Aleksandra Anđelković[1]

JEL: M11, L14, L62, C44
DOI: 10.5937/industrija45-14466
UDC: 005.932:621.113(497.11)
005.552.1
Original Scientific Paper

Implementation of Just-in-sequence concept in automotive industry – comparation of Austrian and Serbian model[2]

Article history:
Received: 6 July 2017
Sent for revision: 25 July 2017
Received in revised form:
Accepted: 1 August 2017
Available online: 10 October 2017

***Abstract**: Strong competition and increasing demands from customers continuously encourage companies from the automotive industry to improve its processes. Jist-in-time as one of the strategies of managing inventory, which is applied 40 years ago in the automotive industry; represent a great support to many companies, particularly Japanese, for achieving a competitive position in the market. However, implementation of Just-in-sequence approach could be used for minimizing the disadvantages of Just-in-time strategy. Author use comprehensive analysis of literature for explaining Just-in-sequence approach. Comparing Just-in-time and Just-in-sequence approach author points to the differences between them. Empirical research shows a level of implementation Just-in-sequence approach in two automotive clusters (one from Republic of Austria and one from Republic of Serbia). Explaining reasons for selecting clusters from these countries, with the use of appropriate statistical methods, author points to the differences between samples.*

***Keywords**: Just-in-sequence, Just-in-time, supply chain, automotive industry.*

Primena Just-in-sequence koncepta u automobilskoj industriji – poređenje austrijskog i srpskog modela

***Apstrakt**: Snažna konkurencija i povećanje zahteva kupaca kontinuirano podstiču kompanije iz oblasti automobilske industrije da unapređuju svoje*

[1] University of Nis, Faculty of Economics, aleksandra.andjelkovic@eknfak.ni.ac.rs
[2] Austrian agency for international mobility and cooperation in education, science and research (Österreichische Austauschdienst - OeAD-GmbH)

procese. Just-in-time kao jedna od strategija za upravljanje zalihama, koja se primenjuje već 40 godina u automobilskoj industriji, predstavlja veliku podršku mnogim kompnijama, posobno japanskim, za postizanje konkurentske pozicije na tržištu. Međutim, implementacija Just-in-sequence pristupa se može koristiti za minimiziranje nedostataka Just-in-time strategije. Autor sveobuhvatnom analizom literature objašnjava Just-in-sequence pristup. Upoređujući Just-in-time i Just-in-sequence pristup autor ukazuje na razlike između njih. Empirijsko istraživanje pokazuje stepen implementacije Just-in-sequence pristupa u dva automobilska klastera (jedan iz Republike Austrije i drugi iz Republike Srbije). Objašnjavanjem razloga za selekciju klastera iz ovih zmalja, uz upotrebu adekvatnih statističkih meotda, autor ukazuje na razlike između uzoraka.

***Ključne reči**: Just-in-sequence, Just-in-time, lanac snabdevanja, automobilska industrija.*

1. Introduction

Supply chains from automotive industry are very complex. Reason for its complexity becomes from a great number of partners, from suppliers (inbound supply chain from automotive industry include a huge number of supplier tiers), producers, distributors to retailers and customers, and also from great number of different components that are necessery for final product (Lešková; Thun, Drüke & Hoenig, 2011, 5511). This level of complexity is present also in supply chains from electronic industry, aviation industry etc. Logistics managment represent imperative for efficient and effective managing of automotive industry, as a very complex area. Each partner in supply chain has a task to integrate all aspects of logistics (Reichhart & Howleng, 2007):

- Internal logistics with focus on networking procurement, transportation, inventory control with information systems, planning, production, inspection, and delivery of final product in one process, and
- External logistics with focus on networking internal operations with sub-suppliers, sales, warehouse management, distribution networks, service providers, and customers.

Inbound logistics activities, in companies from automotive industry, are very complex because of a large number of components that are necessary in production of final product, and because of a great number of suppliers those components. Design of inbound logistics system and flows of material could be a factor of production continuity. Inadequate inbound logistics system can cause interruptions in production, and market supplying. Also, design of inbound logistics is very important because of high logistics cost, which are

