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Generation of production statistics and their impact on a manufacturing company

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Abstract

This article shows the results of the development and deploy of a statistical module for the production and productivity progress reports (from various angles), integrated in a manufacturing management application developed by the Instituto Tecnológico Superior del Sur de Guanajuato (ITSUR). This application is focused on one of the most important companies in the southern area of Guanajuato state, dedicated to the textile manufacturing and sale of the Guanajuato South Zone and due to confidentiality issues will be referred to hereinafter as Textiles SA. The implementation of this module strengthened the application of manufacturing management, taking advantage of the information collected by this application to give visibility in the manufacturing process, by generating reports that allow them to make decisions in a more timely manner and correct bad habits of workers involved in the production process to optimize production, which in turn will increase its profits and therefore will allow it to maintain and enhance its competitiveness in the local, national and international markets.

machinery, textiles, manufacturing, SME

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Introduction

In the south of the state of Guanajuato is one of the largest textile areas in the country, known for the commercialization and manufacture of textile products (flat cloth, knitting and santoni), this area is mainly made up of the municipalities of Uriangato, Moroleón and Yuriria. Within this area, there is a manufacturing company, hereinafter referred to as Textiles SA (for reasons of confidentiality), dedicated to the production of textile garments made of flat cloth, knitted fabrics and santoni. The products produced are sold by the company's own stores, with presence in several municipalities in the state of Guanajuato. Additionally, they are part of the portfolio of producers of department stores such as Coppel or of catalog sales brands such as Cklass.

Textiles SA began as a small family business that has been growing gradually, this growth has brought with it greater complexity to take control of production, especially with the growing competition in the market.

The industrial engineers who have been incorporated in this type of company, make their efforts to try to supervise and maintain control over the production, in order to obtain certain visibility to the entrepreneurs about what happens in their manufacturing plants by means of through tools such as spreadsheets that act as record formats or reports in which they concentrate the information that they can collect from the process.

All this motivated Textiles SA to look for mechanisms that allow it to improve its production processes, both with the improvement of manufacturing processes through external consultancy, as well as the implementation of Information Systems (IS) and Information Technologies (IT).

As mentioned (Vega, 2005), through the implementation of IS and IT solutions, important improvements are achieved in companies; automated operational processes, obtaining a platform of information necessary for decision making and, most importantly, its correct implementation brings competitive advantages and / or reduces the advantage of rivals.

For the implementation of IT and IS solutions, the company Textiles SA requested the collaboration of the Higher Technological Institute of the South of Guanajuato (ITSUR), since the latter had until 2016 with the accreditation of the Integrated Maturity Capability Maturity Model Integration (CMMI) level 3, which according to (Pérez, 2012) is a model that integrates a set of good practices whose main objective is to verify and validate the quality of the software. Therefore, ITSUR has extensive experience in the development of applications under international quality models.

The ITSUR worked on a first implementation that consisted of the base platform that would allow capturing data from the production process, which already has a database of the process that should be used to obtain useful information that allows to see the state of production, with the purpose of detecting and attending more quickly opportunities for improvement, as well as making decisions in a more timely manner. Therefore, the generation of a next version that would include the module of statistical reports was required.

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Methodology

In order to carry out the incorporation of the new module to the existing application, the ITSUR life cycle was applied, which is based on the fusion of the iterative and incremental life cycle models, which, allows the early production of increments, which allow to test, stabilize and mature the requirements implemented in the application.

The statistics module is made up of various reports that contribute to several pre-existing modules in the application, the detected user requirements are shown in tables 1 and 2.

Material module
Reports of consumption of material, at the level of material type, size, color and supplier, within a specified period.
Finished Product Module (FP)
FP delivery reports by customer, color, size, brand and gauge, in addition to contemplate the return by customer, within a specified period.

