THE INFLUENCE OF THE ELECTRONIC KANBAN IN THE STOCK CONTROL OF MACHINING TOOLS

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A INFLUÊNCIA DO KANBAN ELETRÔNICO NO CONTROLE DE ESTOQUE DE FERRAMENTAS DE USINAGEM

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ABSTRACT

The research highlights the advantages of using a simple tool like kanban, often considered outdated, in achieving organizational objectives. It also emphasizes the importance of investing in infrastructure and fostering relationships with suppliers. The study identifies the reasons behind a company's adoption of a new inventory management methodology and the development of the e-kanban system. The research explores how electronic kanban controls tools used in machining materials. Using a qualitative approach and a case study method, it focuses on a leading auto parts company. Data collection involved field observation and document analysis, with data tabulation and graphical layouts used to analyze inventory management models. The study demonstrates that kanban, despite being labeled obsolete, can reduce costs and waste in production processes, enabling organizational objectives. It also highlights the importance of strong supplier relationships for maximizing the tool's potential. A limitation of the research was the inability to conduct







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interviews with company managers. Additionally, the observation technique posed challenges, such as potential researcher bias and the risk of missing key phenomena. The findings suggest that high investment in new methodologies is not always necessary to achieve objectives. The e-kanban system effectively reduces production costs and improves inventory accuracy. The research illustrates how a Brazilian company maintains leadership in a complex sector by leveraging this simple tool. Despite its origins in a different context, kanban continues to offer tangible benefits to organizations today.

Keywords: inventory management; electronic kanban; machining tools.

RESUMO

A pesquisa destaca as vantagens de usar uma ferramenta simples como o kanban, muitas vezes considerado ultrapassado, na conquista de objetivos organizacionais. Também enfatiza a importância de investir em infraestrutura e fomentar relações com fornecedores. O estudo identifica os motivos que levaram uma empresa a adotar uma nova metodologia de gestão de estoques e a desenvolver o sistema e-kanban. A pesquisa explora como o kanban eletrônico controla ferramentas utilizadas na usinagem de materiais. Utilizando uma abordagem qualitativa e o método de estudo de caso, concentra-se em uma empresa líder no setor de autopeças. A coleta de dados envolveu observação em campo e análise de documentos, com tabulação e representações gráficas para analisar modelos de gestão de estoques. O estudo demonstra que o kanban, apesar de rotulado como obsoleto, pode reduzir custos e desperdícios nos processos produtivos, facilitando o alcance de objetivos organizacionais. Também destaca a importância de relações sólidas com fornecedores para maximizar o potencial da ferramenta. Uma limitação da pesquisa foi a impossibilidade de realizar entrevistas com gestores da empresa. Além disso, a técnica de observação apresentou desafios, como o risco de viés do pesquisador e a possibilidade de não registrar fenômenos importantes. Os resultados sugerem que altos investimentos em novas metodologias nem sempre são necessários para alcançar objetivos. O sistema e-kanban reduz custos de produção e melhora a precisão dos estoques. A pesquisa mostra como uma empresa brasileira mantém lideranca em um setor complexo utilizando esta ferramenta simples, mas eficaz.

Palavras-chave: gestão de inventário; kanban eletrônico; ferramentas de usinagem.

1 INTRODUCTION

It is not of today that we hear about globalization, developed and underdeveloped countries, and the so-called economic block of emerging countries BRIC, consisting of Brazil, Russia, India, and China, especially China which has acquired a lot of technology, developing itself rapidly in the industrial sector.

The growing supply of products and inputs from the Chinese market, for example, has significantly affected automotive companies around the world. Products that were previously considered without quality and questionable reliability, ceasing to be a reference for large companies and consumers, today are already seen differently on the world stage.

To remain strong in the market, the companies that are competing with the Chinese market reached the competitive differential of quality, however, with the current scenario change, this



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differential has almost not existed, making the cost factor give significant advantages to the Chinese, which have as a basis for their rapid expansion the devaluation of their currency in relation to other countries and also their low cost of production.

