

# E-Kanban

Ing. Olga MAŘÍKOVÁ<sup>1</sup>

<sup>1</sup>*PhD student, Czech Technical University in Prague, Faculty of Mechanical Engineering,  
Department of Management and Economics*

Email: [Olga.Marikova@fs.cvut.cz](mailto:Olga.Marikova@fs.cvut.cz)

## **Abstract:**

Fluent material flow has a crucial influence on the final cost of a product because internal logistics can create 15-70 % of this final cost. Therefore effective and well-working internal material flow is very important and indivisible part of the supply chain. Kanban is a tool for managing and assuring Just in Time (JIT) production, fluent material flow and Lean Manufacturing philosophy. E-kanban is the next step working more efficiently and effectively with the lean process – advantages are electronic records of pull request, receipt timestamps and electronic acknowledgements all work towards a more unified and dependable method of pull communication etc.

E-kanban in Continental Automotive Czech Republic (managed via SAP R3) had brought many positive influences as handling of thousands of part numbers, real time information about possible delivery problems etc. This article is supposed to suggest key rules and show lessons learned when implementing e-kanban in other production systems.

## **Keywords:**

E-kanban, Just In Time, Kanban, Lean Manufacturing

## **1. Introduction**

Current highly competitive manufacturing environment and lean system demand accuracy, speed and agility from the supply chain. Kanban, one of the most important components of Toyota Production System (TPS), is a simple and effective tool to accomplish the pull concept of lean manufacturing. This method of Just in Time production uses containers or lot sizes with a single card attached to each. Kanban signals indicate demand, so overproduction is not allowed.

However, in recent years mainly under the global competition the increased product variety and physical distance among suppliers in supply chains increase the complexity of kanban applications and result in more mistakes, such as delays, lost cards, and incorrect kanban deliveries. Besides traditional kanban lacks the ability to track and monitor the physical cards. Also the extreme improvement of information technologies in the past decades provides a natural solution for improving the kanban system. An electronic kanban (e-kanban) system can minimize human mistakes and facilitate tracking, monitoring and performance measurement (Wan, Chen, 2007).

As a result, the conventional kanban system, which was created to improve manufacturing efficiency, needs improvement in itself.

## 2. Theory

The American Production and Inventory Control Society (APICS) define JIT as “In broad sense, an approach to achieve excellence in a manufacturing company based on the continuing elimination of waste (waste being considered as those things which do not add value to the product). In the narrow sense, JIT refers to the movement of material at the necessary place at the necessary time. The implication is that each operation is closely synchronized with the subsequent one to make that possible”.

In a pull system, the start of each product assembly process is triggered by the completion of another at the end of production line; products are produced only if there is a customer demand for this product. Otherwise anything is not allowed to be produced.

In general kanban method is quite old method used for many years since 1950's in Toyota. This method of Just in Time production uses containers or lot sizes with a single card attached to each. It is supposed to reduce the level of inventory and improve the synchronized movement of material through the plant.

In the company Continental Automotive Czech Republic at the beginning kanban was called just kanban and after implementation of e-kanban for making it clear they call the first one "card-kanban" and the second one "e-kanban".

### 2.1. Card-kanban

Kanban means a card or a signal; the whole process is based on the idea of the supplier and the customer. In the cycle there is only a certain number of kanbans (boxes with material) and the order for new material is made only when one box is finished in the production line. Therefore kanban signals indicate demand, so overproduction is not allowed. It is necessary to synchronize the processes and to ensure the regular material flow. A kanban system usually performs efficiently and effectively in shop floor control when the demand is repetitive and stable.

