

Abstract # 015-0017**THE USE OF GROUP TECHNOLOGY AS A TOOL TO ORGANIZE A
PRODUCTION KANBAN**

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Abstract: The present issue proposes an optimization method to be applied to a traditional Kanban system using Group Technology (GT) concepts. Widely used by the enterprises, Kanban system helps to control storage level of goods, materials and WIP, but does not consider the loss of efficiency caused by the high number of setups that occur during the scheduled production. On the other hand, GT is a methodology which main targets are finding similarities on design or production characteristics in order to make groups of parts or products aiming the reduction of setup time, among others. Joining Kanban and GT was seen as an excellent tool to face the deficiency found on the traditional Kanban systems. This purpose was applied to a sandpaper manufacturer that produces with small and medium batch sizes. The results showed that the system Kanban joint to the GT brings a lot of advantages, like: greater pursuit rate of machines, reduction of production costs, greater standardization on the production scheduling and an improvement on the level of attendance to the clients.

Keywords: Kanban, Group Technology, Classifying and Coding System, Setup Optimization

Introduction and aim

Over the last decades, the restructuring of production systems of the companies have been subject of investigation. New trends in production management have emerged as a result (Womack et al, 1998).

Going further, with the globalization of economy and production, the possibility of training systems operating world-class has been one of the greatest desires of manufacturing companies in the news (Johnston & Clark, 2002). Increased productivity in the industrial sector is the object of work and concern for those responsible for production, due to an industrial context characterized by increasing competition stronger (Ribeiro, 2002).

Due to this scenario, the decrease of lots and increasing the mix of production will increase in the number of setups and changes in various sets of products to be produced in a short time (Fuchigami, 2005).

According to Dutra and Erdmann (2007), some companies point out that the main problems related to customer service refer to unexpected obstacles that occur in everyday life. This identifies the validity of analyzing the system of planning and production control through the lens of new paradigms. With that comes the importance of developing a proposal, using information taken from tables Kanban, provide the best scheduling production to minimize the setup times of machines and decrease in the number of setups.

The aim of this paper is to present a Kanban-based production technology group for sequencing tasks reduce the time sequence-dependent setups. The aim is to propose a practical methodology for the implementation of a kanban system that allows the supply of efficient, sequence production by reducing the preparation time machine from the optimal sequencing, or the best possible opportunity for production.

Traditional *Kanban* systems

The Kanban is a tool that pulls the production, helping to minimize inventory (Slack et al, 2002). This is a programming method in a short period of time, using pictures and cards to drive the flow of materials from one process to another, and it reduces the waiting time, reducing inventory, improving productivity and linking all operations in a uniform flow uninterrupted (OHNO, 1997, Lewis, 2004).

The kanban has its origins in the system Just in Time (JIT), and is often confused with this manufacturing technology (OHNO 1997). While JIT is a way to make products that affects all aspects of a manufacturing company, the Kanban system is a method of production control and inventory on the factory floor, which strives to provide products or lots only to the extent that they being consumed (Peinado, 2000).

In table Kanban each row (or column) is painted with a color for easy viewing of urgency in order or produce this item. Usually it is used the color green to indicate normal or production request, the color yellow to indicate "attention" to this item, and red to signal urgency in the request or the production of this item (Figure 1) (TUBINO, 1997) . The rule is always to do what is most critical, however, if more than one item with the same priority then should be chosen to produce the item that is easier and more convenient to make the time for production (HUANG; KUSIAK , 1996).

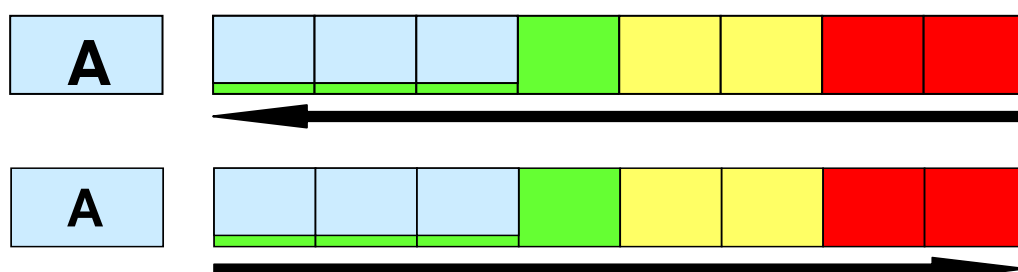


Figure 1 - Scheme of withdrawal and entry of Kanban cards.