Responding to these changes that have been occurring gradually in the global market, with several political and economic crises always occurring, the so-called competitive companies need to be increasingly making use of tools such as, for example, lean manufacturing and the Six Sigma.

Lean manufacturing is an initiative that seeks to eliminate waste, that is, delete what has no value to the customer and print speed to the company. On the other hand, Six Sigma is a strategy whose focus is the reduction of costs and the improvement of the quality of products and processes, with the consequent increase of the satisfaction of customers and consumers and the profitability of the organization (Kamble et al., 2020).

Currently, it is noticed that one of the main costs associated with the transformation of materials in the metallurgical sector is the input of the production process. Inputs are all the resources that go into the transformation process of a certain product or service, but that is not necessarily part of it, such as labor, machinery, and equipment (Zhang et al., 2019).

In order to understand how a company in the automotive metal-mechanic sector behaves in the face of seasonality and diversity of the current market, in relation to the disposal of waste and the reduction of costs in the manufacturing sector, a survey was conducted as qualitative in the industry of buying and inventory of the inputs of production of a company leader in the supply of the joints are not dynamic to respond to the question: how can Kanban control reduce the reduction of tool inventories in a company with variations in demand, without affecting the performance of the productive sector?

To answer this question, it was defined as a general objective to conduct a case study identifying how the electronic kanban controls tools used for machining materials. The specific objectives are to identify how the system was implemented, what costs arise from the stock of machining tools in the production process and analyze the results before and after the implementation of the tool in the company.



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This study becomes relevant, as it will be possible to understand how a company installed in Brazil manages to remain a leader in such a complex segment, with several variables, focusing its efforts not only on the quality of its products but also on the control of the production process, how production controls are carried out and how losses in the process are being reduced.

2 THEORETICAL BASIS

2.1 STOCK MANAGEMENT OF MACHINING TOOLS

Inventory management has become indispensable for an organization to be competitive and prosper in the market where it is inserted. Inventories are necessary to contain variations in demand from customers or the availability of suppliers, however it is necessary to be careful, since the use of inventories implies costs for the company and the availability of physical space, which could be used more productively (Pokuaa-Duah e Nadarajah, 2020).

Production managers usually have an ambivalent attitude towards stocks. Inventories represent risks for the management of production because they present costs to be maintained and managed, on the other hand, inventories can satisfy the need of customers providing certain tranquility to managers (Triana e Beatrix, 2019).

The objective of inventory management is to provide the needs of the production process, immobilizing as little financial resources as possible." Production control tools from the TOYOTA system, such as kanban, show ways to facilitate the approach to this goal (Pekarcikova et al., 2020).

The choice of the appropriate tool for management or control of inventory in each company should be made by the way of its performance in the market, such as the planning of the organization and the system used by the company in the production process, and there are several systems to control the inventory in a company, according to them the simplest and commonly used is the two-drawer system or minimum inventory system (Triana e Beatrix, 2019).

The two-drawer system consists of segregating the items of the same product or input, in different compartments. While items from the first drawer are being used there is no need to place an order or issue a purchase order. At the moment when all the items in the first drawer are consumed, it is evident to the manager, the moment of generating a new replacement order to supply



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the stock, considering that the number of items in the second drawer must be compatible with the need for demand during the lead time of delivery of the product, that is, the quantity of material must be sufficient until the supplier refills the system (Triana e Beatrix, 2019).

Since nothing is perfect, the two-drawer control system can bring problems to inventory management when there is instability in the lead time of supply or in the quantity demanded of products of the company. Only the reduction of stocks is observed, many managers do not estimate the cost and the problems that the lack of this can bring to the organization (Triana e Beatrix, 2019). There is still a need for the third drawer in this system. The Third Drawer will contain a sufficient security stock only to supply the system inconsistencies already perceived or estimated by the Organization (Pokuaa-Duah e Nadarajah, 2020). One of the main ways to scale stock levels in a company is given by the equation:

$$AVERAGE \ STOCK = \frac{MAXIMUM \ OF \ THE \ STOCK}{2} + SAFETY \ STOCK$$

The material requirement planning (MRP) is an example of a system for the control of production and inventory, widely used to define the needs of a business over a certain period of time, however, it is advisable to make use of this tool only when there is an anticipated demand for a product, or when the company does not produce on-demand, that is, where the production system is "pushed out" (Pokuaa-Duah e Nadarajah, 2020).

