COLLECTORS OF DATA: AN ANALYSIS ON THE EXISTENT SOLUTIONS IN THE MARKET

Fernando Aparecido Pacheco da Silva Fortunato, fapsf@ig.com.br
Elesandro Antonio Baptista, elesandro@elesandroab.eng.br
Universidade Nove de Julho, address for correspondence, Avenida Francisco Matarazzo, 612 – 1º Andar – Prédio C – Água Branca – São Paulo – SP.

Nivaldo Lemos Coppini, ncoppini@uninove.com.br
Universidade Nove de Julho, address for correspondence, Avenida Francisco Matarazzo, 612 – 1º Andar – Prédio C – Água Branca – São Paulo – SP.

Abstract. *In the enterprises there is a great demand for informations that they make possible to minimize the costs of production without altering the quality standards, guaranteeing so the survival of the corporations and the competitiveness of his products in the market. Therefore, the organizations look constantly to optimize his productive systems, but to indicate and to value which the stages of the process need to be perfected a lifting information is necessary, with the objective to be careless and to supply reliability to this task there were developed computerized tools known like collectors of data. These tools have the assistant's function in the management of the productive system, providing solid ways to secure the productivity and quality helping in the identification or reduction of losses, costs and terms. At present there are countless types and collectors' models of data, with characteristics you specify each one, these appliances can be connected to several equipments and / or machines he was seeing end or net wireless, providing a complete database manages it with all the informations of the process. Unfortunately the use of the collectors of data is not even very much spread, perhaps for the costs of introduction and maintenance of the equipments or for lack of knowledge on these tools of support the decision, therefore this article has the objective to present the collectors' principal types of existent data in the market, detaching his characteristics and functionalities more relevant, so that the reader has a clear vision on the importance of the subject.*

Keywords*: collectors of data, reduction of costs, monitoring of the production, automation.*

1. INTRODUCTION

Organizations are becoming more competitive and open to opportunities for improvement of their production systems (Junior and Lima, 2009). But, to succeed in the optimization process, engineers and other responsible decision-making, first need to identify the most critical step or operation of the process, i.e. the most variable generates costs (Vieira Vieira and Martins, 2009). This is possible, through the removal of information of the production system, in which company employees fill out documents (spreadsheets), with process information, however, this task is error-prone in filling and generates large volumes of waste paper (Belan, Palma and Lima, 2006).

Faced with the difficulty that businesses have in measure and/or quantify their productive resources, and with technological advances in the area of electronics and computer science, the tools were developed to assist in the acquisition of information, then the data collectors. These computerized tools have the function of collecting information in an automated manner, providing reliable data to assist in decision-making (Martins, 2006).

The importance of data collectors is undeniable, but in many companies, the use of sinks is not yet widespread, perhaps by the costs involving the acquisition and maintenance of equipment, or even through lack of dissemination of these tools, so this article is intended to present the main types of data collectors on the market, highlighting their features and more relevant.

2. BACKGROUND

Before discussing the main subject, which is to present the main types of data collectors, first this article will present the fundamental concepts, on the need of data acquisition and the methods of collecting the information.

2.1. The need for information production systems

To understand and solve a problem in production systems trusted information is needed that represent the actual state of the process, one can say that is demand for information began to gain traction with the scientific management. This model was designed by Frederick Winslow Taylor in 1856, in its design, no work should be performed without the prior, there was a study to determine how the work would be implemented, aiming at achieving the maximum potential of development (Campos *et al*., 2005).

Almost in parallel to the Taylorism there appeared the Fordism created by Henry Ford in 1863, his model also was very important, this philosophy brought countless advancements to the productive systems, when characterized

principally by the creation and implementation of the mass production, which made the accessible automobile to the great part of the population (Ippolito, 2009).

Around 1970, amidst the economic downturn and the apex of the oil crisis, the automakers were adopting Toyota production system (Antunes *et al*., 2008). Is philosophy arose after the second world war, was created by company founder Sakichi Toyota and by his son Kiichiro Toyoda, with the support of company executive Toyota engineer Taiichi Ohno, with the goal of making Japanese industry more competitive (Ohno, 1997).

TPS (Toyota Production System) seeks the Elimination of losses and waste and advocates the production of small batches, with high quality, low cost and with the shortest delivery time possible (Shingo, 1996). With the worldwide expansion of TPS, the need for information of productive systems was evidenced after all his philosophy basically proposes to raise profits by eliminating costs (Emiliani, 2006).