In the case of a paperless card - suppose, the beginning of the production of the day, referring to the table, we observe that this is empty - no part or lot must be produced.

Group Technology (GT)

Group Technology aims to increase the effectiveness and efficiency of production systems characterized by the production of variety of items in small and medium batches of parts. This is done primarily through the formation of families of similar parts in physical terms (process, form, size, color, tolerance, material) and training for manufacturing equipment of the groups or families of parts (TATIKONDA; WEMMERLOV, 1992).

Group Technology (GT) can be viewed as a philosophy in managing the production is to offer companies working with small and medium lots, benefits similar to those obtained in the business of mass production: formation of lines for the production, tooling directed to each family, low setup time, etc. (SÉRIO, 1990).

Based on the principle of similarity, information about the design and the manufacture of a part of the family can be used by all other items of the same class manufacturing costs can be estimated more easily, the process plans can be standardized and programmed to efficient, production orders can be grouped together; times preparations can be reduced and the tools, devices and machines can be shared by families of parts (RIBEIRO, 2002).

A favorable condition for the implementation of GT is in companies that manufacture a large number of small lots and medium (RIBEIRO, 2002), because the efficiency gains come from reducing setup times, the programming sequence of parts of the same family , improvement in process control, among others (OHTA & NAKAMURA, 2002).

Some methods of family formation are used to implement the activities of implementation of Group Technology, among them, the systems of classification and coding (SCC) (TATIKONDA; WEMMERLOV, 1992).

As the aim of this work is to reduce setup times in a system that uses the Kanban methodology, one of the main advantages that a System of Classification and Coding (SCC) offers is to identify similarities in the manufacture of parts, which reduces the time processing of items, the time of preparation of the machine and the waiting time between processes, and finally the cost of tooling (HYER; WEMMERLOV, 1985).

Methodology

For the development of this work was first recognized a need with a company that operates in the industry sandpaper. The company was chosen for manufacturing products (files) in batches small to medium and use the Kanban system for production scheduling, which is the basis for conducting the research.

This study is due to the real need to deal with high product variety (mix) and low flexibility, coming from the large number of setups in production operations of the company. This was verified by studying in the existing systems in the company.

Made the appropriate literature reviews on Kanban system and Group Technology it was drew up a proposal that would allow reconciliation of manufacturing technologies.

The traditional Kanban system has "eyes" just to meet demand at the exact moment of their need, not worrying about the waste with setup times it can generate. Since the BT Group is a tool that has as one of the main goals the reduction of setup times and occupation of the equipment as best as possible. Therefore, the addition of both within organizations can respond more quickly to changes that occur in their operating environment.

Systems within the company.

The existing system in the company production is planned by establishing the sequence of production machinery by providing a framework Kanban traditional (Figure 2). The objective of the framework is to allow the production has visibility of inventory levels and, consequently, is aware of the needs of lots for the next step. With this information the production lot shall be directed to meet these needs.

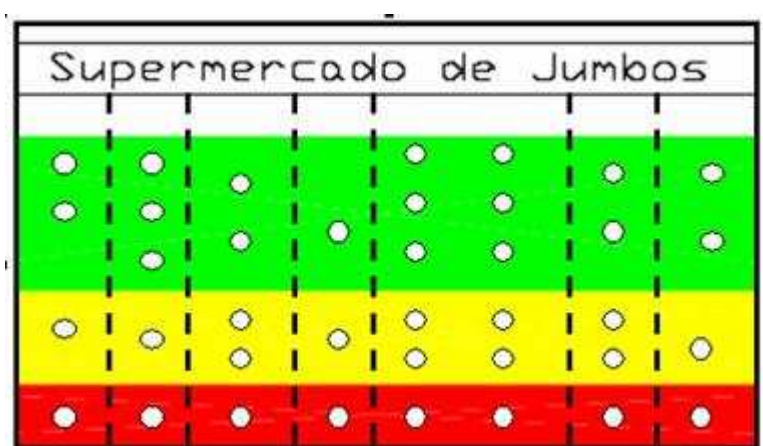


Figure 2 - Example of table Kanban used in the company

Each column has a space for each item; for items of greater demand these spaces are larger. Inside the columns are signs (marks) representing the number of positions to be occupied by the card tables. Each card represents a coil of sandpaper; items most in demand possess more positions on the board.