Very important influences have those factors: factor  $\alpha$ , RLT (replenishment lead time), flow degree and WIP (work in process). The aim is to optimize those as it shows *Fig. 1*

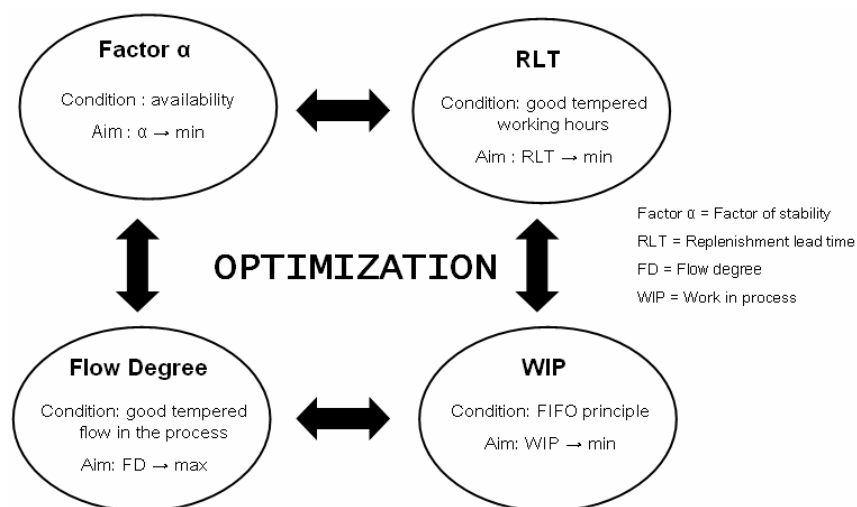


Fig. 1. Parameters for optimization of card-kanban

Modified Toyota formula is used for calculating kanban buffer:

$$\text{Number of Kanbans} = \frac{\text{Customer demand / Work time} * \text{Replenishment lead time}}{\text{Container size}} * \alpha$$

Where: Replenishment lead time = Production time + Transport time + Material waiting time (FIFO time)

Factor  $\alpha$  is over 1.0, compensates machine availability  $<1$ , when kanban loop is introduced can be up to 3.0.

Container size = Number of parts in a container

## 2.2. E-kanban

Very quickly changing environment demanding high adaptability asks also for very flexible way of material ordering. Traditional kanban has certain problems, which can be solved if we use electronic way of kanban. E-kanban system gives to the company and to their suppliers the tools for meeting these demands driving value and performance throughout the supply chain. Even Toyota, the creator of the kanban system, has adapted e-kanban system for sending external pulling signals to distant suppliers.

In general, those advantages of an electronic kanban system are listed:

- Removes the problem of lost cards
- The demand need is delivered right time
- Time and effort needed for cards handling is minimized
- Fast and effective optimization of kanban cards
- Minimizes the material shortages
- Improves the supply chain transparency
- Helps to analyze the supplier efficiency

More information in detail will be mentioned in the chapter about e-kanban in Continental Automotive Czech Republic (e-kanban for the internal purpose).

## 2.3. Aims

Generally speaking, main aim of kanban system is to increase the value by eliminating the waste. Therefore following targets are aimed:

- Reduction of cycle and delivery times
- Reduction of stocks
- FIFO system (first in/first out) to avoid aging of parts (checks expiration data)
- Increase the delivery reliability
- Increased the flexibility of modifications of customer requests
- Find out weak points in the production process, aiming at a long-term production increase
- Increase the planning reliability by adjusting the production program

The prerequisite conditions necessary for fulfilling of targets are followings: synchronized and standardized processes, suppliers delivering the material in in-advance defined pieces of

material in one box, standard work, visual MNG, trained and disciplined employees respecting 5S method.

#### 2.4. Advantages and Disadvantages

The difference between kanban (a signal to trigger specific quantities of supplies in a just-in-time system) and e-kanban, is working more efficiently and effectively with a lean process. Electronic records of pull requests, receipt timestamps and electronic acknowledgements all work towards a more unified and dependable method of pull communication.

In comparison card-kanban and e-kanban it is necessary to say that e-kanban affords higher efficiency when talking about the speed of response and also eliminating of non value added activities (e.g. non-productive work card-handling). Any material number does not have to be written into SAP, there is no checking where is the material; and no writing how much of material should be ordered.