According to Sutherland and Bennett (2007), the losses in TPS can be classified into seven groups:

1. *losses by overproduction:* is loss occurs when it produces beyond the amount required or when production is carried out before the time (early production);
2. *losses for transportation:* transport activities are sometimes necessary between workstations, but should be avoided because it does not add value to the product;
3. *losses in processing itself:* is loss is related to unnecessary processing in obtaining products and services, when the ideal is to keep only the essential tasks of the process;
4. *losses by manufacture of defective products:* results in the production of items outside the pre-established standards or specifications causing rework and waste;
5. *stock losses:* occur when product stocks are kept in process or finished after all keep large stockpiles only generate financial loss and loss of market;
6. *standby losses:* is associated with the time periods in which no operation of the process is running, for example, setup time machines, maintenance, and others;
7. *losses by moving:* occur when operators perform unnecessary movements during production, this generates an increase in the time of operations and higher manufacturing costs;

To eliminate or minimize the losses submitted first is critical to identify the operations or process steps which present problems, for which the responsible staff perform improvement actions. This diagnostic occurs with the removal of information from production systems, in the sequence will be presented the methods used for data collection.

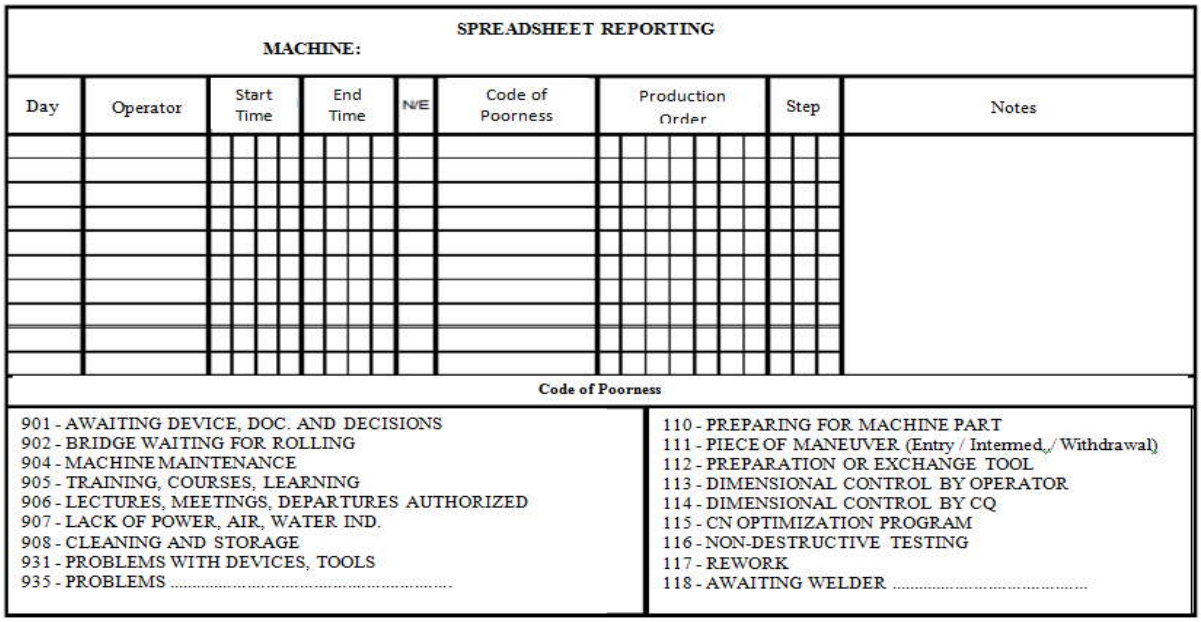
2.2. Methods used for data collection

The survey of information production systems is also known as "pointing of production" or "data collection", the goal of this survey is to provide information about the production systems, allowing the personnel responsible, an accurate view on the situation of the resources employed in the process, facilitating in decision-making (Favaretto, 2002).

According to Marçola and Andrade (2009), collecting data can be classified into two groups: manual and automatic.

a) *Manual collection:* is performed by employees of the company, which inspect a particular group of information during the periods varied during off-hours, such information is filled in spreadsheets or pointing at terminals typed collection. Manual collection is divided into three categories:

   - *centralized manual:* companies that adopt the centralized collection maintains a central direction. When an operation must be performed, the operators inform a central employee registers the process information, for example: time of beginning and end of operations, quantities produced and quantities of waste substances, stops for maintenance and other;
   - *manual with the aid of computers:* this collection method uses terminals installed in strategic locations of the factory floor, i.e. at the start of the operation the operator is directed to a terminal and type collection, process information, for example, the operator name, start time, the description of the operation and others. The same occurs when the operation is terminated, or in the case of events that impair productivity (stops for maintenance, lack of energy and others). All information entered in the terminals are sent to a computer (central database) via network or RS-232 Protocol.
   - *manual written:* this collection category, the operators themselves are responsible for registering process information in spreadsheets pointing (Fig. 1). Which are delivered after a certain period of time to charge or industry responsible for the occurrence of the data analysis.