Figure 3 illustrates a possible situation in which the red arrow shows cards to be produced and the blue arrow shows that there are no cards in the table, with no need to replace that item.

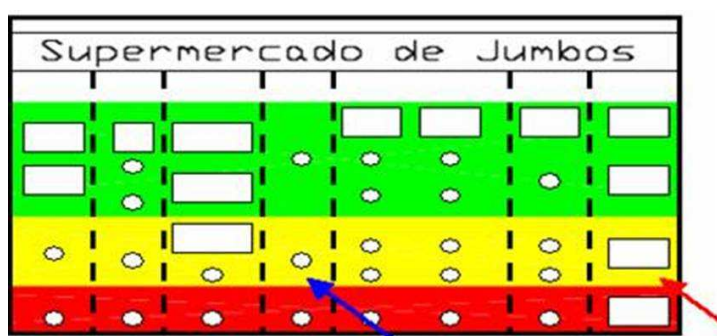


Figure 3 - Table showing Kanban needs existing (red arrow) and smaller (blue arrow).

After the withdrawal of Kanban cards framework, they go to another frame, the Heijunka, whose goal is to show the sequence of production. Table Heijunka consists basically of rules in which the programming of the machine is determined. There are 12 lines, one for each shift, for four days of programming.

The programming is accomplished by placing cards in the rules where the programming of the machine is determined. Each card has a time delay proportional to the time of production of a coil of each item. Thus, the framework will define the sequence of production and the quantity to be produced. The cards are removed from the rule of programming as the coils are being produced, and the set coils and lots and always remain close to the coil or batch after production to its total consumption, and thus returning the flow of Kanban system.

Proposition of a system GT - SCC

As mentioned earlier, activities programming or sequencing in the production of the company studied, occur as small and medium lots, and hard to be reconciled with productivity (Schaller, 2004), given the high number of setups that results from the Kanban system.

Seeking to improve the productivity of the existing system and, consequently, minimize the problems identified by this study, we proposed a SCC that allows for the identification of similar products in the form and process. This SCC when used in combination with existing Kanban system, allows you to complete a production sequencing of different batches scheduled in order to observe and maintain unchanged the main features of construction of the sandpaper, preventing discussion on many setups.

The CMS proposed takes into account the characteristics of the product that most impact the setup times, ie the first digit will have greater weight in the preparation of the machines than the others. Table 1 represents the structure of the code proposed in this work.

Table 1 - Structure of the proposed SCC

Grupo I		Grupo II				Grupo III				
DIG 1	DIG 2	DIG 3	DIG 4	DIG 5	DIG 6	DIG 7	DIG 8	DIG 9	DIG 10	DIG 11
Tipo de cura	Largura	Tamanho do grão	Tipo de abrasivo	Cor da Lixa	Cor de Impressão	Tipo de Costado(Base)	Peso ou espessura do costado	Tipo de Camada	Especificação da Base	Especificações das Camadas de Adesivo

This is a code of mixed structure, consisting of eleven-digit alphanumeric divided into three groups. All fields of the group I have the greatest impact in the setup than the fields of group II, that has a greater impact in the setup than the group III, and this, in turn, causes virtually no impact on the setup time.

Were detected following the similarity to decrease the preparation time: the type of healing (residence time in minutes), width of product (mm) grain size (micron), type of abrasive product color, type of plating, layer type, specification and details on the layers of adhesive. These features are grouped and ranked as shown in Table 1.