results of great number of materials handling operations: unload, load, sort, transfer, packaging, building of loading units, etc. Efficiency of these operations depends from inbound logistics design. These are the reasons why inbound logistics activities need a high level of coordination. From the other side, market requirements influence on outbound logistics activities also in terms of complexity. The fragmentation and segmentation of vehicle models are growing, according to market requirements. Companies from automative industry by customised models and variants try to answer to the customer requests. This makes a complexity of outbound logistics operations. This inbound and outbound logistics complexity makes a huge problem for production-logistics operations of automotive industry. Just-in-Time for this automative environment is not enough. Just-in-Time delivery for this situation resulting in more factory space needed, higher stock levels, elevated handling costs and more problems in the assembly line. Just-in-Sequence is more appropriate for mass-customised production (Wagner & Silveira-Camargos, 2011). In automotive industry exist a lot of terms for sequcencing as sequential supply, just-in-time sequencing, in-line vehicle sequencing, just-in-sequence, sequence parts delivery, synchronized delivery and body-on-sequence (Baudin, 2004). Results of this delivery and production approach are: keeping low level inventories, maintaining fast throughput and reducing the amount of working capital tied up in the process.

2. Literature review

Producers from automotive industry are faced with increased competition. This industry is one of the most globalized, because of the great influence of global flows on companies from automotive industry. One automotive producer could have hundreds of suppliers, from many different countries. Each from these suppliers could be a reason for interruption of production.

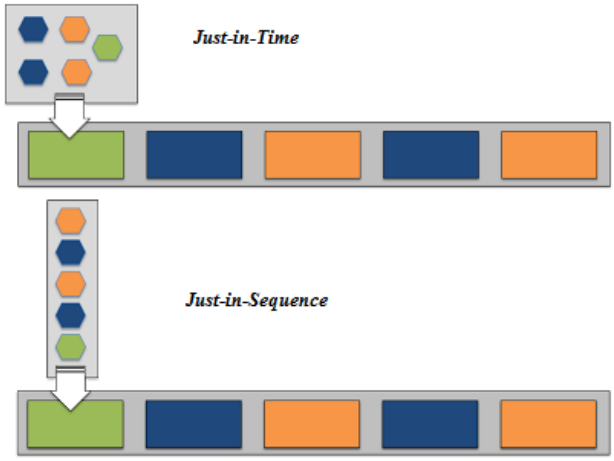
Decision about keeping inventory, as a buffer, in case of unpredictable events is contrary to Just-in-time (JIT) philosophy. This because warehouse and warehousing of inventory present a waste for JIT philosophy. Inventory reduction leads to reducing of warehouse costs and material handling costs, but with increasing productivity. But on the other side, unpredictable events caused by suppliers, leads to increase carefulness of producers from automotive industry, and for today's unpredictable environment it is necessery developing strong buyer–supplier relationships through commitment.

Just-in-Time (JIT), as a strategy of inventory management, for automotive industry, creates the possibility of ensuring enough inventories for current and expected customer requirements. In automotive supply chains we can recognize pull system of moving components, where suppliers answer on the

customers request after their orders. So suppliers will deliver components only if those components are needed. After delivering, components will be in warehouse of producers until final assembly. In automotive industry, modules represent groups of similar components with the same or related tasks. Connection of modules makes platforms which could be used for developing different automotive models. System of modules and platforms could be used for production according on individual customer requirements and for delivery according to schedules of final automotive producers (Lešková). This system of production enable to producers to make different models of automotive in the same plant. On this way producers will be able to reduce the costs of production based on economies of scale and full utilization of production capacity each partner from automotive supply chain.

In modern bussines conditions for automotive industry it is not enough that suppliers have abitity to deliver components on-time, but also is important sequence of delivery, as a condition of minimizing warehouse costs, as well as inventory costs. Because of this requirement supply chains from automotive industry need delivery according to assembly process. In theory and practice this tipe of delivery has called Just-in-Sequence (JIS).

Figure 1. Just-in-Time and Just-in-Sequence in production process



Source: The Lean Mile, Just in Time – Klingt einfach, kennt jeder, kann keiner? (2013), Retrieved from: http://theleanmile.blogspot.rs/2013/06/just-in-time-klingt-einfach-kennt-jeder.html, Accessed on: 22 March 2017.

JIS is strategy of inventory managment. JIS means that components from suppliers arrive at assembly line, at specific moment, when they are needed, not before, what is case in JIT. Each component arrives at the right time, at the right sequence and in adequate version. Considering that components

arrive at right moment, workers on the assembly line, take components directly from containers or pallets and install into final product, without warehousing or sorting. Figure 1 shows difference in organising process of production between JIT and JIS strategy. There are many differences between JIT and JIS strategy. The key of them are presented in following table.