SPREADSHEET REPORTING

MACHINE:

Day	Operator	Start Time	End Time	N/E	Code of Poorness	Production Order	Step	Notes

Code of Poorness

901 - AWAITING DEVICE, DOC. AND DECISIONS	110 - PREPARING FOR MACHINE PART
902 - BRIDGE WAITING FOR ROLLING	111 - PIECE OF MANEUVER (Entry / Intermed. / Withdrawal)
904 - MACHINE MAINTENANCE	112 - PREPARATION OR EXCHANGE TOOL
905 - TRAINING, COURSES, LEARNING	113 - DIMENSIONAL CONTROL BY OPERATOR
906 - LECTURES, MEETINGS, DEPARTURES AUTHORIZED	114 - DIMENSIONAL CONTROL BY CQ
907 - LACK OF POWER, AIR, WATER IND.	115 - CN OPTIMIZATION PROGRAM
908 - CLEANING AND STORAGE	116 - NON-DESTRUCTIVE TESTING
931 - PROBLEMS WITH DEVICES, TOOLS	117 - REWORK
935 - PROBLEMS	118 - AWAITING WELDER .....

Figure 1. Spreadsheet for note of hours (Fonseca, 2006).

b) *Automatic collection:* executes the removal of information of the production system, with the aid of electronic and computerized equipment. This method is classified into two categories:

- *semi-automatic:* is performed by employees of the company with the help of an electronic data collector. This collection, the information is recorded by typing or reading of bar codes. The data obtained in inspection are stored in memory on the appliance, and are later transferred to a PC via cable or Wi-Fi (Wireless Fidelity). This method of collecting is very used in conducting inventories and inventory control;
- *fully automatic:* this collection type is also known as "sensoriada collection" or "real-time" collection, its operation does not require human intervention, because the data acquisition process occurs through sensors and control devices, installed in the location of the operation, with the purpose to monitor and record events in the process, this information is sent to a data collector, which passes the content purchased via cable or wireless network to a central database, giving management a solid, reliable, and up-to-date in real time. This method is applied in production lines with a high level of organization and automation, for example, robotic assembly lines, manufacturing cells and other CNC machines with equivalent level.

2.3. Data collectors

For a long time, collecting data on the production system was performed with the manual fill of printed sheets, with the spread and popularization of information technology, the task of collecting went on to have the aid of computers connected to the network, but both methods are subject to errors that occur in fill or typing the information (Belan, Palma and Lima, 2006).

Faced with the situation presented, portable computerized equipment and data collector called, with the goal of automating the acquisition of information, i.e. assist in the acquisition and management of data, which after collected are transferred to computers for analysis and reporting (Silva *et al*., 2009).

There are on the market numerous types of data collectors, each equipment has particularities which determine the location of your application, therefore, in the sequence as part of the proposed goal, this article will introduce key data collector equipment existing on the market, highlighting their features and more relevant.

3. METHODOLOGY

This article made a conceptual theoretical development approach of exploratory objective (Gil, 2002). Searches were carried out in national and international databases, in order to find jobs related to the main subject of this article. Were also carried out visits to the websites of the manufacturers of data collectors, where it was possible to consult their technical specifications, applications, and numerous other information about these equipments.

4. TYPES OF DATA COLLECTORS

4.1. The PLC acting as a data collector

The Programmable logic controller more known by the acronym "PLC" is electronic equipment with central processing, entries and exits (Soares, 2009). The PLC's are widely used in automation of industrial processes, by open to trigger actions systems and control, its operation is to capture signals from proximity, Keychain, buttons (start/stop) and signs of voltage or electric current (Boaretto *et al*., 2005).

The electrical signals are processed by a central processing, composed of a processor and a memory system that is responsible for performing timing, arithmetic operations, counting, and logic. In the outputs selected equipment are installed according to the necessity of process or operation, can cite as an example, light bulbs, sirens, solenoid valves, motors and others (Da'na *et al*., 2008). The Fig. 2 is an example of PLC.