The first digit (with values of A to U) designates what kind of healing according to residence time and temperature. The residence time is the time a product takes to effect a cure, plus the time of heating or cooling that involves the process. Therefore, items must be produced in the same residence time and temperatures similar.

The contents of the digit 2 (values from A to P) is the width of the product (from 1080 mm to 1700 mm). This feature has great impact on the preparation of the machines, because for each different width should be adjusted rolls of passage and its application field of grain.

The digit 3 (values from A to T) shows a field corresponding to the grain size, a characteristic that also impacts the setup process as there may be contamination of grains of different sizes, degrading the quality of the product. The greater the difference in the diameter of the grains involved, the greater the impact they will have to prepare the machines.

The digits 4 and 5 have the same impact on setup time. They represent, respectively, the type of abrasive, the color of the product and color printing. The fourth digit (values 1 to 9) is the type of abrasive, which characterizes the grain due to its shape, color, conductivity and so on. This also impacts the setup process, as there may be contamination of grains of different types.

The contents of the digit 5 (values from A to J) corresponds to the color of sandpaper. This feature has an impact on the preparation of the machine, because for each different color should be clean pipes and calendaring application of adhesives.

In the digit 6 (figures 1, 2 or 3), the character represents the color of the print side, which identifies each product. This also has little impact on the process setup.

The digits 7, 8 and 9 have no influence on the setup time, but are needed for identification and classification of products. Field 7 - type of base (side view), consists of an alphabetic character (P, C or F, identifying side of paper, fabric or film, respectively). The character of the digit 8 refers to the thickness of the base plate. And the field 9 is intended to identify the type of layer, the amount of abrasive, adhesive or special processes.

The 10 digit only specifies both the type of base and has no impact on setup. It is used only for identification and differentiation of products, and a code already exists in the company.

The last field, number 11, specifies some special applications of the adhesive layer (in some cases these products receive additional processes). It is a feature that has no impact on setup, serving only for identification and differentiation of products. This code also was already existing in the company.

Proposal for a kanban system with SCC

We propose a change from a conventional kanban system to a kanban system based on a system of classification and codification of GT, seeking a manufacturing feature that groups similar products to a string of production from an existing demand. The aim is to optimize the production process with fewer intermediate stocks, changing setups and providing greater utilization of machines, greater flexibility in the process and increasing flexibility.

The SCC proposed in this paper is used to identify products in relation to their physical characteristics and processes. Based on these attributes and similarities in the process formed the families of products and processes that form the basis for a form of production schedule from the Kanban system demand.

The operation of the proposed system is as follows. The return of the kanban card on the empty table indicates that the stock or part of it was consumed and not returned kanbans represent that there are still stocks the supermarket. Thus, the operator knows that the production should start making the product indicated on the card to replenish consumables.

In the former system used in the enterprise, the priority is to serve the production batches that were consumed (demand); it is not prioritized the preparation time in the decision of the sequencing of production. There are produced items that are with the red region the wider invaded, like the example in Figure 4.

In this example, would be produced in order to meet the Kanban system (demand) the items 7 (F102D), 3 (DCJ2E), 1 (BLS2A), 6 (FIN2D), 2 (BLT2A) and 5 (EIK2C), according to this sequence, and item 4 (EIN2C) would not be done. Note that for the items produced, all existing orders in Kanban table will be met (eg, item 7, all 4 orders).

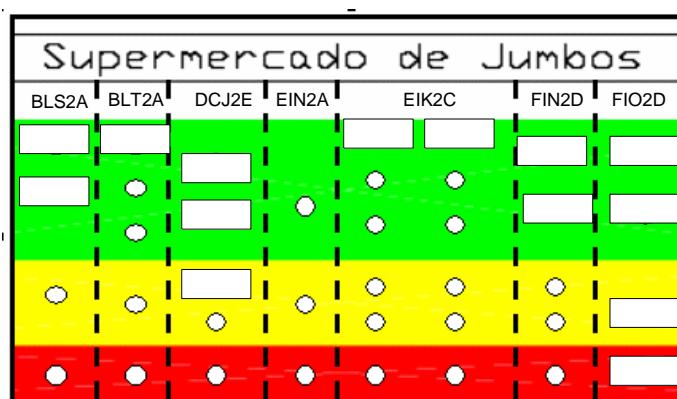




Figure 4 - Example of sequencing production of the former system.