Many authorities in the matter believe that Lean philosophy and just-in-time techniques have been the most important individual influence around operations management over the past 50 years. Although there has been some backlash against the more simplistic elements of lean and just-intime philosophy, it remains as the biggest influence on operations management (Triana e Beatrix, 2019).

2.2 INFORMATION TECHNOLOGY



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The development of technology has facilitated the exchange of information between customers and suppliers for Supply Management. The electronic exchange of information is based on a means of disseminating the critical information of a company's supplies in its value network (Matsuo e Barolli, 2020).

When it comes to service management, information technology is helping to define the competitive strategy of successful companies. Investments in Information Technology are directly proportional to the size of the organization, where medium and large companies, installed in Brazil, have a great financial return on Applied Technologies (Matsuo e Barolli, 2020).

One cannot be conservative about changes, however, there is no need for a constant acquisition of new technologies from the systems. Many organizations end up entering a state of underutilization in relation to new technologies, when in fact, the ones they already have are not properly implemented or optimized (Matsuo e Barolli, 2020).

2.3 JIT AND KANBAN

The kanban tool originated in Japan after Taiichi Ohno observed flaws in Henry Ford's mass production system during periods of low growth. The mass production approach generated waste due to overproduction inherent to the system. The concept of kanban was inspired by American supermarkets, where shelves were restocked only when empty. Limited space meant items were replenished based solely on necessity (Andrade et al, 2023). To the authors, Kanban aims to coordinate production activities, ensuring parts are produced at the right time according to demand. The system focuses on reducing inventory and leveling production across sectors to maintain alignment.

According to Corrêa (2010), kanban is as it is called the system that controls stocks and flows pulled in systems such as just-in-time and lean (Triana e Beatrix, 2019). The production system Just-in-time aims to reduce the production costs of the company, eliminating waste and delivering to the customer the product at the right time and quantity, without losing quality kanban cards are placed in a frame, called Kanban frame, this is composed of three colors where the cards are distributed according to the needs of the customer (Goh e Goh, 2019).



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Overproduction is considered one of the worsts of the seven production losses. the Kanban Tool, in addition to assisting in the control of overproduction and stocks, has advantages regarding the simplification of administrative control, flexibility in the mix of products, the autonomy of the factory floor, and the identification of products (Triana e Beatrix, 2019).

In a company, the JIT and kanban system favors the simplification of the production process, the optimization and valuation in the use of employees, the elimination of errors, and the reduction of costs (eliminating unnecessary expenses), thus reducing uncertainties and assisting all levels of Management (Triana e Beatrix, 2019).

The correct operation of kanban cards requires the availability of parts among internal customers. This ensures the preparation of the products in a certain period. Kanban is not advisable for organizations that do not contain a standardization of their product mix or when the company produces through projects (Goh e Goh, 2019).

One of the adaptations, commonly used between customers and suppliers, is the replacement of physical cards with electronic cards. In addition to allowing the use of the tool externally to the company, this adaptation is known as e-kanban, or electronic kanban, brings advantages such as: (i) improve the relationship and evaluation of suppliers; (ii) greater accuracy in order quantities; (iii) decrease the handling of roles in the organization (Triana e Beatrix, 2019).

An electronic Kanban is characterized by following the same premises of simplicity, low stocks, and lean production, the same system of scaling the number of cards, and the involvement of teamwork necessary for the proper functioning of the traditional kanban. The difference, in essence, lies in the use of the internet and other information technologies in place of traditional kanban cards (Goh e Goh, 2019).

One of the main features of e-kanban is the ability to maintain constant control of stocks, this allows the company a rapid restructuring at the points of product orders in addition to simultaneously informing the supplier, through a sharing software (Triana e Beatrix, 2019).