Big limitations of card-kanban are data availability and scalability; paper cards can be lost. That is a positive thing of electronic kanban – it has its history in SAP therefore historical data can be analyzed and than relevant setting of e-kanban can be done according to that. Card-kanban has no history so there is no possibility of checking the history whether people are using kanban properly.

However, there are still areas where card-kanban can be better than e-kanban; this happens when there is no proper information in SAP about how much of product we are supposed to produce in the certain day. Than it is necessary to count this info (e.g. in another database) and according to that create relevant number of classic paper kanban cards for card-kanban cycle.

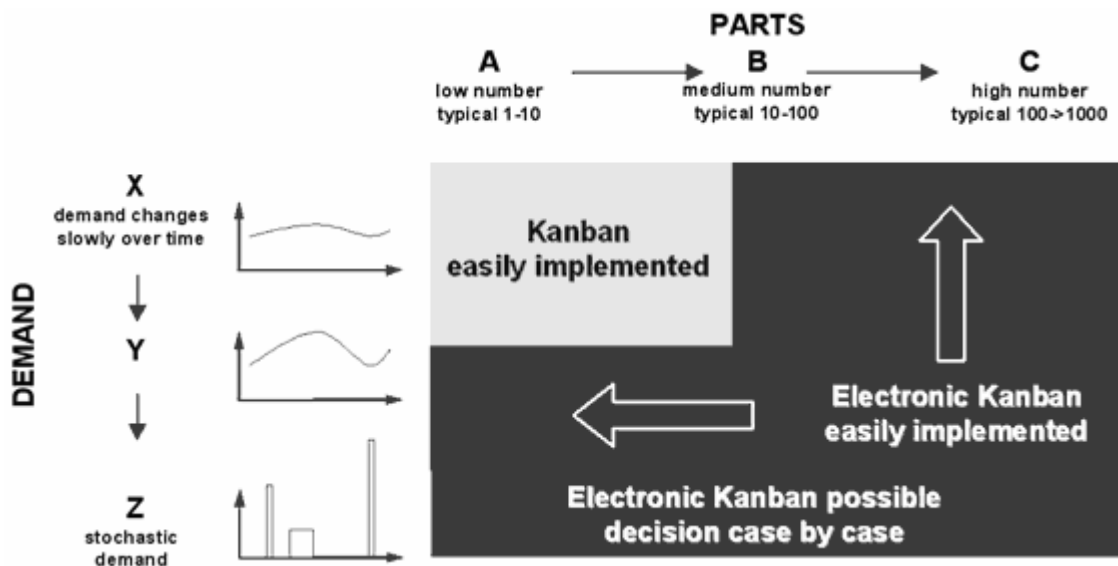


Fig. 2. E-kanban increases the areas where kanban can be successfully applied

As Fig. 2 shows with increasing numbers of materials becomes impossible to have card-kanban as it is not possible to control too many cards. Also with growing speed of changes e-kanban proves better applicability.

Table 1 demonstrates the comparison of card-kanban and e-kanban – their pluses and minuses.

Table 1: Comparison of card-kanban and e-kanban

	<i>Card-kanban</i>	<i>E-kanban</i>
<i>Transparent material flow</i>	✓	✓
<i>Control of ordered material level</i>	✓	✓
<i>Easier and faster ordering of material</i>	✓	✓
<i>Easier work for handlers with material</i>	✓	✓
<i>Visualisation of problems in production</i>	✓	
<i>Setting of priorities</i>	✓	
<i>Regulation and optimization of stock</i>	✓	✓
<i>Simplification of production planning</i>	✓	✓
<i>Improves the flexibility of the production line</i>	✓	
<i>Improves the quality (by batch size)</i>	✓	
<i>Works with high amount of materials</i>		✓
<i>Long distances between stations</i>		✓
<i>Quick and precise info</i>		✓
<i>Big financial investment</i>		✓

### 3. Continental Automotive Czech Republic

Originally German company Continental Automotive is a worldwide well known company with 140.000 employees and sales around 25 billion Euro. In the Czech Republic there are 4 plants - Brandýs nad Labem (2.436 employees), Frenštát p. Radhoštěm (2.381 employees), Adršpach (734 employees) and Trutnov (614 employees). There are followings divisions of products Powertrain P, Interior, Chassis & Safety C and Central electronic plant SSO producing actuators, motor drives, fuel supply, instrumentation, displays etc.