In the proposed system, if several points are made replacement at the same time, as shown in Figure 4, the production will follow the system of classification and coding, using the rule of the code and then knew what it must be made first and how to produce. The sequence of production would be as follows: FIO2D (item 7), FIN2D (item 6), EIK2C (item 5), DCJ2A (item 3), BLT2A (item 2) and BLS2A (item 1), and EIN2A item (item 4) the same way would not be produced.

Comparing the attendance of the traditional Kanban and of the Kanban-SCC, the sequences presented by both occurred as follows appointed under table 2.

Table 2 - Comparison Kanban traditional sequence (situation 1) vs Kanban SCC (situation 2)

	Situação 1 					
Necessidade real (<i>Kanban</i>)	1º	2º	3º	4º	5º	6º
Sequência <i>Kanban</i> tradicional	item 7	item 3	item 1	item 6	item 2	item 5

	Situação 2 					
Necessidade real (<i>Kanban</i>)	1º	4º	6º	2º	5º	3º
Sequência <i>Kanban</i> SCC	item 7	item 6	item 5	item 3	item 2	item 1

Analyzing Table 2, the greatest need was met in both situations. Items of need will be met under a different sequence in the two situations. At first in order to meet the real need Kanban, not taking into account the setups, the total time for the production will be higher than in situation 2. In the second situation is made the sequencing of production based on the similarity of the SCC of each item, so the setup time is reduced or absent in some situations.

The priority code is where the first digits are more important than the subsequent, so should always be produced items that have the same digit or as close as possible (Table 3).

Thus, there is a sequence of programming more flexible than the traditional production Kanban. In these circumstances, there is no need for human trial to decide what to produce between two or more products that have reached the point replacement.

Table 3 - Example of grouping for prioritizing the sequence of programming.

Grupo I		Grupo II				Grupo III				
DIG 1	DIG 2	DIG 3	DIG 4	DIG 5	DIG 6	DIG 7	DIG 8	DIG 9	DIG 10	DIG 11
Tipo de cura	Largura	Tamanho do grão	Tipo de abrasivo	Cor da Lixa	Cor de Impressão	Tipo de Costado(Base)	Peso ou espessura do costado	Tipo de Camada	Especificação da Base	Especificações das Camadas de Adesivo
A	L	S	7	E	1	F	I	F	C	L
A	L	S	9	E	1	F	I	D	C	*
A	L	S	9	E	1	F	I	F	C	L
A	L	S	9	E	1	F	I	I	C	*
A	L	T	2	A	1	F	I	A	C	*
A	L	T	2	E	1	F	I	B	C	*
A	L	T	3	E	1	F	I	B	C	*
E	F	D	2	D	2	C	D	D	D	*
E	F	D	4	D	2	C	D	D	D	*
E	F	E	2	D	2	C	D	D	D	*
E	F	E	4	D	2	C	D	D	D	*
E	F	F	2	D	2	C	D	D	D	*
E	F	F	4	D	2	C	D	D	D	*
E	I	H	2	A	1	C	A	A	D	*
E	I	H	2	D	1	C	E	B	D	*
E	I	H	2	I	3	C	E	B	E	*
E	I	H	2	I	3	C	G	B	E	*
E	I	H	3	E	1	C	D	B	D	*
E	I	H	4	A	1	C	E	B	W	*
F	I	L	2	C	1	C	H	A	D	*
F	I	L	2	D	1	C	E	A	D	L
F	I	L	2	D	1	C	E	A	D	*
F	I	L	2	D	1	C	E	B	D	*
F	I	L	3	E	3	C	G	B	F	*

Analysis of the results

Here are the results obtained with the application of Kanban SCC for thirty days at the company studied. In this period were produced 262 different items. These results are compared with results of previous production, held under the traditional system of kanban.

With the system available to sequence and scheduling, we measured the following indexes:

- Total time producing;

- Total setup time;
- Dead time;
- Level of clients attendance

First, the results are shown with an average of 3 months of production under the traditional kanban system (red columns) and compared with the month in which the method was applied Kanban SCC (blue columns) (Figure 5).