Table 1. Relations between Just-in-Time and Just-in-Sequence

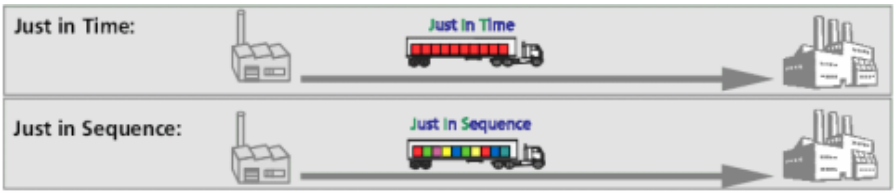
Characteristics	***Just-in-Time***	***Just-in-Sequence***
Safty buffer	Inefficient	Highly inefficient
Module Specification	Low	Maximal
Requirements for IT system	Integrated	Fully integrated
Stability of sequence	Irrelevant	Absolute necessity
Downturn reaction times	Hours/days	Hours/minutes
Switching cost	High	Maximal

Source: Wagner, S. M. & Silveira-Camargos, V. (2011). Decision model for the application of just-in-sequence. International Journal of Production Research, 49 (19), p. 5714.

Adventage of JIS over the JIT is in adequate sequence for supplying and delivering components. Figure 2 shows JIS in delivery process. JIS concept includes sequence according to the customer's production schedule. This means that JIS requires a high level of synchronisation between production process of suppliers and customers. In that sence, it could be possible to recognize three generic types of sequenced delivery from external suppliers can be observed (Graf, 2007; Wagner & Silveira-Camargos, 2011):

1. Delivers are direct from suppliers to producer's plant;
2. Suppliers deliver semi-finished modules to final assembly plant which is located near to producer's plant.

Figure 2. Just-in-Time and Just-in-Sequence in delivery process



Source: Lešková, A. Logistics concept of supply chain in automotive production, Retrieved from: http://web2.vslg.cz/fotogalerie/acta_logistica/2012/3-cislo/4_leskova.pdf, Accessed on: 15 February 2017.

Synchronisation between delivery of suppliers and production process depends from sharing information and transparency among partners in supply chain. By sharing information, partners will be able to detect on time each

possible disorder. Synchronization implies suppliers' production and delivery of components according to the schedule (Bautista & Fortuny-Santos, 2016). Relationship between suppliers and automotive producer need to be stronger for implementation JIS concept, than for JIT (Wagner & Silveira-Camargos, 2012). Johansson (1991) points on three tipes of supply system: (1) continuous supply, (2) batch supply and (3) kitting. According to Figure 3 continuous supply is present in situation when all part numbers of materials are delivered and sorted by part number. Batch could be recognized in situation when select part numbers are delivered, but sorted by part number. The last tipe of supply sistem, kitting, includes selection of part numbers material, but sortet accorting to assembly object. Sequencing of single components sorted by assembly object or Just-in-Sequence is not mentioned in Johansson's supply systems.

Figure 3. Johansson's supply systems

	Selection of part number	All part numbers
Sorted by part number	BATCH	CONTINUOUS
Sorted by assembly object	KITTING	

Source: Johansson, M. I. (1991). Kitting systems for small size parts in manual assembly systems. In Pridham, M & O'Brien (Eds.), Production research: approaching the 21st century (225-230). London: Taylor & Francis.

Kitting is become very important for automotive industry and substitution for continuous supply. Kitting includes a low level of inventory and delivering of components to assembly line sorted according to assembly needs. That means that adequate components are grouped, kitted and putted in kit container. According to this there are similarities between sequenced delivery and kitting. The key difference between those two concepts is that kitting includes a few components that will send to assembly object, and for sequencing only single component. Compared to continuously supply, benefits of kitting and sequencing are results of flexibility and control. This is because the concepts of kitting and sequencing include handling and routing of each individual component in assembly system.

According to Bozer and McGinnis (1992) kit is group or collection of parts, components or subassemblies in the same container needed for given product or retail. Explanation for kit according to Johansson (1991) is that is a set of parts which are need for assembly object. Kitting is very important in situation with a great number of components and variants, also. But this way of delivery to the assembly line is not the best solution in serial lines, where each assembly station has a many components. Companies with production

of complex product also are not adequate for implementation kitting concept (Bozer & McGinnis, 1992).

JIS could be used as a source of competetive adventages thanks to benefits of implementation this concept. Benefits of implementation of JIS concept are: low level of inventory, perfect synchronisation of material flows, high level of leaness of process, customised products (Lešková). Without implementation of JIS concept each component or part of final product need to be stocked nearly to the production process (Lešková). Beside this benefits implementation of JIS concept lead to (Kafer, 2007):

- Decreasing cost of capital lockup as a result of low level of inventory at the producer's as well as at the supplier's;
- Less needs for space because of direct delivery at assembly line from the loading carrier;
- High degree of production flexibility and customization according to specific customer orders;
- Shorter cycle time, as a result of sequenced delivery.

