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Resolution of Technical Problems on High Production Equipment through the use of Information Technologies Case Study: Plant of plastic products in Honduras

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Abstract:- In this research is discussed the application of information technology to solving technical problems in high production equipment. A case study of a company in the plastics industry located in Hondurasto install a new cutting machine of plastic bags is analyzed, the failures presented, and how using information technologies and collaborative systems the problem was solved. Preliminary results indicate an improvement in the response time and a significant decrease in the cost of technician per diem and the plant downtime cost of opportunity.

Keywords:- High production equipment, problem solving, information technology, plastic products, case study.

I. INTRODUCTION

The sophistication of the new equipment of plastic process has increased productivity to levels that we could not imagine 20 years ago, this need to increase capabilities has emerged as a result of several factors such as: the need to reduce unitary cost of products, to participate in the markets competition for economies of scale, reducing quality errors caused by humans, the decline of the social charges for excess of staff and development of more specializedmanufactured products with new raw materials to meet the requirements of customers. This sophistication has also generated some problems, having its origin in the difficulty of keeping to the technological vanguard in the resolution of technical problems and failures of equipment. In this sense,according to (Rivas, Zubieta and Garcini, 2002) the systems of detection and automatic fault diagnosis have much importance since there is a growing demand at the international level of systems that provide a high level of reliability and critical safety. These systems can include not only the aerospace, nuclear andchemicalindustries but also to systems in a variety of industries including automotive, health and plastics among others.

The industrial plants had been modernized with new machines manufactured in developed countries, which are installed in environments where the working conditions and energy inputs (energy supplied by the national companyor local supplier of electric energy) are of high quality, conditions that are not commonly found in developing countries (i.e.: Latin America), and given the external conditions of the environment failures in operating systems difficult to resolve.

This document is part of the implementation of good practices and aims to present an approachto howinformation technologies have been a key element for the resolution of technical problems in companies in the plastics industry, we present a case study in a company of thisindustrylocated in the city of Tegucigalpa, Honduras that has applied these technologies to the installationand diagnostics of a cutter equipment of plastic bags. The objective of this research is demonstratinghowthe use of information technologies can be easy the installation and diagnosis of high production equipment, and in the case of failure the acceleration of respective corrective maintenance. The innovative nature of this research resides in the fact that there are few documented cases of the resolution of problems in the detection and diagnosis in real time, through the use of information technologies, in the industry of plastic products.

1.1. - Resolution of technical problems of high production equipment through the use of IT

In the decade of the 70's, GarcíaEstartús (1970) discussed the realization of applied research on the plastics industry in order totake full advantage of the information stored in the official and private documentation. In that historic moment application of computing in the production area was very expensive, however,it was perceived that could impact in management techniques and/or within the companies in the industry and it was believed that computers would have a growing use in the field of plastics.

In the 80's the use of computers intensified and many industrial processes were automated not only with PLCs (programmable logic controllers) but also with the assistance of microcomputers. In the 90's was given a process called Networking that not only allowed sharing resources, but also brings the collaborators closer in the organizations and the control of processes on-line via the Internet. At the beginning of the twentieth century the evolution of the technological platforms, allowed that the communications of voice and data, as well as access to the Internet increased, impacting on high speed and broadband wireless platforms, such as cell phones, portable devices and personal computers in environments of wireless networks. According to Laudon and Laudon (2008), thanks to the continuous deregulation of the communications and the accelerated innovation in information technologies, telephone networks and computers converged toward a digital network that uses standards and shared computer based on the Internet.

Currently, information has become one of the most important assets of the organizations, in the context of the industrial systems, the information is involved in the process of monitoring operations and not only allows manager to keep the operator of the plant and the maintenance staff better informed of the status of the processes, but also the attends to take the appropriate corrective actions to remove the abnormal behavior of the processes (Chiang, Braatz and Russell, 2001). This information has been used in the manufacturing sector to perform business intelligence. In this regard, (Harding, Shahbaz, Srinivas and Kusiak, 2006) discusses the data mining application in the engineering of the manufacturing, addressing particular production processes among which are: operations, failure detection, maintenance, decision support and improvement of the quality of the product. More specifically, in the plastics sector (Saurina, 2003; Vargas and Castellanos, 2005) propose monitoring or surveillance technology for the plastics industry with the purpose of identifying trends, opportunities and threats in the industry and generating strategies that allow the innovation.

The computer in the plastic sector has also been used for the simulation of processes, for example in Martinez-Muneta, Juanes-Márquez, Rodriguez-Villagrunto et al. (2012) is analyzedthe use of simulation on injection machines by means of a graphic user interface (GUI) that is operable and programmable by users, which allow them the selection of parameters until obtaining correct parts.

