Overcoming the barriers of consignment stock policy implementation in a manufacturing company

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Abstract. The present study represents a part of a wider research, centered on consignment stock program adoption and implementation in a supply chain governed by lean and agile strategies. The paper attempts to explore the challenges and the barriers which may occur prior or during the implementation stages of the project, to identify and mitigate the risks and also to establish safe approaches to overcome project failure. The work includes a brief overview on consignment stock model and its benefits, along with the implementation risks perceived by the internal stakeholders, mostly viewed as a human factor reaction to change. The methodology consists of a survey addressed to the business functions directly affected by the project, in order to identify the main barriers and risks, and of an assessment of the risk severity and its distribution within and among different groups of stakeholders, using One-way ANOVA statistical method. A solutions framework to the identified risks is proposed, in order to overcome implementation barriers.

1. Introduction

In manufacturing companies, the levels of inventories at all stages, as raw material, work-in-process and finished goods inventories, may indicate the company's competitive positioning. Lowering the inventory in terms of level and value, especially for the purchased items as raw materials and packaging, is an essential objective in any business environment [1]. In this view, 'consignment stock' (CS) represents a particular case of the vendor managed inventory approach, where the vendor maintains a stock of materials at the buyer's plant, which in the present case is the manufacturing company. The idea is based on a close collaboration between the vendor and the buyer, aiming to create a win-win situation through revenue sharing [2-3]. In accordance with a general CS policy, the vendor guarantees the buyer to continuously keep a stock between a minimum and a maximum level, limits that have been agreed between the two parties [4].

Under a CS approach, the inventory location is with the buyer, along with the holding costs for stocking items and ordering responsibility, while the inventory ownership is with the vendor, until the stock is consumed [5]. At that moment, the inventory which corresponds to the consumed amount is transferred to the buyer, via invoicing, usually once or twice a month, depending on the consignment agreement concluded between the parties. As a consequence, there are no financial implications for the buyer concerning the consigned stock, meaning that the overall raw materials or packaging inventory is diminished with the value of the consigned materials. There are several benefits associated with CS implementation, as 'zero cost' for the consigned inventory, 'zero' procurement lead-times, no out of stock situations, improved cash-flow, no more disruptions and forecast accuracy problems, just to name a few of them. All of these contribute to enhanced agility, while shortening the chain downstream towards the final customer. From the benefits point of view, CS model seems to be a very attractive proposal, however every significant change is linked to challenges and brings elements that can't be neglected and need to be identified and deeply assessed prior to the decision making process, in order to find out at what extent is a supply chain or an organization ready to adopt it, and how to proceed in order to avoid an implementation failure. There have been discussions and studies that revealed the fact that supply chains under certain management strategies, as lean and agile practices for example, are more suitable to support innovative initiatives and transformation processes, improving overall performance [5-8].

Lean and Agile strategies seem to be a very common approach that companies choose to adopt, in order to get enhanced efficiency and effectiveness in their supply chains [9]. Lean technics are mostly used to improve effectiveness [10], while agile tools enable the chain to become more flexible, increasing its adaptability, towards greater responsiveness and customer satisfaction [5].

2. Problem formulation

The present research is based on exploratory case studies, represented by real attempts of CS implementation in two different subsidiaries of a multinational company. The two facilities, A and B, producing FMCG goods, are based in different countries, with certain differences in respect of the economic and legal environments. The medium size plant A was chosen as a pilot of CS adoption project, resulting in a successful implementation, discussed by Faur & Bungau (2019) [1]. Based on the positive and valuable outcome of plant A, the group management recommendation was to implement the same project in a larger size plant, B. Despite the fact that the two plants are part of the same organization, governed by the same strategies and rules, and having almost the same organizational culture, the idea of adopting CS in plant B generated several challenges to the project team, raised by the stakeholders. At a first sight it looked like a usual resistance to change, which is somehow in human's nature, but the things escalated and generated real barriers to the implementation process. In this respect, the present research aims to investigate and assess the risks associated with the challenges, and propose a solution framework, in order to overcome the barriers towards achieving the benefits of a CS program.