#### 3.1. Current Situation

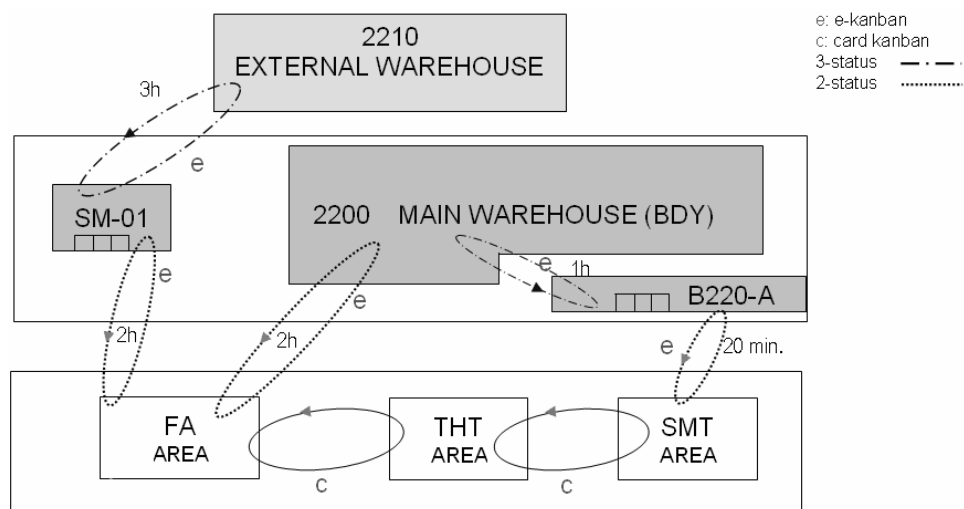


Fig. 3. The flow of the material managed by "card kanban" and "e-kanban" in Continental Automotive Brandýs nad Labem (by author)

In the *Fig. 3* there is a flow of material in Brandýs nad Labem plant. Card-kanban is between SMT - THT area and THT – FA area. Other material flows are managed by e-kanban. Material is moved from the main stock (2200) to the supermarket kanban stock (B220) for having the material available in 20 minutes after calling from SMT lines (Surface Mount Technology). In the first workstation (SMT lines) the material is called via e-kanban and worked up (if the next workstation needs). They are always working only on the product which is necessary.

The limit for delivering of material after calling is 20 min for the cycle B220\_A – SMT, 1 hour for the cycle 2200 – B220\_A, 2 hours for the cycle 2200 – FA, SM01 – FA, and 3 hours for the cycle 2210 – SM01.

Workstation THT (Through Hole Technology) uses two different materials: the semi finished material (HALB) from SMT lines and also purchased material (ROH) from the main stock. Next workstation FA (Final Assembly) is the same as the previous one, it also work with HALB material from THT lines and ROH material from the main stock – but here e-kanban works for calling ROH material as on SMT lines.

### 3.2. Key Principles and Rules of E-kanban in Continental Automotive CZ

#### Ordering of material

Limit for delivering of material is 2 hours. When an operator on the production line needs material (*Fig. 4*), he scans the kanban card with the barcode. The order is generated via mb1b transaction in SAP (the barcode includes information what material, how much, its proper specified position on the production line and from what stock to what production line it has to go). The card is used only for calling of material; it always stays on the production line without any movements. There is no information about the material and amount in the barcode etc.; it only includes the way to SAP where the information is specified.