Positive effects from implementation JIS concept depends from following elements (Wagner & Silveira-Camargos, 2012):

- Supplier management - include monitoring of supply base by standardized key performance indicators (KPIs). KPIs could be used as a measure and signal for acting in situation when producer assess that the suppliers will not achieve the planned results (in terms of quantity and/or quality of materials, delivery lead time and etc.). This is the way of improving supplier performances in short time.
- Sequence stability - Is necessery for efficient planning and operating with less working capital. Stabile production is imperativ of implementation of JIS concept. Also, stabile prodution with low internal complexity (in terms of building less models on a single body) is a condition for JIS concept implementation. With stabile sequence, suppliers do not have a problem with planning its production of materials.
- Process transparency - Has a positive influence on stability of production and sequence. Also, high level of transparency between producer and its supplier base is necessery for identification the potential interruptions, on the right time. So, for positive effects of JIS concept implementation it is necessery installing appropriate information technology, between suppliers and producer.
- Crisis management - Includes proactive reaction on unpredictable events. Proactive reaction consist defining of training plan, simulations of operating in case of unpredictable events, prepare for risk events through "learning by doing".

High level of transparency and information exchange is necessary for sequenced deliveres. Also, implementation of JIS requires frequently deliveries and high level of coordination and colaboration between suppliers and producers (Baudin, 2004). Frequent deliveries and smaller quantities are one of the ways for solving the inventory problem. This could be a source of increasing cost of transportation. For JIS concept where suppliers deliver components arranged according to production sequence, high cost of transportation could not be a problem (Johansson & Medbo, 2004). It is obvious that JIS is approach of short order lead-times and delivery on-time to the customers. In the same time, those two things are necessary for sustainability of JIS. According to Meissner (2010) on stability and sustainability of JIS concept have influence:

- Process control effectiveness;
- Material supply reliability;
- Process quality;
- Product planning stability;
- Infrastructure and layout design of the plant.

The mid-twentieth century producers from automotive industry had a great number of suppliers, in some cases more than 2,000. Problems with coordination between all partners were a reason for reducing supplier base. Car porducers made decision to have a direct comunication with small number of suppliers ie first-tier suppliers. These suppliers have obligation to deliver aggregate parts or group of components. This way of supply has higher level of transparency, greater efficency and better coordination between car producers and its first-tier supplier. Also, all these implications are necessery for synchronous producing. According to this we can conclude that suppliers' performances depend from car producers, and also have a influence on ability of suppliers to deliver parts Just-in-time (Bautista & Fortuny-Santos, 2016). Nissan is well known as a company that recognized importance of synchronized production and developed the Nissan Production Way (NPW). NPW was made with purpose to answer on real consumer requirements, but with coordination of all operations and materials. Principles of NPW are (Bautista & Fortuny-Santos, 2015):

- Never ending synchronization with the customer - Nissan uses the term *Douki-Seisan* which includes sequenced and simultaneous/synchronized production. This way of production requires complete synchronization among all partners in supply chain, after customer places an order. Also, this kind of production requires sharing information and an efficient procurement and manufacturing system.
- Never ending quests to identify problems and put in place solutions – Identify gaps between desired manufacturing state and present

manufacturing settings. Nissan uses the term *Genba kanri* – shop floor management to solve problems where they occur most (in the shop floor) and make improvements.

For Nissan is very important sustainability of production sequence, because that is the requirement for producing all parts and components of product according to the same schedule, and inventories will be not necessary (Bautista & Fortuny-Santos, 2015).

The key problems of JIS are risk problems and availability of JIS supply. Possibility of real-time monitoring of material flow in supply chain can help for detecting problems of supply on time. If some company define order of delivery and sequence for every supplier and each material it is necessary to make change its production and assembly processes, according to defined delivery order and sequence (Bányai, 2013). Lacks of JIS are result of potential risk events, which are not rare in case of implementation JIS concept. Sensitivity of production process and distruptions in case of delays of delivery, absence of delivery, wrong or defective components or quality problems (Kafer, 2007). Production process with implemented JIS concept is very complex because of each components need to be delivered in right time, on right place at assembly line according to precise sequence. According to this, dependence of producer from suppliers is huge, in context of delivery on time.

