 2016. doi:10.17512/pjms.2016.14.2.11
- [17] HACKETT, P.: *Introduction to training*, Trowbridge, The Cromwell Press, 1997.
- [18] KOTLER, P., ARMSTRONG, G.: *Principles of marketing*, New Jersey, Pearson Education, Inc., 2010.
- [19] PEKARČIKOVÁ, M., TREBUŇA, P., KLIMENT, M.: Digitalization effects on the usability of lean tools, *Acta logistica*, Vol. 6, No. 1, pp. 9-13, 2019. doi:10.22306/al.v6i1.112
- [20] DIMOPOULOS, G.: *Paperless Joy, Paperless Business & Lifestyle Design with Information and Communication Technology*, Baltimore, Digital Life Artist Inc, 2008.
- [21] DRUCKER, D.J., BRUCKENSTEIN, J.P.: *Virtual-Office Tools for a High-Margin Practitce*, New York, Bloomberg Press, 2002.
- [22] PIERSON, M.D., CORLETT, JR., D.A.: *HACCP, Principles and Applications*, New York, Chapman & Hall, 1992.
- [23] BENTLEY, T.J.: *Making Cost Control Work*, London, The Macmillan Press LTD, 1978.

Review process

Single-blind peer review process.