In other order of ideas, in Honduras, as in other developing countries, is necessary tropicalize industrial equipment before putting it into operation (similar status to a football team that travels to another climatic environment or that isat a different altitude to pursue a competition), this includes surge power variations, connecting to aelectric network of other larger equipment to balance the voltage drop of the national system of energy without affecting its operation, and in some cases modifying certain parameters of operation with the support of the information technologies –i.e. track software- to adjust them to the productive needs of the Organization.

1.2. -Problem at hands

The company Interplast S.A. de C.V. (Interplast, 2015) is located in Tegucigalpa, Honduras and produces four types of plastic bags: abag of popular consumption, bag for trade, industrial bag and biodegradable bag. In recent years the local market has been flooded by plastic bags of Asiatic origin and low price, trying to be more competitiveInterplast ownerstook the decision to purchase a new equipment of conversion (cutter) of bag of polyethylene plastic packaging of high speed (230 cycles per minute, with capacity to process 120,000 pounds/month) fromthe company Century-Tech Incorporated (Century-Tech Incorporated, 2015) based on Maspeth, New York, to replace part of the operational equipment of low capacity, with the aim of maintaining competitive advantage and conserved is place as a market leader as regards the speed of product delivery and flexibility of the same.

Fig. 1. Cutting Machine bag of polyethylene plastic packaging used in the industry, Source (Century-Tech Incorporated, 2015)

The structure of processes in the organization is oriented to flexibility, taking advantage of the idiosyncrasy of the Honduran traders and industry, since the company seeks to place orders at the last moment looking for zero inventories. The competence of the plastic bags is done in a mass consumer market economy of scale, so the management costs of manufacture are vital to develop the financial profitability as the ultimate purpose of any strategy (Porter, 2007).

The equipment CT-9400 entered the plant on 23 March 2015 and it was installed by the maintenance and technicalstaff of the company with 25 years of experience, due this fact it was not requested the supervision of a technician of the manufacturer house for traveling with such equipment. Normally this is one of the basic points for the application of the guarantee in high-cost equipment (in this case valued in 150,000 USD), and due this fact it must be installed by a technician of the manufacturer, in this case, this wasobviated given the prior knowledge of installation of other similar equipment.

Once installed the equipment,a technical staff proceeded to perform the basic tests of the operation and the machine worked well during the test day and it was left working on the night shift, however, there was a failure and the security system of the computer stopped the operation.

(a) **(b)**

Fig. 2. (a) Control Panel of the cutter, b) failure reported "Fails in Internal Servo"

Once assessed the possible causes of failure it was determined that one of the servo drives had been burned, and later in subsequent tests are burned the second servo.

II. MATERIALS AND METHODS

The methodology to be employed is own of the company under study, it was supported by the information technologies for the diagnosis and identification of faults, which is used because it has proven its usefulness in practical problem solutions with similar equipment. This methodology is limited to the support given by the supplier of the high production equipment, requires automated equipment with USB port, a computer running in Windows environment and a high-speed Internet connection forthe stage of Remote Diagnosis.

Below is listed the sequence of the procedure applied:

Step1 - Review of the computer's touch screen and reading of the registered fails. Registered fail: failure in the Internal Servo.
Step 2 - Review and verification of all safety sensors on the interior side, which must be disabled, to discard the sensors as cause of the failure.
Step 3 - Review and verification of all safety switches that are turned off, with the goal of scrapping that this is the consequence of the failure.
Step 4 - Review of the Poka Yoke (error-proof mechanism, gears plastics for this particular case) from the inner side to discard that none of this is damaged and identify which is causing the failure.
Step 5 - Review of all the mechanical parts, bushings, motors, bearings, gears, bearing points, bands, and the various settings in the machine.
Step 6 - Review of the electrical portion of the inner side, power supply, fuses, ground, sensors, false contacts, PLC, inverters, servo motors. To rule out the possibility that the above listed is causing the failure.
Step 7 - Verification and analysis of the data of the Emerald (computer of the machine), which records the reading on the Servo Drives.

It was diagnosed, according to Table of failures for Servo provider drive: inside damaged; affected part resulted in main Transistor.

Part	Position	Lecture
Emerald	Main computer	A
Servo Driver	Interior	F 014
Servo Driver	Exterior	4

Table I. Fault found according to Table of failures

Step 8 - Download to the portable computer with Windows Operating System 2007 onwards, the software TeamViewer07 (collaborative software) or its most current version.
Step 9- is activated the TeamViewer07 software in the computer to start the remote connection through the Internet from any place of the world.
Step 10- communicate with the provider and deliver the ID and password, as described in the following screen.