Figure 2. Example of a PLC (Festo, 2010).

4.2. The microcontrollers acting on data collection

Microcontrollers are integrated circuits (CI's), these electronic components have memory and processing power, your goal is to control functions and actions of hardware. Each microcontroller is composed of a CPU (central processing unit), memories (RAM, ROM and EPROM) and input and output ports, there are numerous types of microcontrollers, each family possess distinct characteristics that must be carefully studied in the project stage (Ab-Rahman, Premadi & Jumari, 2008).

The microcontrollers are widely used by permit Automation efficiently, portable and low-cost (Avdikos *et al*., 2005). Such features are interesting for monitoring equipment and data collection. Microcontroller-based solutions are composed of electronic boards, LEDs, buttons, LCD, CI, socket for the accommodation of the CI, PIN to receive signals from sensors and other outputs that provide an interface with microcomputers (Kwakye and Baeumner, 2007). In addition to design and build the hardware, it is also necessary to program it, this can be accomplished with a variety of programming languages, for example, Assembly, C++, and other (Avdikos *et al*., 2005).

Figure (3) is a prototype of data collector based on a microcontroller, designed to operate in industrial environment, collecting information about the type of machinery used and the start and end times of operations (Leandro *et al*., 2006).

Figure 3. Prototype data collector based on a microcontroller (Leandro *et al*., 2006).

4.3. Data collectors used in collecting semi-automatic

The data collectors used in semi-automatic collection are computerized and electronic devices, which stand out for being mobile, portable, robust and accurate in data acquisition (Silva *et al*., 2009).

Its architecture is composed of a processor, flash memory, RAM, operating system, display, keyboard and bar code reader. These data collectors have a HMI (human machine interface) accessible and intuitive, which seeks to facilitate the work of collecting, generating a significant gain in time and a satisfactory reduction of costs with the training of personnel (Honeywell, 2010). Fig 4 presents an example of equipment used in semi-automatic collection.

Figure 4. Data collector used in semi-automatic collection (Honeywell, 2010).

Data collection with this type of equipment flows through the reading of bar codes or via keyboard (Honeywell, 2010). The method more efficiently uses the reading of bar codes (Silva *et al*., 2009), generated by special software and printed on labels or packaging (Lima, Palma and Neri, 2005). Reading occurs when an employee places the player in front of the bar code, the information is stored in memory of the equipment or sent via cable or wireless management computers. Another method of data acquisition occurs via keyboard, where the employee observes the process and record the corresponding information in the appliance (Honeywell, 2010).

There are several applications for these types of collectors, but generally speaking, all undertakings may use it in the preparation of inventories or logistical, monitoring and control in order to ensure the reliability and accuracy of the information about enterprise resources (Becker *et al*., 2007). Fig. 5 presents a vehicular data collector (built in a vehicle), allowing the operator to acquire information about the product in stock.

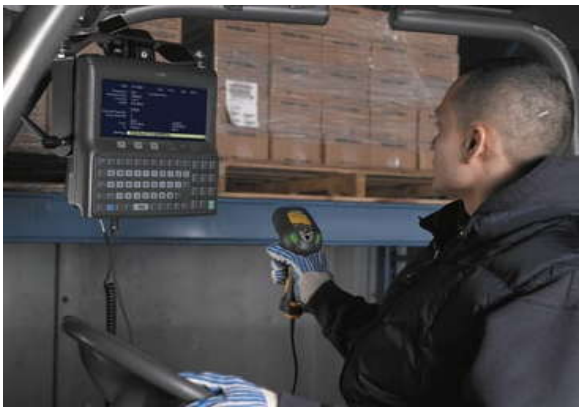


Figure 5. Embedded data collector on a vehicle (Marcamp, 2006).

4.4. Data collectors used in fully automatic collection

Automatic data collection uses solutions developed to serve on the collecting and monitoring processes, to provide reliable information about the productive resources in real time, in order to ensure productivity and avoid losses (Subramaniam *et al*., 2009). Fig. 6 is an example of data collector used in fully automatic collection.

Figure 6. Example of an Automated Data Collector (Directa Automação, 2010).

These collectors are installed in the location of the process or operation, therefore, its architecture was designed to withstand the severe conditions (Directa Automação, 2010). In this case, acquisition of information can occur with the use of sensors or by capturing electrical signals, which are issued by the numerical control machine (Subramaniam *et al*., 2009). Fig.7 represents the operation of automatic collection.