3. Research methodology

The data collection has been conducted by one of the authors, being part of the buying organization project team. A questionnaire survey has been addressed to the internal and external stakeholders, in order to find out their concerns and their risk perception regarding the CS system adoption. Once data consolidated, the main risks have been identified and all stakeholder categories have been asked through another questionnaire to assign scores between 1 and 5 to each identified risk, 1 being the score for the lowest risk and 5 for the highest risk. The data has been further analysed through one-way ANOVA statistical method, run in Matlab program. One-way (or single factor) analysis of variance, abbreviated ANOVA, is a statistical model that can be used to compare means of two or more samples, using the F distribution [11]. Developed by statistician and evolutionary biologist, Ronald Fisher, the method allows the estimation of the relative significance of different parameters within and among the groups [12].

4. Barriers and perceived risks identification and assessment

When it comes to acceptance of a new technology, a new business model adoption, or a new policy implementation, perceptions of risk and benefit are generally important, if not crucial [13-15].

Decision making needs to also consider risk perceptions and these perceptions are based on a frame of reference and sometimes on incomplete knowledge on the subject [16]. Provided information related to a new project can be insufficient or ambiguous, generating discomfort and sometimes a fake perception of risk. Perceived risks and benefits of an innovative approach are constantly subject to change, depending on the information shared and on the problem understanding degree. A new technology, a new policy may be perceived as risky, but, when it is embedded in routine behaviour the perception of it can change to not risky [17]. Furthermore, perceived risks and benefits also influence each other; the level of perceived benefits can have an impact on the acceptability levels of the perceived risks [18]. Slovic (1999) notes that risk is subjective, “from the initial structuring of a risk problem, to deciding which end-points or consequences to include in its analysis, identification and estimation of exposure, and so on”[19].

The perceived risk may consist of psychological, physical, financial, social, and performance factors [20] and can affect a decision implementation by bringing negative consequences [21]. Some authors also mention functional risk, and time risk [22]. The idea is to identify all type of perceived risks prior to a project implementation in order to prevent a negative outcome. Therefore, further research into this area is required. However, the perceived risk can have a negative relationship with the variable perceived benefit, generating barriers to a project implementation. Perceived risks might also have substantial impacts on the decisional processes for innovations [23-24]. From the above categories, the following risk types are most related to the present research: financial, functional, psychological, performance and time-related. Financial risk relates to the potential negative financial outcomes which are associated with new system adoption [25]. Psychological risk can be defined as anxiety and/or uncomfortable feelings arising from anticipated post-behavioural emotions such as worry and tension [26-27]. Functional and performance risk origin from the insufficient information shared, misaligned procedures, lack of knowledge, lack of training, or lack of understanding the functionality of the new proposed approach (how it works). Time risk relates to the perception that the adoption and use of an innovative idea will take too long [28], or will be a perceived as waste of time [29-30].

The carried-out surveys by the project team on B plant’ stakeholders revealed the main barrier categories, challenges and risks associated with the CS adoption and implementation process, presented in figure 1.

Barrier Category	Challenges	Perceived Risks
Internal processes	Extra resources not included in business plan (BP), additional workload and missing competences	- Inaccurate reports due to increased complexity - Extra financial resources for training requirements - Increased time per operation (more attention required) - Additional human resources vs BP - special aprovals needed, along with financial resources - Extra working time - overtime constraints
Organizational capabilities	Storage space limitation	- Reshape warehouse material flow due to extra storage place required by CS policy (material delimitation per each vendor)
Regulation	Legal constraints	- Lack of local legislation regarding CS concept
Financial	Additional reports and workload	- Weekly reconciliations with vendors - time consuming activities
Technical	Integrated information systems	- Lack of coordination and correlation in case the vendor uses a different system than SAP
Internal procedures	Clear procedures	- Misaligned procedures across functions
Vendor selection	Vendors evaluation	- Questioning suppliers' reliability and capabilities

Figure 1. Barrier categories, challenges and related risks that limit the implementation of CS program.