Table 1 User requirements for reports of the Material and FP modules
Source: *own elaboration*

Production module
Production reports broken down by model for a customer, color, brand, size or gauge, within a specified period.
The generation of reports that allow visualization at the programmer level must be allowed: the number of authorized technical sheets (TS), the time of authorization of average TS, number of production orders (PO) initiated and production advance in number of pieces completed and pending of the POs initiated within a specified period.
It should be possible to obtain downtimes weekly or monthly, being able to indicate the type of machine or contemplate them all. It should be considered day and night shift, making the breakdown for each day of the week at the level of machine, programmer and weaver.
It should allow the generation of reports that show the average weekly efficiency of each of the types of machines that the company has and assume a period of 650 net productive minutes per shift, with the possibility of updating this parameter.
It should allow the visualization of the advance in the production of the POs for each phase of the production process through which they have elapsed, in addition to visualizing the breakdown in each phase, of the advance of complete garments or components (depending on the phase).

Table 2 User requirements for the reports of the Production module
Source: own elaboration

The previous user requirements were broken down into System requirements that allowed the more detailed division of the functionalities required to comply with the user requirements. The aforementioned requirements were not completely specified in a single round, but were handled by iterations at the module level.

Subsequently, each of the requirements, both at the user and system level, were reviewed and approved with the client.

Once approved, the low-level design and suitability of the high-level design was carried out, since much of the high-level design (architecture) was already defined from previous versions of the application. The work of the low level design, consisted in the specification of sequence diagrams that show the interaction between the classes that make up the System.

It should be noted that once each phase is completed, a peer review is carried out to ensure that the products generated by it are correct and meet the requirements. This is done independently if the product generated by the phase will be validated or not by the client.

Once the design stage is completed, it is implemented, following a coding standard defined in the organizational repository for CMMI L3.

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Subsequently, system and integration tests are applied to verify that the new requirements can be correctly integrated into production, detected anomalies are corrected and the version is put into production. The process is repeated until the iterations and the scope agreed with the client are completed.

Results

Every information system to be implemented begins to generate large amounts of information, which should be exploited, otherwise the system becomes a costly tool, sometimes tedious and if you do not get benefits can be only a burden for users.

The implementation of this module allowed the integration of 25 reports in the different modules (taking into account each individual report depending on where it is generated).

It should be clarified that the correct and timely capture of the components or complete garments in the course of the phases of the production process ensures the correct interpretation and reliability in the information presented in the reports, otherwise the reports will show information that could deviate the information causing erroneous decisions to be made, especially when committing delivery dates for future orders.

It is an arduous task to raise awareness and form habits among the workers participating in the process, as they are providers of information that feed the data bank.

Below are some of the most useful reports of the statistics module.

Production advance

This report (which can be seen in Figure 1), shows a concentration of the current POs within a period, the progress of the PO can be visualized in each of the phases of the production process allowing to visualize bottlenecks, in addition to perceive in which phases there is greater waste that causes the decrease of complete garments of first quality (it was possible to determine that the phase with greater tendency to this problem is cut, although in tissue this problem is also commonly presented, in this phase they detect in time the missing and produce again the amount needed to pass complete garments to the next phase).

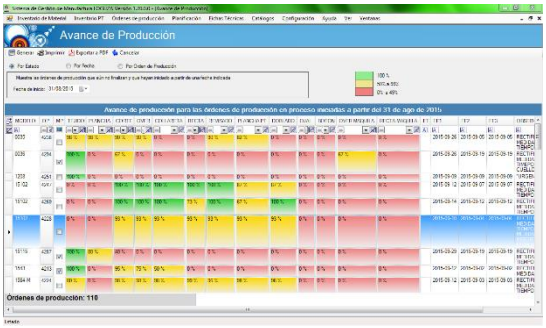

Figure 1 Production progress report
Source: manufacturing control system

Production report by programmer

The weaving phase that follow-up through component (or canvas) is the main phase that generates a bottleneck in the process, since in the complete garment phases they can not work until they have fully complete garments, that is, all and each of the components that make it up. The problem is mainly due to the fact that the machines that the company has can only weave one component at a time and each change of component creates a certain delay or dead time, so workers usually produce only one component at a time until they end, causing a long time to have the complete components.