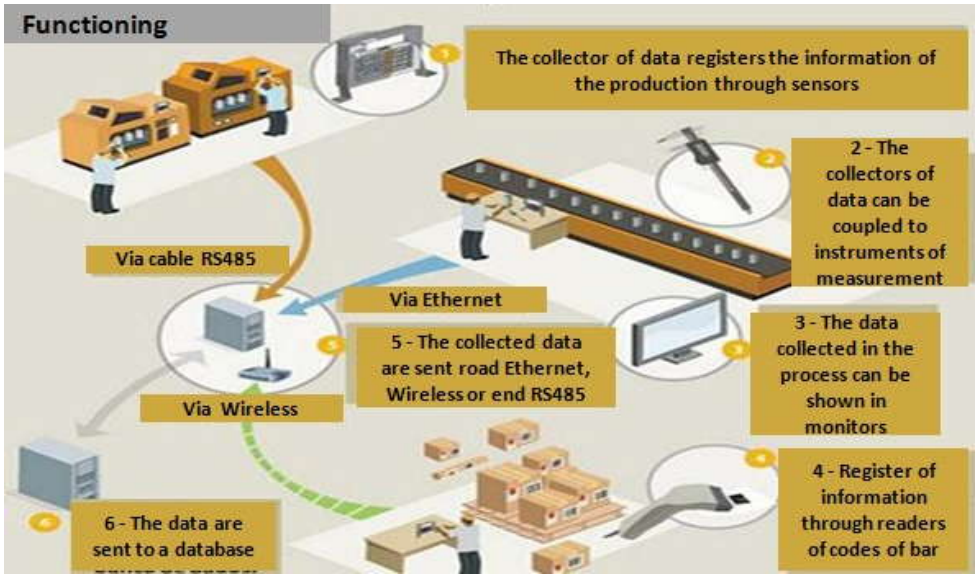


Figure 7. Operation of automatic data collection (adapted from Directa Automação, 2010).

In Fig. 7 it is possible to notice, that collectors can be installed on every workstation, including measuring instruments, stock control, monitors for status monitoring and other resources. All information collected is sent to a server that stores and makes available the contents of the database to the management, can be observed that the communication method between the collectors and the server is the most diverse possible, and can occur via RS485 cable, wireless and ethernet network (Directa Automação, 2010).

4.5. PDAs acting as data collectors

PDAs (Personal Digital Assistants) are portable computers popularly known as pocket computers with the ability to run software, process information and access the internet (Mustafa, Yazid & Aezwani, 2007). With the great technological diffusion this equipment became affordable, so many companies began to use this small and powerful computer in collecting information from its systems (Neumann, 2007).

Data collection with PDA is accomplished by typing information in the display of the appliance, these data are entered in text editors or in other similar programs, which after being saved are stored in memory of the equipment or are sent to other computers via wireless network (Lidak, Rebelato and 2006). Fig.8 gives an example of the PDA.

Figure 8. Example of a PDA (Hewlett-Packard, 2010).

4.6. The terminals for data collection

This data collection, the operators enter the process information collection Terminal, this operation can occur through reading bar codes or by typing (Belan *et al*., 2006). Fig. 9 presents a data collection terminal.

Figure 9. Terminal for data collection (Mondini, 2002).

The information entered in the terminals are sent to a computer via RS-232 cable or network, for feeding a database (Mondini, 2002). Fig. 10 demonstrates a series of collector terminals connected to a microcomputer.

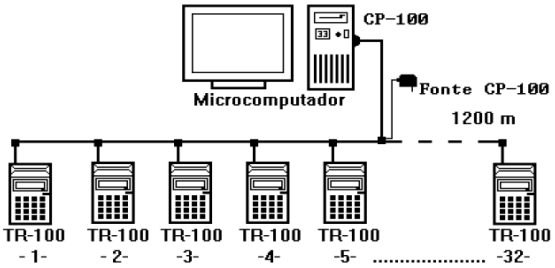


Figure 10. Collection terminals connected to a microcomputer (Mondini, 2002).

4.7. The mobile data collector the acting

Mobile phones are increasingly present in people's lives, these apparatus which initially were used only to make and receive calls has evolved rapidly, and today began to add many other features, among them include the ability to run applications especially developed for your platform and the possibility of connection to the internet and other wireless networks (Franke *et al*., 2006).