3. Research methodology

Empirical research analyses the area of supply chain management, which, so far, has not been sufficiently analysed in the Republic of Serbia. Even more so, results of research and ideas, as a pioneering venture, will lay the foundation for further research in the field of automotive industry because concept of JIS is very important for continuity of supply chain functioning. Research will fulfil its mission in terms of promoting implementation of JIS throught whole supply chain, as a tool for increasing competitive advantage in modern automotive industry. Complex supply chains, as supply chains from automotive industry, are the best examples for analizing and observing implementation of supply chain concept. Beside this, selection of automotive clusters for empirical research is justified by the fact that clusters are kind of interorganizational networking, as well as supply chians. Selection of automotive clusters from Republic of Serbia and Rapublic of Austira and comparation of the results of JIS concept implementation is justified with fact that those two countries have automotive industry but do not have automotive as a final product. Also, author analysing economy of the Republic of Austria as an example of the best practice, based on development of small and

medium enterprises sector, and Republic of Serbia could used experience of Republic of Austria in the filed of automotive industry.

Questionnaire is used for data collecting in Republic of Austria as well as in Republic of Serbia. Research in Republic of Serbia was conducted from 01st June to 31st August 2016, and in Republic of Austria from 01st September to 30 September 2016, during a study visit of author at the University of Economics in Vienna. The questionnaire includes two parts. The first part includes general questions about the company (name, business address, legal form of the company, the origin of capital and etc.). The second part of the questionnaire is related with implementation of JIS concept through automotive industry and containes statements about elements of JIS concept, which are necessary for the implementation of this concept.

According to Meissner (2010) and Wagner & Silveira-Camargos (2012) the most important elements for implementation JIS concept are: supplier management and monitoring, sequence stability, process transparency and crisis management. Using this elements author defined following variables for measuring level of JIS concept implementation: Politics of supplying includes monitoring of suppliers by the producer (1), Exchange of information is on daily level (2), Information technologies are implemented at the level of the network (3), Information technologies are implemented at the level of company (4), Deliveries of raw materials are frequent (from 1 to 3 days) (5), Deliveries are small considering its quantity (6), Production is modular (7), Results of production are a small number of models (8), Training of emplyee are used for responding on crisis situations (9) and Simulations are used for responding on crisis situations (10). Managers of companies, from the sample, were asked to express their opinion on the level of agreement with the statements by Likert scale (1 – I totally disagree, 2 – I partially disagree, 3 – I have no opinion, 4 – I partially agree, 5 – I fully agree). In purposes of empirical research, author used different statistical methods. Beginning from unavoidable descriptive statistics (arithmetic mean analysis, frequency, standard deviation), author used variance analysis and correlations between variables.

3.1. Analising of sample

Automotive industry of Republic of Austria each year earns EUR 43 billion in revenue (Association of the Austrian Vehicle Industry). From Republic of Austria has been chosen Styrian Automotive Cluster (ACstyria), as excellent example of networking in automotive sector. ACstyria was founded in 1995. The main goal of developing ACstyria is promoting automobile-industry competency. The mission of ACstyria Autocluster is integrating all stakeholders from the business, academic and political sector into a robust network, and identifing areas for improvement and investment (ACstyria

Autocluster). Today, ACstyria has a 250 partner companies from different fields: production, services, research and development; and more than 50,000 employees (ACstyria Autocluster). ACstyria has also ACstyria Academy which was found for traning and developing competences. Automotive cluster of Serbia (AC Serbia) is a network of enterpisess and organizations which are part of automotive sector. Members of AC Serbia are suppliers of automotive components and services. The most important aims of AC Serbia are: increasing competitiveness of the cluster's members, achieving long-term profit-making positions within the chain of added value of international car manufacturers and indirectly improving the economic position of the automotive sector. AC Serbia has over the 40 members and 15 partners and partner and supporting institutions (AC Serbia). For purpose of researching questionnaires were sent on 190 e-mail addresses of companies which belongs to ACstyria and 36 e-mail addresses of companies which belongs to AC Serbia. From first cluster 22 companies sent respond and from AC Serbia number of answer are 15.

3.2. Define of hypotheses

Researching defined variables author assesses level of JIS concept impelemntation in two selected automotive clusters. This is the way for identifing differences (if they exist) between analyzed clusters, as well as the variables that need to be improved in order to utilization of the benefits from the implementation of JIS concept. In addition, the author analyzes the influence of complexity on level of JIS concept impelemntation. As an indicator of the complexity author used the number of partners networked through cluster. In this sense, first hypothesis is defined:

H_1: Level of JIS concept implementation depends from number of partners

This hypothesis is based on the fact that it is easier to manage with a smaller number of partners and expectation is that will be easier to implement and develop JIS concept in supply chains with smaller number of partners or in those situations where producers directly communicate only with first tiers suppliers.