Fig. 3. (a) Remote Control Panel of the collaborative software TeamViewer

Step 11- Wait that the provider to connect remotely to the laptop through the TeamViewer07 software using the ID and password provided.
Step 12- Once connected, the provider connects the laptop to the machine using a USB cable in the general port, with the purpose of determining what caused the failure to access the database from your computer manufacturer.
Step 13- The manufacturer performs the corresponding readings and their respective graphs, controlling the PC and performing remote tests from the US.

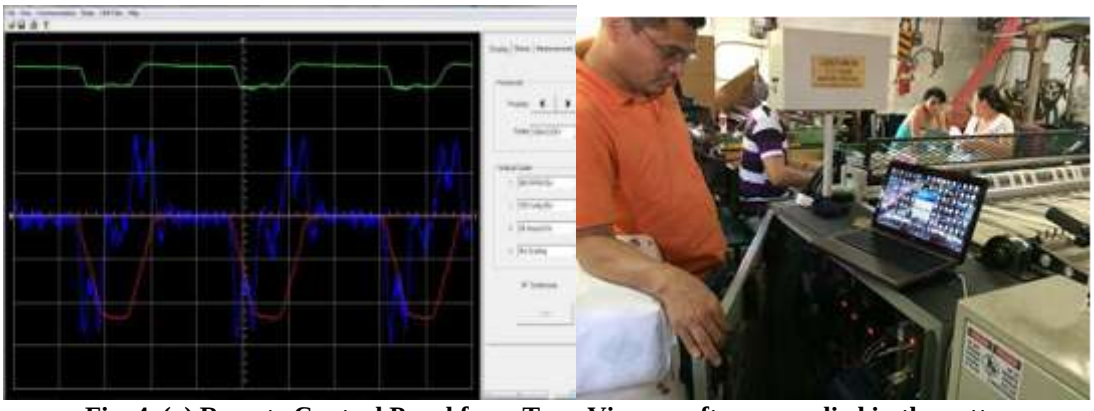

Fig. 4. (a) Remote Control Panel from TeamViewer software applied in the cutter

III. RESULTS

The failure was caused by the absence of proper speed limits parameters, for what was initially worked above of the range program for the equipment, which caused the damage of two Servo Drives. The problem lays in the establishment of the initial parameters of the software in the United States was not considered the different bag sizes, for example: the bags of medium size 8x12" are at 215 cycles per minute, however before

rectification ran at the same speed of a small bag 4x8", 5x11", 220 cycles per minute, this situation forced the machine and burned the Servo Drives.

To correct the failure has applied the guarantee to the computer. The manufacturer was responsible for send and refit the two new Servo Drives withouta cost and make a new programming according to the specifications of the product for the production plant.

Item	Traditional Diagnosis	Diagnosis supported by IT
Availability of technician	Yes	Yes
Technician per diem (USD)	4,000.00	0
Equipment downtime	3 to 4 weeks	1.5 weeks
Opportunity cost (time)	1 to 1.5 months	1.5 weeks

Table II. Comparative traditional diagnosis with respect to the diagnosis supported with TICs

The use of new technology of broadband Internet, mobile intelligent, database of the manufacturer and the software for diagnostic failure helped to solve a problem that a few years ago would have involved: a) to wait until there is availability of a technician from the manufacturer of the machine, which normally traveled half world and had a great waiting list, b) have a equipment downtime in the plant without producing (typically 3 to 4 weeks), c) detect the failure in the Interplast and wait for the spare parts (1½ week), d) costs of transfer, lodging and feeding of the technician (4,000 USD) and e) The cost of opportunity to stop production for a month and a half as a minimum.

The diagnosis of the equipment and its solution in this case study was achieved by using IT, solution was developed in a period of 5 days, a day to detect the failure and perform tests, and four days more to receive the Servo Drives in warranty from the supplier and install them.

IV. DISCUSSION

The results described above coincide with those obtained with the use of collaborative systems based on the Internet, which are the reduction of response time and savings of per diem (Morgan, 2012; Turban et al., 2005, Cohen and Asin, 2007). As well as the diagnosis and troubleshooting of industrial equipment in real time show that decreases substantially the time of response and the time that the equipment is out of service (Pouliezos and Stavrakakis, 2013). However, the fault being detected on line was carried out by means of human intervention but could be improved by using artificial intelligence techniques such as the use of expert systems, artificial neural networks or qualitative simulation using the experience of human experts in the solution of such problems as described in Angeli and Chatzinikolaou (2004). The case study shows a failure caused by a problem of tuning, which figures among the main causes of problems in industrial plants along with nonlinear limits in cycles of control and interaction with drivers (Thornhill and Horch, 2007).

Conclusions and further work

The use of information and communication technologies "ITC" in the diagnosis and troubleshooting in an equipment of high production, reduce substantially the time of response and per diem cost. It complied with the aim of documenting a good practice in the plastics industry. As future work, we propose the use of mobile devices as part of the processes of diagnosis and resolution of faults in high production industrial equipment.

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