With the great expansion of mobile telephony and the need for reliable information, processes and operations, made of cellular phones, a low-cost option for monitoring and gathering information to distance (Ozdemir & Karacor, 2006). This type of collection occurs through the typing of data in cell phones, the information is entered in text editors or software installed on the appliance. Then the information is sent to microcomputers or other mobiles via wireless network (Rebelato and Lidak, 2006). Another much used in the transmission of collected data occurs via GSM (Global

System for Mobile Communications). It is important to note that in addition to the acquisition of data, you can also consult the information already sent (Ozdemir & Karacor, 2006). Fig.11 demonstrates the data query via cell phone.

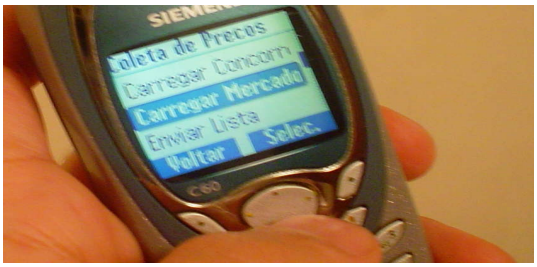


Figure 11. Collecting data via mobile phone (Fazion, 2011).

5. ANALYSIS OF THE RESOURCES

This article presented a solid theoretical base and informative, on the main types of data collectors on the market, highlighting their features and more relevant, in addition to presenting the main methods of data collection processes and operations. To assist in understanding, was drawn up on the Tab.1, with some advantages, disadvantages and application examples of sinks.

Comparison between data collectors			
Collection type	**Advantages**	**Disadvantages**	**Examples of applications**
PLC	- Increased reliability and agility in gathering information; - no human contact for data collection;	- Cost of acquisition and deployment of equipment.	- CNC (Computer Numerical Control) machines, recommended for production lines in large quantities.
Microcontroller	- Increased reliability and agility in gathering information; - Low construction cost; - portable equipment.	- Low data transmission rate.	- CNC, conventional machines, production lines, small applications and etc.
Collector semi-automatic	-Greater reliability and agility in information gathering; -are resistant; -are mobile.	- Cost of acquisition of equipment.	- Inventory control, inventory and fulfillment etc.
Collectors fully automatic	- Increased reliability and agility in gathering information; - No human contact for data collection.	- The purchase cost of equipment; -requires a high level of organization of the production floor.	- CNC Machines, robotic assembly lines and etc.
PDAs	- Increased reliability and agility in gathering information; - are mobile; - are multifunctional.	- Acquisition cost of equipment; - possible problems with impedance to send and receive information.	- CNC, conventional machines, production lines, small applications and etc.
Collection terminals	-Greater reliability and agility in information gathering; -reduces the chance of errors with the use of bar code readers.	- Cost of acquisition and maintenance of equipment.	- Floor-to-factory terminals positioned at strategic locations.

Mobile phones	- Greater reliability and agility in information gathering; - are mobile; - low cost of acquisition; - use wireless networks; - are multifunctional.	- Possible problems with impedance to send and receive information; -costs of the GSM network.	- CNC, conventional machines, production lines, small applications and etc.

(1) : comparison between the data collectors

5. FINAL CONSIDERATIONS

The great demand for information production systems arose with the scientific management and gained strength in the Ford, but gained notoriety with the rise of the Toyota production system, whose philosophy advocates the total elimination of losses and waste. But to identify or eliminate a loss, information is needed to help managers in decision-making. This data collection began with the completion of manual pointing spreadsheets, with technological advances and many studies by researchers in the field, there were new methods that optimized the removal of information.

Arise then the data collectors, these portable equipment and computerized aim to automate the acquisition of information. On the market there are numerous solutions for data collection, but each equipment has particularities which determine the location of your application, on the relevance of the subject, this article has presented the main data collector types found in the market, demonstrating its features, functionality and applications, so that readers are aware of the existence and importance of these tools to support decision-making, that assist in collecting, monitoring and optimization of processes and operations.

A limitation found during the writing of this article was the lack of content addressing exclusively the subject "data collector", what motivated even more performing this search. As a suggestion for future work, the authors propose the project of a data collector, which perform the optimization calculations with the data collected

6. REFERENCES

Ab-Rahman, M.S., Premadi, A. and Jumari, K., 2008, “Remote Monitor and Control Based Access Control System Using PIC”. IJCSNS – International Journal of Compute Science And Networks Security, VOL. 8, N.° 11.

Antunes, J., Alvarez, R., Pellegrin, I., Klippel, M. and Bortolotto, P., 2008, Sistemas de Produção – Conceitos e Práticas Para Projeto e Gestão da Produção Enxuta. Porto Alegre, Editora Bookman.