Note that there is an increase in hours of production and a reduction in setup times in the event that the proposed system was applied. With regard to the dead hours, the observed increase can be credited to the fact that this value is computed by adding the production times and setup minus the total hours available, for about 575 hours per month. That is, there is more inefficiency due to higher production efficiency of the proposed system (especially with regard to reducing the setup of equipment).

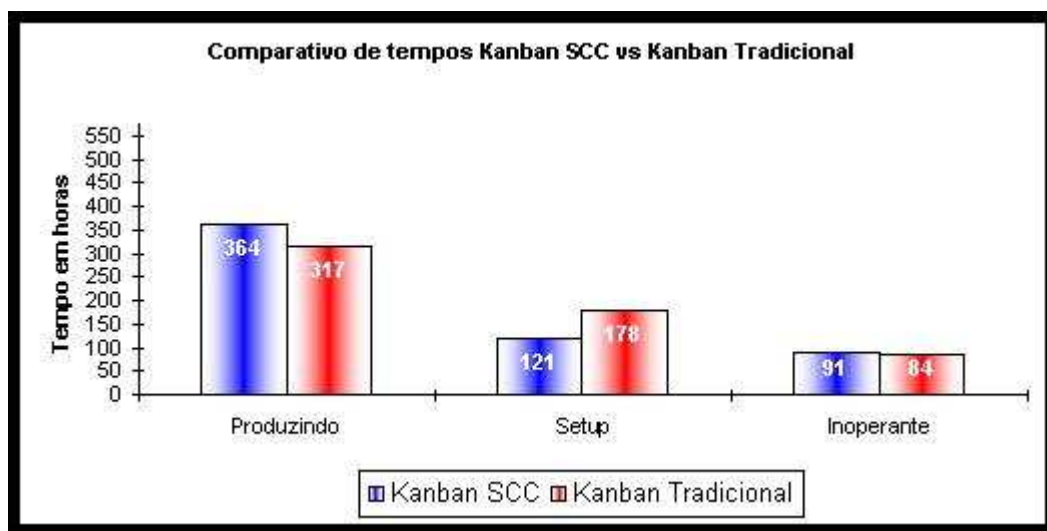


Figure 5 - Comparison of times obtained in systems Kanban vs. Kanban Traditional SCC.

Figure 6 shows the same results, but in percentages of the total number of hours considered available (575 hours).