As mentioned that one of the key disadvantages of JIS concept is possibility of distruption of production due to the small change and disrespect sequencing, second hypothesis is defined as:

H_2: Distruptions are present in supply chains with a higher level of JIS concept implementation.

4. Research results and discussion

According to results of descriptive statistics tested enterprises from AC Serbia five from ten variables have got mean value less than 3.5. Variables with the highest marks are Deliveries of raw materials are frequent (from 1 to 3 days), Deliveries are small considering its quantity, and Results of production are a small number of models (4.6). The lowest mean value has variable Simulations are used for responding on crisis situations (1.8667). The greatest degree of agreement between companie's managers from the sample is present in the case of variable Politics of supplying includes monitoring of suppliers by the producer (0.83381) in terms of underrepresentation of this variable within the cluster.

Table 2. Descriptive statistics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
AC Serbia N = 15										
Min.	1.00	2.00	2.00	3.00	4.00	4.00	3.00	4.00	1.00	1.00
Max.	3.00	4.00	3.00	4.00	5.00	5.00	5.00	5.00	3.00	3.00
Mean	2.1333	2.8667	2.4000	3.6000	4.6000	4.6000	4.2000	4.6000	2.2000	1.8667
Std. Deviation	.83381	.63994	.50709	.50709	.50709	.50709	.77460	.50709	.77460	.51640
ACstyria N = 22										
Min.	3.00	3.00	3.00	3.00	3.00	3.00	4.00	3.00	3.00	3.00
Max.	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Mean	4.0909	4.1364	3.8636	4.6364	4.0909	4.5000	4.5000	4.0455	3.8182	3.7273
Std. Deviation	.81118	.77432	.63960	.72673	.81118	.74001	.51177	.78542	.79501	.70250

Source: Author's calculation

Menagers of enterprises from ACstyria cluster have assessed all analized variables with marks above 3.5. Variables with the higher marks, according to manager's opinion, are Deliveries are small considering its quantity and Production is modular (4.5). Simulations are used for responding on crisis situations is variable with the lowest mark. However, even with the lowest mark this variable has a rating above 3.5. The highest level of agreement, between enterpreses's managers is present in case of variables Politics of supplying includes monitoring of suppliers by the producer and Deliveries of raw materials are frequent (from 1 to 3 days) (0.81118). According to manager's opinions and results of analysis for both clusters it could be concluded that the degree of JIS concept implementation at AC Serbian is on unenviable level. In addition, it is very worrying level of implementation of information technology at the level of the network, and at the level of company. Lack of information technology at the level of company, as well as

at the level of the network could be a limitation for daily exchange of information, and also for higher degree of transparency, which is one of the conditions for JIS concept implementation.

Table 3. Correlations between variables

Varibales		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1)	Pearson Correlation		.571*	-.526*	543**	566**		.459*			
	Sig. (2-tailed)		.026	.012	.009	.006		.032			
(2)	Pearson Correlation	.571*			.769**		.540**	-.519*			
	Sig. (2-tailed)	.026			.000		.009	.048			
(3)	Pearson Correlation	-.526*			.667**	-.526*	.453*				
	Sig. (2-tailed)	.012			.007	.012	.034				
(4)	Pearson Correlation	.543**	.769**	.667**		.543**		.512*			.600*
	Sig. (2-tailed)	.009	.000	.007		.009		.015			.018
(5)	Pearson Correlation	.566**		-.526*	.543**		1.000*	.764**	1.000*		
	Sig. (2-tailed)	.006		.012	.009		0.000	.001	0.000		
(6)	Pearson Correlation		.540**	.453*		1.000*		.764**	1.000*		
	Sig. (2-tailed)		.009	.034		0.000		.001	0.000		
(7)	Pearson Correlation	.459*	-.519*		.512*	.764**	.764**		.764**	.468*	
	Sig. (2-tailed)	.032	.048		.015	.001	.001		.001	.028	
(8)	Pearson Correlation					1.000*	1.000*	.764**			
	Sig. (2-tailed)					0.000	0.000	.001			
(9)	Pearson Correlation							.468*			.786**
	Sig. (2-tailed)							.028			.001
(10)	Pearson Correlation				.600*					.786**	
	Sig. (2-tailed)				.018					.001	

* Correlation is significant at the 0.05 level (2-tailed).** Correlation is significant at the 0.01 level (2-tailed).