Avdikos, E.M., Prodromidis, M.I. and Efstathiou, C.E., 2005, “Construction and Analytical Applications of a Palm-Sized Microcontroller-Based Amperometric Analyzer”. Sensors and Actuators, Science Direct, pp. 372-378.

Becker, M., Sayyed, G., Wenning, B. -L. and Görg, C., 2007, “On Mobile Agents For Autonomous Logistics: an Analysis of Mobile Agents Considering The Fan Out and Sundry Strategies”. International Journal of Services Operations And Informatics.

Belan, H.C., Palma, J.G. and Lima, R.H., 2006, “Análise da Implementação de um Sistema de Execução da Manufatura”. XIII SIMPEP – Simpósio de Engenharia de Produção. Bauru – SP.

Boaretto, N., Bernardo, J.I., Reis, D.R. dos. and Scandelari, L., 2005, “Inovação em Processo e Produto: Um Estudo de Caso da Produção em Aviários de Postura”. XXV ENEGEP – Encontro Nacional de Engenharia de Produção. Porto Alegre – RS.

Campos, R.C., Ferreira, A.S., Machado, A.O. and Rodrigues, J.S., 2005, “Estudo da Mudança da Organização do Trabalho Implantada em um Setor Produtivo de uma Empresa”. XII SIMPEP – Simpósio de Engenharia de Produção. Bauru – SP.

Da’na, S., Sagahyroon, A., Elrayes, A., Al-Ali, A.R. and Al-Aydi, R., 2008, “Development of a Monitoring And Control Platform For PLC-Based Applications”. Computer Standards & Interfaces, Elsevier, Science Direct, pp. 157-166.

Directa Automação, 2010, “Equipamentos”. Available: <http://www.directaautomacao.com.br/equipamentos.aspx>. Acessed: 04 sep. 2010.

Directa Automação, 2010, “Equipamentos Ethernet”. Available: < http://www.directaautomacao.com.br/equip_ethernet.aspx>. Acessed: 04 sep. 2010.

Emiliani, M.L., 2006, “Origins of Lean Management in America – The Role of Connecticut Businesses”. Journal of Management History, Emerald Group Publishing Limited, Vol.12, No. 2, pp. 167-184.

Favaretto, F., 2002, “Considerações Sobre o Apontamento da Produção”. XXII ENEGEP – Encontro Nacional de Engenharia de Produção. Curitiba – PR.

Fazion. Produto_Coletor_Dados_2.JPG., 2006. Height: 843 pixels. Width: 552 pixels. ISO-8859-1. 223,42kb. Format jpeg. Compressesd. Available: <http://www.fazion.com.br/uploaded/Image/Fazion/produto_coletor_dados_2.JPG>. Acessed: 01 set. 2010.

Festo, 2010, "Inovações 2010". Available: < http://www.festo.com/net/SupportPortal/Downloads/17335/Innovaciones2010_BR.pdf>. Acessed: 03 sep. 2010.

Fonseca, E.C. da, 2006, "A Avaliação dos Tempos e Custos Improdutivos em usinagem Pesada". Dissertação de Mestrado em Engenharia de Produção – Escola Federal de Engenharia de Itajubá. Itajubá – MG.

Franke, C., Basdere, B., Ciupek, M. and Seliger, S., 2006, "Remanufacturing of Mobile Phones — Capacity, Program And Facility Adaptation Planning". Omega, The International Journal of Management Science, Science Direct, pp. 562-570.

Gil, A.C., 2004, "Como Elaborar Projetos de Pesquisa". São Paulo, Editora Atlas – 4ª Edição.

Hewlett-Packard, 2010, "HP iPAQ 114 Classic Handheld". Available: < http://h20195.www2.hp.com/v2/GetPDF.aspx/4AA2-5406PTL.pdf>. Acessed: 05 sep. 2010.

Honeywell, 2010, "Dolphin 7850". Available: < http://www.honeywellaidc.com/CatalogDocuments/Dolphin7850_DS_RevD_EN.pdf>. Acessed: 03 sep. 2010.

Ippolito, A., 2009, "Creating Value in Multiple Cooperative Relationships". International Journal of Quality and Service Sciences. Emerald Group Publishing Limited, Vol.1, No. 3, pp. 255-270.

Junior, J.J. and Lima, P.C., 2009, Análise da Aplicação do Sistema Andon em Diferentes Ambientes de Montagem. Revista INGEPRO – Inovação, Gestão e Produção, Vol. 1, N. 2, ISSN 1984 - 6193.