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This report allows to visualize the progress of the various components and their shortcomings in order to detect which components urge more to weave, in order to generate lots of complete garments that can be sent to the next phase, in figure 2 an example of the report is shown classified by programmer and the models assigned to each of them.

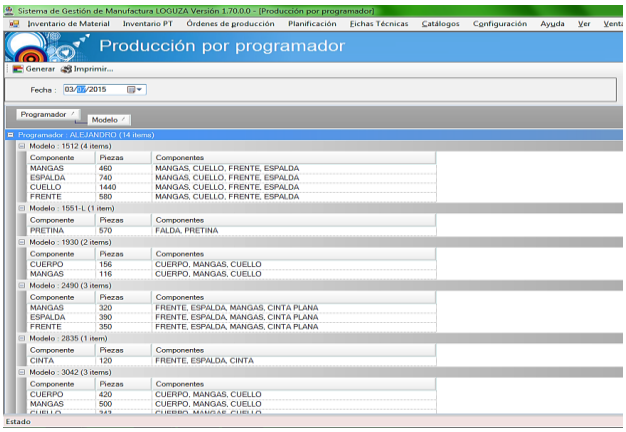

Figure 2 Production report by programmer in weaving phase
Source: manufacturing control system

Dead time report

Because the weaving machinery (in the case of knitted garments) becomes an indispensable shared resource, it must be exploited to the extent possible by contemplating its capabilities and minimizing the existence of non-productive times (Martínez , Vega, Gutiérrez, & Morales, 2015).

During the work shift of the weavers, various factors may arise that cause the machinery to be momentarily unworked, these non-productive periods of time are known as dead time.

Therefore, it is important to identify the causes of the existing Dead Times, although dead times must first be identified.

This report allows to visualize at the level of machine, programmer and weaver the average dead time generated, based on the assumption that there are approximately 650 productive minutes per shift, the production of components is obtained and thanks to the existence of a technical data sheet for each model that includes an approximate time in which the machine ends each component that makes it up (known as the time of descent). From these data it is possible to obtain the dead times of each of the machines in the plant and associate the models and machines with the programmers and weavers. This report has made it possible to detect on some occasions constant breakdowns (which occasionally keep the machine out of operation for several days), lack of supplies such as needles, lack of raw material (thread) which can not be taken if the warehouse manager is not there, change of dyeing of the raw material, time of delay for change of shift, production stop by detection of defects and in the worst case, by carelessness, lack of conscience and discipline on the part of the weavers. The early identification of these events through the report has facilitated the implementation of strategies to overcome these situations. In figure 3 you can see the report that shows color indicators in each % dead time, broken down by machine and by turn.

Figure 3 Dead Time Report
Source: manufacturing control system

The reports together have provided a decision-making tool, based on the data bank created by monitoring the garments and components during the production process. They have contributed information from the raw material that is consumed the most to maintain the raw material required in new orders, the productivity of the workers who are participants in the process, to post-production statistical information regarding the most produced finished product and associate it with the clients that more consume, which can later give way to the implementation of other types of solutions focused on the client, taking more advantage of IT tools.

Conclusions

The complexity of the implementation of the system, above all because the correct operation and the veracity of the information generated by the statisticians depends directly on the complete, correct and timely capture of the company's workers, which present a large area to the change, especially knowing that many of them do not work in the right way, that is, the presence of ant stealing, the inattention of the weavers to the machines and the lack of responsibility of the workers that make up the weaving area, who sometimes they lose components of the garment which causes that despite having almost all of the garment with a single component that is absent can not assemble a complete garment, this type of monitoring also gives the possibility of changing the scheme of payment to the employees to pay by piece, which promotes a greater responsibility of the diverse workers, since if they do not realize the tracking of the components or garments made can not be accounted for their payment.

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