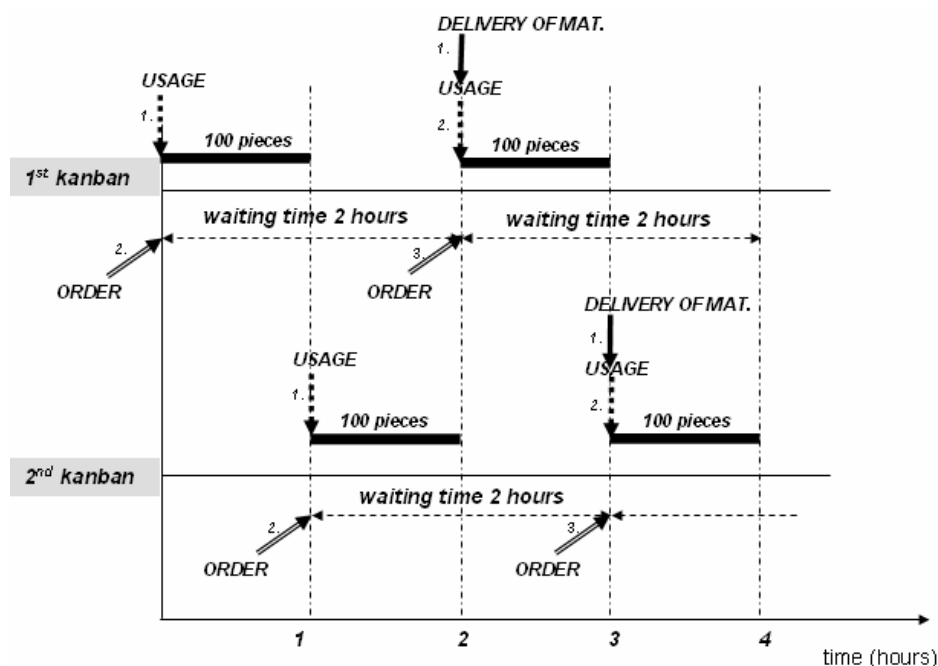


Fig. 4. The process of ordering material using e-kanban (by author)

## Accepting of material

When material arrives to the production line, it is checked by operator whether it is the proper material in the proper amount and than the barcode is scanned on the same kanban card as the material was ordered. By scanning, the material is automatically accepted to this production stock via transaction lt12 and than the card is ready for another using. From status "empty" (after ordering) it can only go to status "full" (after accepting), therefore, only 2 deliveries are ensured if there are 2 cards.

## Setting in SAP

All information about material has to be specified in SAP transactions pk05 and pkmc (Fig. 5).

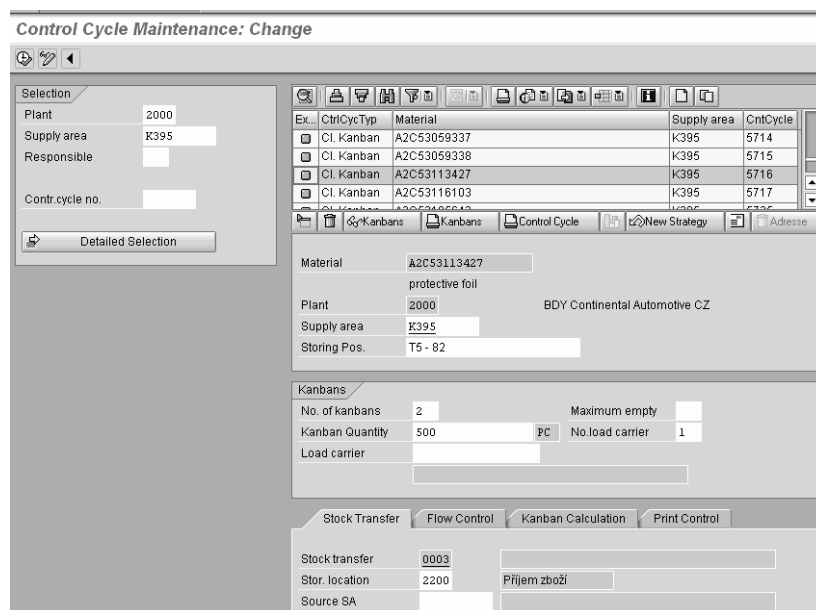


Fig. 5. Transaction pkmc, SAP (OZV means supply area)