The collected data is influenced by people’s perceptions or interpretations. The consolidated data from the second questionnaire addressed to the stakeholders is reflected by table 2.

		Allocated scores by the internal stakeholders					
Risk no.	Perceived Risks	Planning	Finance	Operation	Procurement	RM Wh.	Legal
R1	Inaccurate reports due to increased complexity	3	4			5	
R2	Extra financial resources for training requirements	4	3	5	2	4	
R3	Increased time per operation (more attention required)	3	4	4		4	
R4	Additional human resources vs BP - special aprovals needed, along with financial resources		4			5	
R5	Extra working time - overtime constraints	3				4	
R6	Reshape warehouse material flow due to extra storage place required by CS policy (material delimitation per each vendor)			3	2	4	
R7	Lack of local legislation regarding CS concept		3	2	2		4
R8	Weekly reconciliations with vendors - time consuming activities	4	4	1		4	
R9	Lack of coordination and correlation in case the vendor uses a different system than SAP	4	4	1	3		
R10	Misaligned procedures across functions	2	3	3	2	4	3
R11	Questioning suppliers' reliability and capabilities		4		3		2
		Scores between 1-5 (1 lowest risk - 5 highest risk)					

Figure 2. Score allocation for the perceived risks.

Data analysis is further required in order to evaluate the risk dispersion on each steakholder category and the risk relationship among different categories.

5. Risk assessment using one-way ANOVA

ANOVA determines whether the groups created by the levels of the independent variable (the perceived risks, in our case) are statistically different by calculating whether the means of the treatment levels are different from the overall mean of the dependent variable (represented by the stakeholder groups). The test statistic, F, assumes independence of observations, homogeneous variances, and population normality. The one-way ANOVA tests the null hypothesis: $H_0 : \mu_1 = \mu_2 = ... = \mu_s$, where μ = group mean and s = number of groups, which states that samples in all groups are drawn from populations with the same mean values. If, however, the one-way ANOVA returns a statistically significant result, we accept the alternative hypothesis ($H_\alpha : \exists \mu_i \neq \mu_k, i \neq k$), which is that there are at least two group means that are statistically significantly different from each other.

Following the data processing in Matlab, ANOVA model provided the information highlighted in figure 3.

ANOVA Table

Source	SS	df	MS	F	Prob>F
Groups	16.7095	5	3.3419	4.8	0.002
Error	23.6905	34	0.69678		
Total	40.4	39			

Figure 3. Processed data through One-way ANOVA, in Matlab.

where ‘Groups’ represents SSA (Sum of Squares Among groups), defined by the following relation:

$$SSA = \sum_{k=1}^{s} n_k (\bar{x}_k - \bar{\bar{x}})^2 \quad (1)$$

$\bar{x}_k$ being the mean of group k; n_k is the number of values corresponding to group k and s is total number of groups;

‘Error’ (Matlab notation) represents SSW (Sum of Squares Within groups), calculated by the below relation:

$$SSW = \sum_{k=1}^{s} \sum_{i=1}^{n_k} (x_{ik} - \bar{x}_k)^2 \quad (2)$$

where x_{ik} is value i from group k and n is total number of values $n = n_1 + n_2 + ... + n_s$

‘Total’ means SST (Total Mean Square), representing the variance between groups;

‘SS’ = the numerical value of SSA and SSW;

‘df’ = the number of freedom degrees

‘MS’ reflects MSA (Mean Square among Groups) and MSW (Mean Square within Groups);

‘F’ = Fisher test - representing the ration of the mean squared errors (*MSA*/*MSW*);

'*p*' is the probability that the test statistic can take a value greater than or equal to the value of the test statistic, i.e., P (F >4.8). The small *p*-value of 0.002 indicates that differences between group means are significant (figure 2).

The synthesis of ANOVA application is presented in table 1.