AC Serbia; ACstyria; AC Serbia and ACstyria

Source: Author's calculation

The table 3 shows the correlation between the variables in analyzed automotive clusters. Using the Pearson method have been determined connections between the variables whereby table shows only variables between exist statistical significant correlation (Sig. <0.01 or Sig. <0.05). Analised automotive clusters have the same resuls, in terms of correlations between variables only in next cases Deliveries of raw materials are frequent and Production is modular, Production is modular and Deliveries are small considering its quantity, as well as between Training of emplyee are used for responding on crisis situations and Simulations are used for responding on crisis situations. According to manager's opinions from AStyria, Production is modular is variable which is in correlations with the greatest number of the variables. According to mark of this variable (4.5) it is impression that the enterprises networked through AStiria recognized the importance of this variable as very important for the implementation and sustainability JIS concept.

In past few years the Fiat company (enterprises are networked in AC Serbia around this company), was faced with disruptions of production process (in June and October 2013 and September 2014). Analyzing the reasons of disruptions of production process of Fiat, in the past five years, it was found that the key reasons are delays of delivery by suppliers, blocked of railways, while the last disruption was a result of the economic crisis on the European and world market. From all disruption reasons, only the first had internal character and it was easier to predict or manage in terms of successful avoiding. Also, this imposes the need to analyze the variables Privacy supply includes monitoring of suppliers by the manufacturer. This variable is assesed with low mark. Also, this variable (according to manager's oppinion) is correlated with variable Exchange of information on a daily basis. Therefore, the establishment of better relations and monitoring of suppliers in the cluster requires exchanging information on a daily basis. This is at the same time the answer on the second hypothesis about influence of implementation of JIS concept at the number of disruptions and/or interruptions in supply chain. In the last 3 years ACstyria Cluster has never faced with some disruption despite the fact that managers recognize high level of JIS concept implementation. In addition during the same period AC Serbia was faced with disruptions three times espite the fact that managers recognize low level of JIS concept implementation.

The answer on the first hypothesis requires the application of analysis of variance. According to marks of JIS variables and the number of partners in the analyzed clusters author is assessed the impact of complexity on implementation and sustainability of JIS concept. In this case additional hypotheses should be formulated as it follows:

H_0: There is no difference in implementation JIS concept between clusters with a different level of complexity, which is a result of number of partners, and

H_1: There is difference in implementation JIS concept between clusters with a different level of complexity, which is a result of number of partners.

Table 4. Analysis of variance

		Sum of Squares	df	Mean Square	F	Sig.
(1)	Between Groups	34,178	1	34,178	50,792	,000
	Within Groups	23,552	35	,673		
(2)	Between Groups	14,378	1	14,378	27,463	,000
	Within Groups	18,324	35	,524		
(3)	Between Groups	19,106	1	19,106	54,854	,000
	Within Groups	12,191	35	,348		
(4)	Between Groups	9,579	1	9,579	22,822	,000
	Within Groups	14,691	35	,420		
(5)	Between Groups	2,312	1	2,312	4,645	,038
	Within Groups	17,418	35	,498		
(6)	Between Groups	,089	1	,089	,207	,652
	Within Groups	15,100	35	,431		
(7)	Between Groups	,803	1	,803	2,021	,164
	Within Groups	13,900	35	,397		
(8)	Between Groups	2,743	1	2,743	5,799	,021
	Within Groups	16,555	35	,473		
(9)	Between Groups	23,354	1	23,354	37,716	,000
	Within Groups	21,673	35	,619		
(10)	Between Groups	30,876	1	30,876	76,659	,000
	Within Groups	14,097	35	,403		

Source: Author's calculation

Results of analysis of variance in Table 4 shows that Sig. <0.05 for eight from ten tested variables These results confirm that there is a statistically significant difference between the samples tested. Thus, the degree of complexity, which is the result of a greater number of partners, can be a limitation of JIS concept implementation. The null hypothesis could be accept only for variables Deliveries are small considering its quantity and Production is modular, which means that only these variables do not depend from the number of partners in supply chain.

4. Conclusions

Empirical research on a selected sample has showed significant differences in the implementation of JIS concept in two analyzed automotive clusters.

According to the marks of variables has been determined higher level of JIS concept implementation into AStyria cluster. In spite of expectations that higher level of JIS concept implementation has influence on the increase number of disruptions, due to the need for greater coordination and organization of activities, it was found that the disruptions were present in cluster with a lower level of implementation of JIS concept. Therefore, disruptions in the supply chain not necessarily be result of JIS strategy.

Author was found that the number of partners, as a factor of the supply chain complexity, on analyzed sample can affect the implementation of JIS concept. Automotive supply chains are very complex. First, because of a great number of partners, which are connected directly or indirectly, from suppliers (first, second, third tier...) to final customer. Second, becuse of a great number of components, modules and plaforms necessary for production final products. However, based on the analyzed clusters can not be confirmed that a great number of partners could be limitation for JIS concept. Moreover lower level of JIS concept implementation is present in cluster with fewer partners.