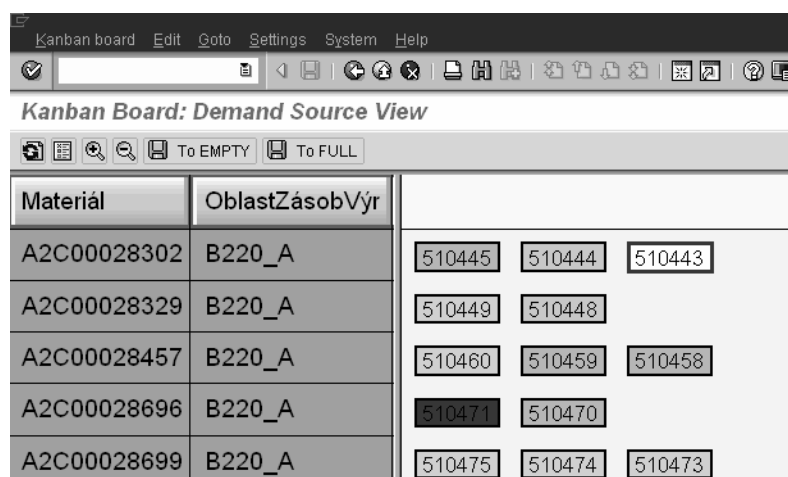


Fig. 6. Transaction pk13n, SAP (Kanban Board)

In transaction pk13n there are statuses: "waiting" (1) - violet, "empty" (2) - red, "full" (5) - green, "error" (9) – white with red frame. In addition there is also one more status for kanban between "2200 – B220\_A"; and "2210 – SM01" – this status is "material in usage" (6) – blue.

Wa...	Transfer order no.	Mov...	Mov...	Material	Goods recipient...	Source storage type	Dest.storage ty...	Creation date	Time created	Confirmation date	Confirmation time		
220	0002422674	411	317	A2C53102715	K325_B	J 060	921	13.03.2008	09:21:09	13.03.2008	10:55:11	0	01:34:02
220	0002422673	411	317	A2C53008024	K395	J 010	921	13.03.2008	09:20:08	13.03.2008	09:51:13	0	00:31:05
220	0002422672	411	317	A2C53092379	K375	J 040	921	13.03.2008	09:19:17	13.03.2008	10:07:28	0	00:48:11
220	0002422670	411	317	A2C53092379	K375	J 040	921	13.03.2008	09:19:12	13.03.2008	10:07:31	0	00:48:19

Fig. 7. Transaction ZKANOBW, SAP (transaction for checking turn rate of the material created in Brandýs nad Labem)

In transaction ZKANOBW (*Fig. 7*) all orders managed via e-kanban are traceable. It is possible to see from which stock the material was called (main stock 2200), transfer order number (0002422674), the material was called via movement 411 and accepted via movement 317, material A2C53102715, accepting stock K325\_B, requirement type J (JIT = Just in Time), source storage type 060, destination storage type 921, date and time of creation of order, date and time of confirmation and total time needed for processing.

It is very important to pay attention when the kanban cycles were set up "2200 – B220\_A" and "B220\_A – SMT"; or "2210 – SM01" and "SM01 – FA". Those cycles had to correspond to each other; e.g. a cycle "2200 – B220\_A" is a supplier for a cycle "B220\_A – SMT" and "2210 – SM01" is a supplier for cycle "SM01 – FA".