2.3 MACHINING TOOL STOCK COSTS



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Cutting or machining tools are objects of studies because they require strict control of inventory maintenance due to the high technology involved in their development and the cost that this generates for the organization. Cutting tools can account for up to 30% of total machining costs in companies responsible for the development of automotive parts and components (Carvalho et al., 2019).

Without the appropriate tools, no company in the metallurgical sector can produce their respective products with quality, however, the control of these inputs is crucial for the organization. High or very low levels of stocks of machining tools, greatly affect the performance of the organization. The control of the machining tools is relevant, as they represent a large part of the company's investments and can generate savings not only because of the reduction of stocks or purchases but also because about 30% to 60% of the tools in stock are not under control (Carvalho et al., 2019).

3 METHODOLOGY

For the development of this article, a bibliographic search was first carried out on books, scientific articles, and theses already published, to substantiate the subject in question and exemplify the proposed conditions. The bibliographic research aims to build knowledge by providing information for any other type of research, where the researcher does not conduct any type of interview or make observations about their own lived experiences. To carry out bibliographic research, it is essential that the researcher make a survey of the themes and types of approaches already worked by other scholars (Pizzani et al., 2012).

Given that the experiment seeks to understand how a leading company in the Auto Parts segment controls its stocks of cutting tools, the research was defined as qualitative and will be carried out through a case study. In the case study, the idea is to reflect on a set of data to describe in-depth the object of study. The case study is limited to one or a few units researched, understood as a person, a family, a product, a company, a public body, a community, or even a country. This modality has a depth and detail character and may or may not be performed in the field (Yin, 2015).

Data collection will be done through field observation, systematic, non-participant, and individual. This consists of a planned and technical research, carried out in real life, but without the



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involvement of the researcher with the object of study. Observation is a very important technique for science because it is through it that studies of problems begin. Therefore, the observation must be accurate, complete, successive, and methodical. Observation as a technique is not a blessed and passive contemplation; it is also not a simple attentive look. It is essentially an active look sustained by a question and a hypothesis. The observation has limitations regarding the researcher's opinion being able to influence the description and the possibility of not being present when a certain phenomenon occurs. Based on this, there is a need for an in-depth documentary analysis of tool consumption reports in the company, from the beginning of the transition period between inventory management systems (Malhotra, 2012).

The documentary research is like the bibliographic one. The only difference is the type of font. In the bibliography, we use scientific texts that analyze the same object of study. In the documentary, we use sources that do not have the objective to analyze the subject in question (Barros e Lehfeld, 2007). For analysis and understanding of the results obtained, a comparison will be made between the models of inventory management of machining tools in the company. In addition to facilitating the interpretation, the tabulation of the data and their graphic layout help in the interrelation of the information obtained.

4 RESULTS

4.1 DESCRIPTION OF THE INITIAL SITUATION

The study was conducted in an automotive industry present for 40 years in Brazil. To preserve the company's image, the company will be dealt with in this article only by Company X. Over time Company X has become a reference in the segment and main supplier of the domestic market. In 2005 it was acquired by an English group when it held 85% of the national market and a large share in the international market, which generated production of approximately 15 thousand pieces per day, enough to assemble 7.5 thousand cars.

With investments made by the English group, as well as the remodeling of processes, acquisition of new customers, and increase of the product mix, the productive capacity of the company reached the mark of 30 thousand pieces per day in 2012, an increase of considerable if



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compared to the date of acquisition. However, the development of the organization and the increase in the product mix brought other needs to the company, as shown in Table 1.

Need	Description				
Acquisition of new production equipment.	More modern equipment and with a production capacity of about 50% higher than the so-called obsolete machines, caused the need to develop new suppliers of cutting and machining tools. The machining tools that were used in the old equipment no longer guaranteed the quality and capacity of the new operating scenario.				
Acquisitions	With the growth not only of the company but also of the automotive market, it was				
of specific	necessary to adapt to the constant development of new cutting tools, making others				
tools for	old-fashioned. With the reduced product mix, by the end of 2009, it was possible to				
differentiated	maintain a low mix of resources and a reduced variety of machining inserts,				
products.	laminating Combs, and grinding wheels, the main resources used in production.				