Table 1. Synthesis of One-way ANOVA application

Variation source	Degrees of freedom	Sum of Squares	Mean Square (the variance)	F test
Among Groups	s-1	SSA	$MSA = \frac{SSA}{s-1}$	
Within Groups	n-s	SSW	$MSW = \frac{SSW}{n-s}$	$F_{calculat} = \frac{MSA}{MSW}$
Total	n-1	SST	$MST = \frac{SST}{n-1}$	

6. Results and interpretations

The performed statistical analysis revealed that signifficant differences exist in at least two groups from the compared ones. The differences refer to the severity degree of the risks.There are also differences between pairs of groups acting as a majority, and a third group: e.g. Finance and Raw Material Warehouse (RM Wh.) groups compared to Procurement – figure 4.

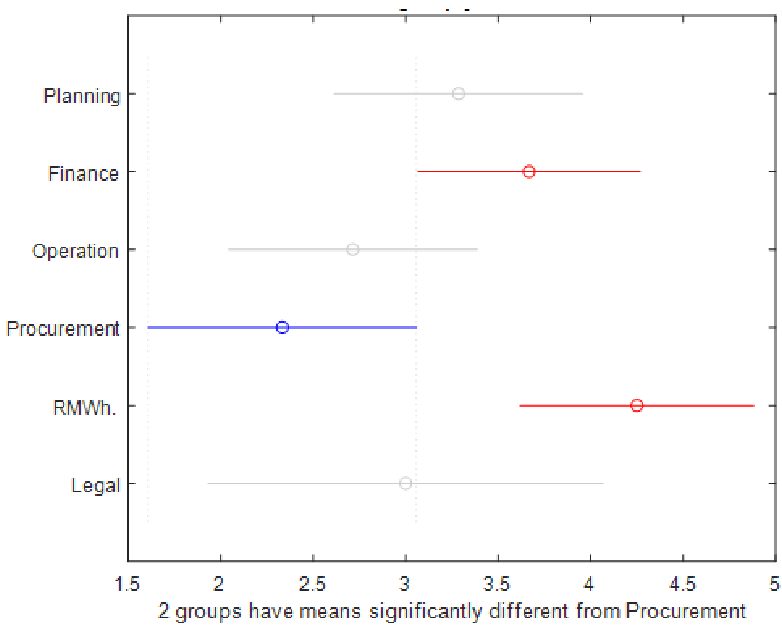

Figure 4. Risk severity degree between groups (Matlab generated).

ANOVA method also provided the output shown in figure 5, concerning risk dispersion within stakeholders.

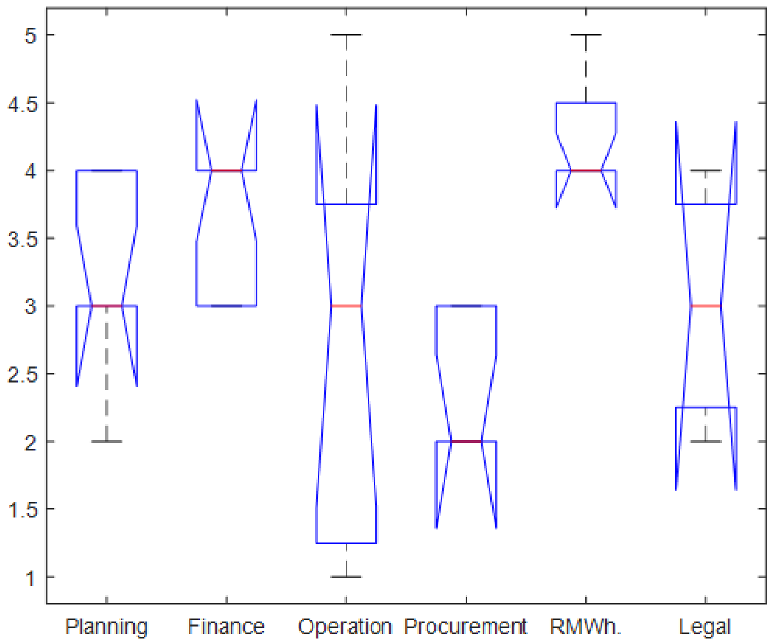

Figure 5. Perceived risk dispersion within groups (Matlab generated).