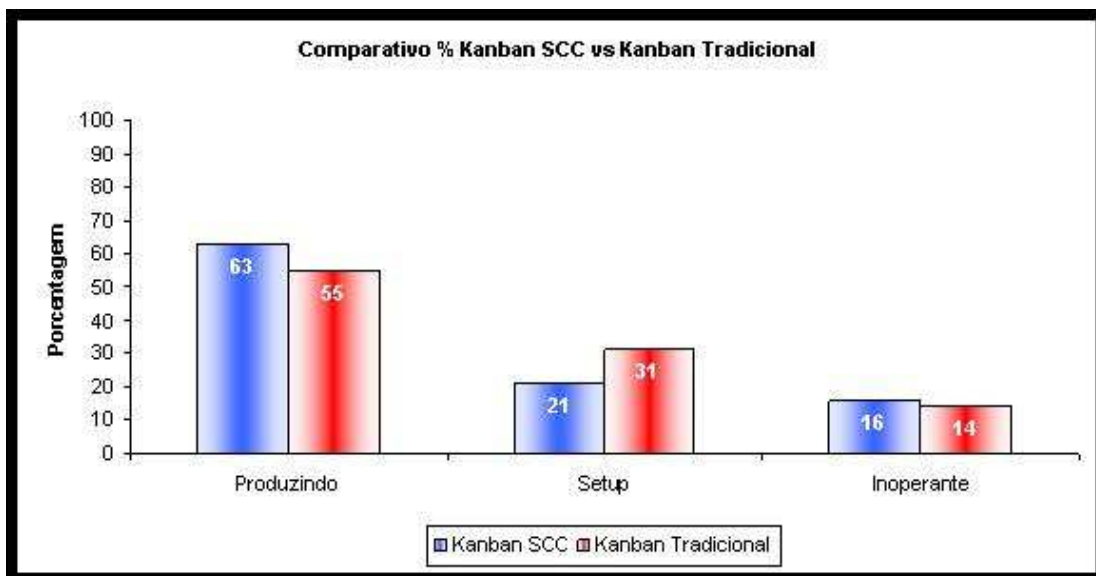


Figure 6 - Graph comparing SCC Kanban vs. Kanban Traditional (in percentages).

Another index was measured at the level of attendance to clients, the requests that have been met within the stipulated time. Figure 7 shows a comparison of results between systems Kanban and SCC traditional Kanban system, in which can be seen that there is an improvement in the level of attendance to clients when it was started to use the Kanban system with SCC.

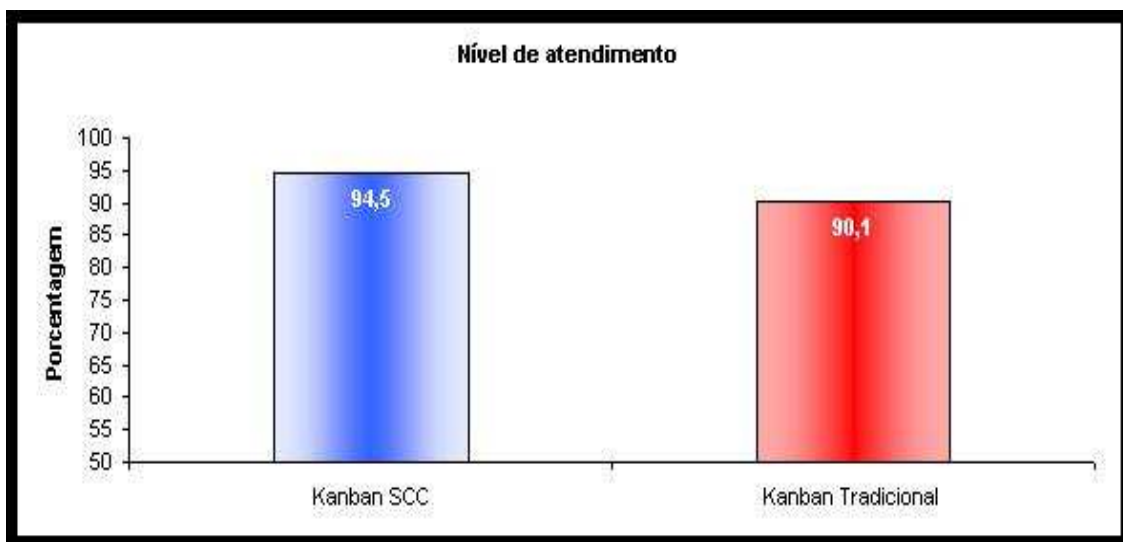


Figure 7 - Comparison of the level of attendance to clients between Kanban SCC and Kanban traditional.

Conclusions

The use of a Kanban system associated with the GT is an unusual initiative in various branches of industry, in particular in the production sector of sandpaper. The most common applications are the use of GT followed by the use of Kanban systems without the combination of these.

The proposal to add these two advanced manufacturing technologies aimed to cover a gap that the isolated use of Kanban reveals: the concern about the care of the most pressing needs do not consider the possibility of optimization of setup times. The high setup times, coupled with an inadequate production schedule, are factors that generate waste and cause increased costs of products.

Furthermore, the use of the proposed method seeks the interaction of the technologies involved with factors that lead to reduced costs of products. The interaction between Kanban and GT can be achieved, and shows the importance of not just knowing what to produce, but the best way to produce.

According to the results shown above, one can observe that the method proves efficient and, for the study period:

1. The monthly time spent on setup decreased;
2. Increased the occupancy rate of the machines;
3. Increased the time available for production;
4. Improved demand attendance.

Additionally, the application shows that you need to know about the manufacturing process or product to schedule production, since it can be done from the encoding GT.

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