Table 1 - Evolving production needs and adaptations

Source: survey data.

With the advent of new equipment, and new customer needs, it has been necessary to develop other forms of machining, such as, for example, to replace the machines that require agents are of great environmental impact, such as grinding wheels, and cutting oils for machining modernday use of the synth for strength and quality, but, on the other hand, you do not have a manufacturing country. According to the data collected in the reports of the organization, this change in processes and machinery increased by approximately 50% of the level of stocks of machining tools in the organization. Based on the observation made and the data collected from the documents studied, some deficiencies of this model of purchase and inventory management were identified as presented in Table 2.

Table 2 - Shortcomings of the planned purchases model

Disability	Description
Bureaucracy	With each new material requisition, the purchase request had to go through several departments of the company, demanding authorizations from supervisors and



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	managers. The lead time of this process ranged on average from one to twenty-four				
	hours to be delivered to the supplier, depending on the availability of all areas				
	involved.				
Uncertainty	The volume required in the purchase had to be calculated based on delivery times				
in acquisition	and cost, considering the schedule made by the sales sector.				
	There was no correct forecast of the costs of each tool, since, with each new				
Change in	request, it was necessary to negotiate again the prices of each product with the				
tool costs	suppliers, often becoming vulnerable to the price stipulated by the market at the				
	time of acquisition.				
Physical	There was a need for a large physical space to pack the maximum stock of tools,				
arrangement	since in each purchase the amount of material delivered was sufficient to support				
anangement	the entire month of production				
	Because it is a company with a large mix of products and that there are constant				
High level of	changes in orders and cuts through customers, the number of tools was always				
security	calculated for more. When the technician responsible for ordering machining tools				
stocks	made the forecast of what would be needed for the period, he was instructed to add				
	an average Safety Margin 10% higher.				
Lack of	In some products of exclusive use of the company, there was no stock at the				
material in	supplier. The suppliers that produce in the make-to-order regime did not generate				
supplier	stocks, they waited for new order to start producing, which took time.				
	Source: survey data.				

In this sense, and from the scenario analyzed, a program of control and maintenance of inventory known as e-Kanban was implemented.

4.2 E-KANBAN IMPLEMENTATION PROCESS

Before choosing the methodology to be implemented in the purchase of tools and investing in the purchase of software, training of employees, and provision of physical space, it was necessary to study the ability of suppliers to fit the new system, as well as their receptivity to the change.

The company's purchasing managers, together with preset technicians, responsible for the control and development of cutting tools in the machining process, contacted all the company's suppliers, where it was possible to diagnose the main characteristics of each supplier, thus being



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able to develop a tool that would meet everyone's ability or demonstrate which companies would be able or not to adapt to the new model.

Table 3 presents general information about the company's six main suppliers. The table shows the origin of the production (domestic or imported) if there is a distribution center in Brazil and the lead time for delivery of each supplier.

Supplier	Production	Distribution center in Brazil	Lead time delivery / days
Supplier 1	National	Yes	2
Supplier 2	National	Yes	2
Supplier 3	Foreign	Yes	3
Supplier 4	Foreign	Yes	1
Supplier 5	Foreign	Yes	2
Supplier 6	Foreign	Yes	3

Table 3 - List of the main suppliers of the company and their origin

Source: survey data.

Table 3 shows that all tool suppliers have distribution centers in Brazil. The presence of distribution centers close to the company makes it feasible to apply e-kanban, because transportation costs are lower when compared to imported ones. Based on the needs perceived in the first stage, the company's technology department was contacted, in which the sharing software between the company and the suppliers was developed. The exact cost of the software cannot be estimated because of a lack of accurate information during the development of the work. The employees directly involved with the use of the tool, preset technicians, and purchasing department, were constantly involved in the development of the project. At least one representative of each sector involved participated in the events that led to the implementation of the tool and had the task of disseminating the applicability of the system with other employees.