The output shows that there are significant differences among Procurement function and RM Wh. group in terms of risk severity. It can be seen that RM Wh. category is the most affected by the CS policy adoption, which is true, because the most activities connected with the new project are executed by this department. The scores assigned to the risks that are relevant for this compartment are concentrated at relative high level, compared to Procurement function, which has a risk level below average. Operation (Production) has a wide risk dispersion, which is somehow understandable, as almost all the other departments operate as support functions for the Production group and at the end all the perceived risks have an impact on the manufacturing process. Finance and RM Wh. have quite similar average risk levels and the same situation can be observed when comparing Planning, Operation and Legal functions. Procurement is the less impacted function and this is correct, as once the consignment agreements are concluded, Procurement responsibility is only to monitor the suppliers and the other groups to stick to the agreements. Legal compartment identified a reduced number of risks, but they cover a large range in terms of severity, almost like the Operation function. From the risk type perspective it has been found that finance and functional risks have the highest severity level (e.g. Finance group and RM Wh.).

The analysis provided a general view of the risk perceptions among and within the stakeholders. This approach helped to further more deeply assess the causes that generated the risks and the people perceptions. As a next step, a solution framework has been proposed, having the purpose to mitigate risks and bring them to an "acceptable level", make the stakeholders understand the outcome of the CS program and its great benefits for the business, in order to give the project an implementation chance. The solution framework is presented in figure 6.

Perceived Risks	Proposed solutions for "acceptable level" of risk
R1 - Inaccurate reports due to increased complexity	Resources allocation for new competences develpoment
R2 - Extra financial resources for training requirements	Organizing workshops with SAP experts on CS module
R3 - Increased time per operation (more attention required)	Skills development, motivating incentives
R4 - Additional human resources vs BP - special aprovals needed, along with financial resources	FTE (full time equivalent) re-calculation, additional resources allocation
R5 - Extra working time - overtime constraints	
R6 - Reshape warehouse material flow due to extra storage place required by CS policy (material delimitation per each vendor)	Re-thing stock dimensions for all materials in place; implementation plan / time-frame to be extended in order to properly prepare the storage space
R7 - Lack of local legislation regarding CS concept	Legal and Financial functions research in the field; finding a compromise solution; carrefully drafting vendor agreements
R8 - Weekly reconciliations with vendors - time consuming activities	System integration with vendors, for data visibility and transparency; ease-up reconciliation reports
R9 - Lack of coordination and correlation in case the vendor uses a different system than SAP	Technical know-how and expertize from consultants
R10 - Misaligned procedures across functions	Service level agreement on procedures across all implied functions
R11 - Questioning suppliers' reliability and capabilities	Accurate and transparent evaluation of vendors

Figure 6. Risk solution framework.

7. Conclusions

The case study reveals that even though a project implementation has a successful outcome in one facility of an organization, the same positive result is not warranted for another subsidiary of the same company, acting in a different economical and legal environment and having a larger size.

In case the challenges are addressed and the identified risks are assessed and brought to a level of acceptance, the chances of a positive implementation will significantly increase.

Many risk analysts assume that people opposition to innovative projects is mostly due to unfounded fears of their perceived risks. The one way ANOVA provided a useful output to analyse the risk dispersion within stakeholder groups and risk impact among different groups, which further permitted to investigate whether the perceived risks are real and have a significant degree of severity.

The assessment of the perceived risks demonstrates that people perception can be changed when the issues are properly addressed, problems are clarified, pertinent information is provided and targeted solutions are proposed.

The barriers arisen in a project implementation can be overcome by bringing the risks to an acceptable level, which could allow the acceptability of the project that has been judged or declined.

Further research objectives on the perceived risks might be in the range of grouping the risks by different criteria and exploring which specific risks are most predictive of acceptance.

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