These results show that the JIS concept does not necessarily lead to problems, especially not in a situation where exists control of effectiveness, material supply reliability, process quality, product planning stability, adequate infrastructure and layout design of the plant. Research results could be used for further testing of poor implementation of JIS concept through cluster AC Serbia. But certainly as one of the reasons for the successful implementation this concept in AStiria compared to AC Serbia are variables with a higher marks variables Politics of supplying includes monitoring of suppliers by the producer, Exchange of information is on daily level, Information technologies are implemented at the level of the network, Training of emplyee are used for responding on crisis situations and Simulations are used for responding on crisis situations.

References

AC Serbia, Serbian Automotive Cluster, Retrieved from: https://www.acserbia.org.rs/

ACstyria Autocluster, Retrieved from: http://www.acstyria.com/en/acstyria/

Association of the Austrian Vehicle Industry. (2015). *Statistical Yearbook 2015* Retrieved from: www.fahrzeugindustrie.at

Bányai, Á. (2013). Just In Sequence Supply with Multilevel Cross Docking. *Advanced Logistic Systems*, 7(2), 5–12.

Baudin, M. (2004). *Lean Logistics: The Nuts and Bolts of Delivering Materials and Goods*. New York: Productivity press.

Bautista, J., & Fortuny-Santos, J. (2015). *A conceptual model to manage supply sequences in automotive industry for Nissan Barcelona*. Paper presented at the XXI International Conference on Industrial Engineering and Operations Management, 9th International Conference on Industrial Engineering and

Industrial Management, International IIE Conference 2015, Aveiro, Portugal. July 6-8, 2015.

Bautista, J., & Fortuny-Santos, J. (2016). Improving "Just-In-Time, Just-In-Sequence" Delivery in First-Tier Suppliers. *Brazilian Journal of Operations & Production Management*, 13(3), 286-298.

Bozer, Y. A., & Mc Ginnis, L. F. (1992). Kitting versus line stocking: A conceptual framework and a descriptive model. *International Jorunal of Production Economics*, 28(1), 1-19.

Casestudyinc.com. (2011). *Nissan Production Way*. Retrieved from: http://www.casestudyinc.com/nissan-production-way

Graf, H. (2007). Innovative logistics is a vital part of transformable factories in the automotive industry. In Dashchenko, A. I. (Ed.), *Reconfigurable Manufacturing Systems and Transformable Factories* (pp. 423-457). Berlin, Germany: Springer.

Johansson, E., & Medbo, L. (2004). Use of product data in the design of the materials supply system. *Journal of Manufacturing Technology Management*, 15(7), 641–650.

Johansson, M. I. (1991). Kitting systems for small size parts in manual assembly systems. In Pridham, M & O'Brien (Eds.), *Production research: approaching the 21st century* (pp. 225-230). London: Taylor & Francis.

Kafer, R. (2007). Advantages and disadvantages of a Just in time/Just in sequence production. *10th Doctorate Conference on 20 november 2007 Herlay* (pp. 205-207).

Lešková, A. *Logistics concept of supply chain in automotive production*. Retrieved from: http://web2.vslg.cz/fotogalerie/acta_logistica/2012/3-cislo/4_leskova.pdf

Meissner, S. (2010). Controlling just-in-sequence flow-production. *Logistics Research*, 2(1), 45-53.

Reichhart, A., & Holweg, M. (2007). Creating the customer-responsive supply chain: A reconciliation of concepts. *International Journal of Operations & Production Management*, 27(11), 1144-1172.

The Lean Mile. (2013). *Just in Time – Klingt einfach, kennt jeder, kann keiner?* Retrieved from: http://theleanmile.blogspot.rs/2013/06/just-in-time-klingt-einfach-kennt-jeder.html

Thun, J. H., Drüke, M., & Hoenig, D. (2011). Managing uncertainty – an empirical analysis of supply chain risk management in small and mediumsized enterprises. *International Journal of Production Research*, 49(15), 5511-5525.

Wagner, S. M., & Silveira-Camargos, V. (2011). Decision model for the application of just-in-sequence. *International Journal of Production Research*, 49(19), 5713-5736.

Wagner, S. M., & Silveira-Camargos, V. (2012). Managing Risks in Just-In-Sequence Supply Networks: Exploratory Evidence from Automakers. *IEEE Transactions on Engineering Management*, 59(1), 52-64.