Kwakye, S. and Baeumner, A., 2007, "An Embedded System For Portable Electrochemical Detection". Sensors and Actuators B, Chemical, Elsevier, Science Direct, pp. 336-343.

Leandro, G.V., Lenz, E.P., Batista, G. R., Salvadori, F., Rech, C. and Campos, M. de., 2006, "Aquisição de Dados de Máquinas Operatrizes em Ambiente industrial". XXV ENEGEP – Encontro Nacional de Engenharia de Produção. Porto Alegre – RS.

Lima, R.H.P., Palma, J.G. and Neri, R.C., 2005, "Sistema de Acompanhamento da Produção no Chão de Fábrica na Indústria Moveleira". II SEGe'T – Simpósio de Excelência em Gestão e Tecnologia. Resende – RJ.

Marcamp. 32.JPG., 2006. Height: 400 pixels. Width: 300 pixels. ISO-8859-1. 38,34kb. Format jpeg. Compressed. Available: <http://www.marcamp.com.br/produtos/imagens/32.jpg>. Accessed: 02 set. 2010.

Marçola, A.M. and Andrade, J.H., 2009, "Melhorias no Processo de Apontamento Manual de Mão-de-Obra em Ambientes de Produção Engineer-to-Order – Um Estudo de Caso". XVI SIMPEP – Simpósio de Engenharia de Produção. Botucatu – SP.

Martins, J.E.P., 2006, "Proposta de um Modelo Educacional Para Capacitação em Sistemas de Sensoriamento e Aquisição de Dados, Como uma Ferramenta na Área de Gestão Ambiental". XIII SIMPEP – Simpósio de Engenharia de Produção. Bauru – SP.

Mondini, L.A., 2002, "Software Aplicativo Para Coleta de Dados em Ambientes Críticos". Trabalho de Conclusão de Curso, Curso de Ciências da Computação – Universidade Regional de Blumenau. Blumenau – SC.

Mustafa, M., Yazid, M. and Aezwani, W., 2007, "Smatchecker: Real Time Monitoring And Tracking Student's Class Attendance Using Wireless PDA". Molta – Conference On Mobile Technologies And Applications.

Neumann, P., 2007, "Communication in Industrial Automation – What is Going on?". Control Engineering Practice, Sciense Direct, pp. 1332-1347.

Ohno, T., 1997, "Sistemas de Produção – Além da Produção em Larga Escala". Porto Alegre, Editora Bookman.

Ozdemir, E. and Karacor, M., 2006, "Mobile phone Based SCADA For Industrial Automation". Kocaeli. University, Technical Education Faculty, Electrical Education Department, Turkey.

Rebelato, M.G. and Lidak, G., 2006, "A Transmissão de Dados Sem Fio Aplicada à Coleta de Dados no Chão-de-Fábrica". XXVI ENEGEP – Encontro Nacional de Engenharia de Produção. Fortaleza – CE.

Shingo, S., 1996, "O Sistema Toyota de Produção – Do Ponto de Vista da Engenharia de Produção". Porto Alegre, Editora Bookman.

Silva, L.L. Da, Dias, A.F. and Souza, O.S., 2009, "Sistemas de Produção – Proposta de Integração de Sistemas de Coleta de Dados: Um Estudo de Caso da Toshiba Transmissão e Distribuição do Brasil". Parlatorium – Revista eletrônica da FAMINAS-BH – Faculdade Minas. Belo Horizonte – MG.

Soares, L.C., Medeiros, A.D. de, Protásio, A.D.D. and Bolonhini, E.H., 2005, "Sistema Supervisório para o Método de Elevação Plunger Lift". XXV ENEGEP – Encontro Nacional de Engenharia de Produção. Porto Alegre – RS.

Subramaniam, S.K., Husin, S.H., Singh, R.S.S. and Hamidon, A.H., 2009, "Production Monitoring System For Monitoring The Industrial Shop Floor Performance". International Journal of Systems Applications, Engineering & Development.

Sutherland, J.; Bennett B., 2007, "The Seven Deadly Wastes of Logistics: Applying Toyota Production System Principles to Create Logistics Value". CVCR - Center for Value Chain Research. Lehigh University.

Vieira, A.J.T., Vieira, H.T.T. and Martins, A.A., 2009, "Gestão Integrada Empresarial: Aplicação do Sistema de Informação Gerencial (SIG) Em Uma Micro Empresa da Região de Joinville-SC". XXIX ENEGEP – Encontro Nacional de Engenharia de Produção. Salvador – BA.