During the negotiations of purchases and provision of services, suppliers receive instructions on the operation of e-kanban, which does not require much complexity given that they do not need to purchase the software, only access the server created by the company where they receive all the necessary data. With each new negotiation for contract renewal, suppliers receive information about



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possible changes made to the system. In addition, Company X provides channels for the exchange of information that are relevant to the improvement of the data-sharing system.

Each item in the company already had a stock code, discriminating in the system what each material was. This stock code was used to create kanban cards, there are no two cards with the same number, but cards with the same stock code, the differentiation of the card number is the final consumer, that is, who ordered it.

Kanban cards were created with the colors green, yellow, and red, representing the degree of criticality of the material, being the red indicator of the maximum level of urgency. In addition to criticality, kanban cards indicate which sector of the factory the item belongs to, the volume of material per card, and the supplier. The panel was built with a steel sheet, in which were added colors representing each level of the stock and drawers where the cards are packed according to their color and supplier. The control panel had a cost of approximately R\$ 1000,00 to be made.

4.3 OPERATING DYNAMICS OF INVENTORY CONTROL BY E-KANBAN

Figure 4 shows the steps of the machining tool control process currently performed in the company, using the e-Kanban system.

Step	Setting					
Step 1	A special purchase order is generated for each supplier, with the conclusion of a					
	contract where items such as:					
	- Values and price changes according to time or percentage.					
	- Delivery form or lead time of delivery of each order.					
	- Preset card reading dates.					
	- Stock level at supplier.					
Step 2	Items are stored on a shelf along with their respective cards, obeying colors and					
	quantities.					
Step 3	As the tools are consumed, following the order of the cards from Green to red, the					
	employees deposit the cards in the control panel shown in Figure 1, where twice a					

Table 4 - Steps of using the e-kanban system in tool management.



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	week the manager makes control and inserts the card number into the system, placing				
	it in the drawer of purchased materials.				
Step 4	After each reading the system automatically sends an e-mail to the suppliers ' portal, in				
	which each supplier immediately receives its pending.				
Step 5	As cutting tools arrive at the company, the system instantly sends the requester a				
	notice that their orders are already available in the company's central warehouse				
Step 6	When replenishing the stock, employees take out the purchased panel card and put it				
	back on the shelf together with the material.				

Source: the author.

Making a direct relationship with the scheduled purchase, e-kanban allows more autonomy on the part of technicians, responsible for inventory control, since there is no need to request authorizations for every purchase. Inventory management by e-kanban causes orders to be sent to suppliers immediately after the need is perceived.

Figure 1 compares the company's overall forecast of kinetic Homo joint sales, and what was sold in the months of April to August 2015. In this sense, the orders for tools were made based on the sales forecast, which could cause a lack or excess of material in stock, since the actual variations of production could be greater or smaller than planned. In the e-kanban program, the difference between the forecast and the realized does not generate a direct impact on the level of stocks.



Figure 1 - Expected demand / realized demand

Source: survey data.



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Given the constant cuts made by car manufacturers in 2015 due to the economic crisis, it is noticed that in some months there was a significant difference in products between what was estimated at the beginning of the month and what was produced. Table 5 shows the volume and total costs of the main machining tools purchased by the company in the period of May 2015.

Table 5. The ratio of the purchased quantity of each tool in May 2015, and the total costs of these.

Description	Quantity Purchased in May	Total Cost	
Turning tools	3040	R\$ 59.930,00	
Drilling tools	203	R\$ 20,074.00	
Milling tools	156	R\$ 69,585.00	
Total	3399	R\$ 149.589,00	

Source: the authors.