#### 4. Lessons Learned

There were many problems during the implementation of e-kanban, which were completely or at least partly solved already. Let's mention at least few lessons learned.

It is very important to pay attention when setting information input into SAP. This was a problem after the start with kanban in B220\_A – it is one quite big supply area with around 2300 materials. The data were not exact and we spent a lot of time only on correcting input data as system was not able to process it.

Even the automation is very developed, there are still working people and therefore it is very important that they also support lean thinking and they deal according to that. Different trainings for better understanding to the problem and developing of their culture are crucial for the success of lean processes. It is inadmissible that someone does not use the kanban system if it is implemented already.

Other issue is a problem around micrologistics – e.g. too big shelves on the line lead to the extremely high stock on the production line even all that material is not really necessary for producing the product. It is just the problem of visualization when people on the line see half empty shelves; they will subconsciously think that they do not have enough material. Even if it is not true they will tend to create not required overstock.

Currently, our big problem is that there is no limit for level of material on the production line necessary for producing defined number of products – there is not established any limit in SAP. E.g. production cycle of the line is 100pc/hour and the production line needs 2 pc of certain material for producing 1 product. There will be 2 kanbans for 200 pc since the material on the line has to cover 2 hours consumption. If the material is already delivered in 1 hour and another kanban is ordered, unwanted buffer will be created on the production line. Therefore, there is an effort to develop another transaction (or table for checking certain specified limit), in which will be possible to see if the inventory on the line exceeds this specified limit. Accordingly the warning comes up saying "check the level of material on the production line whether physical situation is the same as in SAP".

### Case of Built Environment

Partly, the kanban system is also the logistic tool for moving the material in the plant in small batches (idea of lean logistics); therefore this system is applicable in all industries and fields as logistics is in every kind of the production. The case of kanban in the automotive manufacturing system is the most complicated case for many reasons – e.g. the material is very expensive therefore it is not good to have too much of material in WIP (work in process); there are very strict rules for the quality control; it is necessary to take into consideration the expiration of material.

In the case of Built Environmental, where the situation is completely different, it is possible to use only easier application of kanban. Most of the time the most clever things are very easy, and this is probably that case, as the idea of kanban is also hidden there. Big potential for using e-kanban is the supplier kanban. Sometimes there are long distances between the supplier and customer, but when using e-kanban all distance problems in the communication can be solved. It is not necessary to order 20 camions of bricks for 20 days (and receive it all in one day), if it is possible to order 1 camion for each day. The material is automatically called from the supplier after using one batch (or when the level of material falls under the allowed limit). The pluses are more than obvious: a big warehouse is not needed; the money is not fixed in this investment before it is really necessary; the material cannot be lost or destroyed during working around and many others.

## **5. Conclusion**

In last decades with quickly changing environment demanding high adaptability and also asking for very flexible way of ordering of material, it was a logical step that traditional kanban was substituted by e-kanban.

The difference between kanban (a signal to trigger specific quantities of supplies in a just-in-time system) and e-kanban is to work more efficiently and effectively with a lean process. E-kanban improves the supply chain transparency; it assures handling with high amount of material in proper way without losing cards and reacting more flexible for changing demands of customers.

It is necessary to take into the consideration the financial view – investment into implementation of e-kanban costs a lot because of expensive costs of terminals and other expenses connected with development and IT implementation. Also, the communication within production, logistics and IT department is very important for successful

implementation. If the whole implementation is done well, e-kanban is a big improvement and it helps to optimize the process.

However, there are still areas where card-kanban can be better used than e-kanban; this happens when there is no proper information about customer demands for every single day in SAP. It always depends on the current problems, which is supposed to be solved.

The complexity of kanban system depends up to the sector but it has a big potential for using e-kanban as the supplier kanban in construction area. It can bring cost savings and well organized system of orders. All factors have to be taken into consideration whether the investment into this system is relevant.

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