Taking as an example the month of May, in which the actual production had a difference of 25,000 pieces less than expected and knowing that in the same period the company had a total cost with the acquisition of tools equal to R\$149,589. 00 already by the e-kanban model, one can calculate the reduction of the company's costs in:

$COST \ PER \ UNIT = \frac{TOTAL \ COST \ OF \ THE \ TOOLS}{AMOUNT \ PRODUCED}$

Thus, the average unit cost of tools is R \$ 0.40. Multiplying the unit cost of tools by the 25,000 pieces that the company stopped producing, it has an approximate value of R\$10,000.00. This amount is associated with the waste that the company would have with machining tools in the month of May if it had acquired the stock for the period based on the sales forecast made at the beginning of the month. Figure 2 shows the monthly consumption of the main tools used by the company and the average consumption of them in the period from May 2015 to September 2015.



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Figure 2 - Monthly consumption of the main machining tools.

Source: adapted from the enterprise X tool consumption reports.

Based on the monthly average of the main items used for machining in the company and using the average inventory calculation cited by Chiavenato (2008), it is possible to scale the stock levels in each management model. Table 2 visually demonstrates the average inventory cost of each tool in the two management models, both in e-kanban and by scheduled orders.

Tool	Unit cost	Medium	Kanban cost	Average	Cost	Gain
type		stock/ka		stock /	scheduled	
		nban		scheduled	purchases	
				purchases		
DNMG	R\$ 15.72	168	R\$ 2,640. 96	504	R\$ 7,922. 88	R\$ 5,281. 92
SNGA	R\$ 212,51	10	R\$ 2,195. 94	31	R\$ 6,587. 81	R\$ 4,391. 87
Drill	R\$ 75.15	21	R\$ 1,578. 15	63	R\$ 4,734. 45	R\$ 3,156. 30
WNMG	R\$ 9.54	117	R\$ 1.113,00	350	R\$ 3.339,00	R\$ 2,226. 00
Total	-	316	R\$ 7.528,05	948	R\$ 22.584.14	R\$ 15,056. 09

Table 6. Average monthly inventory ratio of the main items.

Source: adapted from enterprise X consumption reports



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The main aspect noted during the analysis of the results of the application of e-kanban concerns the level of the average stock of the machining tools in the end customer. By showing the values of the main items consumed month by month in the company, we can notice a significant reduction in the unused stock of tools. By using the e-kanban model to manage the stock and trigger the purchase orders of machining tools the company reduced from R\$ 22,584.14 to R\$ 7,528. 05 the amount of investment in the stock, a difference of approximately 67% compared to the previous model.

5. FINAL CONSIDERATIONS

The general objective of this work was to identify how a simple visual control system known as e-kanban, and said by many as obsolete, can help a company reduce costs and waste of the production process. With the realization of the research, it was possible to realize that the e-kanban system helps in reducing the costs of the production process and allows greater accuracy in the level of tool stocks even in the face of variations in market demand, be they for production losses or migration of customers since it considers what is produced and not what was predicted. The specific objectives were also met. Based on the study, it is possible to identify the reasons that led the company to implement a new methodology for managing the stocks of machining tools, as well as the steps that provided the development of the e-kanban system.

To understand the impact of the cost of tool stocks on the company's profitability, it was perceived as an advantage a significant reduction in the waste that was generated before the application of the system. With a controlled level of average stocks, the company managed to reduce the number of items in a state of obsolescence, in addition to reducing the number of employees involved in controlling stocks and ensuring greater accuracy in the service of internal customers, since the e-kanban facilitates the perception of the need for replenishment. As a disadvantage we note the increase in transport costs, even if they are not so expressive when compared to the investments that were made previously.

These results show that high investment in new methodologies is not always necessary to meet certain objectives. In the case described the company only improved a simple tool and well



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known to the employees, to facilitate the maintenance of stocks of machining tools. On the other hand, the tool only became effective in the company, since it had highly developed suppliers located in its vicinity.

The research had limitations in obtaining accurate information about the costs related to the acquisition and implementation of the information-sharing software, accuracy in the costs related to transportation between distant companies, and information about the perception of suppliers about the use of the system.

For future research, it is recommended to analyze the impact of the application of e-kanban in the control of suppliers ' processes, to contemplate the entire chain involved in the development of machining tools and the estimated costs in transporting these items to the final consumer. It is also suggested to conduct a study comparing the applicability of the e-kanban system against other possible stock management systems.

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