Comprehensive Study on Wastages of Supply Chain Information Sharing in Automotive Industries

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Abstract. A supply chain is a very extensive concept, which encompasses many problems and features when it comes to controlling. Now a day’s lean concept is a very common method to several areas, such as service sectors and manufacturing. Applying the lean concept to supply chain management is a very popular study part, it has attracted many industrial practices and researchers with different applications. Information sharing and technology remain one of the key factors of integrating the supply chain members. Current scenario the competition is no longer between the competing companies, but it happens between the supply chains. So the efficiency of the supply chain is very important. And the effective sharing of information can enhance the supply chain efficiency through minimizing the inventories and Information sharing can increase supply chain efficiency by reducing inventories and stabilizing the production. This paper describes and discusses about the seven deadly wastes of supply chain information with the comparative principle of Toyota production system (TPS) principle approach. How the TPS can be applied to supply chain information sharing And lean tool of 5S concept possibility improve the information sharing.

1. Introduction
The structure of a supply chain management encompasses several elements, facilities, administrations, sections, and so on, giving cooperative efforts to achieve the requirements of the customer. The supply chain coordination is the important element, which line up the different elements working consistently to achieve the common objective. To increase performance of the supply chain, the coordination of the supply chain should be enhanced. The expected supply chain performance of effectiveness and efficiency increase through the effective coordination [1]
Supply chain activities are associated with information through the flow of goods and services from the stages of raw materials to the final end user [1]. The materials are flowing in forward direction and the flow of information in both directions. The flow of material and information move concurrently in the supply chain, could hardly detach one another [2]. The supply chain configuration starts with central business which might be operational service or manufactured; then spreads to the next level of
partners. These partners are stated as supply chain actors of central business. Encompassing from the central business, the suppliers are the upstream partners, which could be suppliers of components, materials, tools, technique, resources of manpower, transport facility and so on. In other side the downstream are customers could be mass supply of distribution, retailers, wholesalers and so on [3][4].

2. Research methodology
This objective of this study was carried out the Toyota production system seven wastages comparison and same of in supply chain information sharing through literature. And ways to improve the information sharing of 5S concept of information sharing management system.

2.1. Lean Thinking Toyota Production system (TPS)
Toyota Production system (TPS) was initiated by Womack, Jones and Roos in the concept of lean. They observed that an approach of continuous improvement can eliminate the muda from the production process. Muda is the Japanese word meaning of waste. It was identified first by Taiichi Ohno in the production process. He defined the waste as, which one does not create value in the activities for the end customer. As per the Taiichi Ohno, in the manufacturing environment, there are seven types of wastes available. There are overproduction, inventory, transportation, motion, waiting, extra processing and defects. This seven wastes will describe in detail in the below paragraphs.

2.1.1. Overproduction
Overproduction is the activities of continue the service or product after obtain the required level. It means the manufacture of product quantity or services more than the customer requirement. This excess of production is mentioned as excess as resources are utilized, values are not added from the view of end customer [5]. This overproduction doesn’t give the additional value to the service or product because it is not required by the customer. Therefore, it is observed that there is having no value addition from the view of end customer’s. This overproduction considered as inventory, which also is defined as waste.

2.1.2. Transport
Movement of material is the unnecessary in the production process. The transportation of material from one production cell to another is considered as the working progress (WIP) and adding the time value the process, without value addition to the service or product from the view of end customers and should be defined as waste. It is also increasing the possibility of damage to the materials [5].

2.1.3. Waiting
If there are no activities performed with the product or service, it is called waiting. Due to waiting of materials, product or service, no values are added to the process. So from the requirement of the end customer, it doesn't add the values to the end product or service and should be considered as waste. The situation of waiting will happen, when the downstream supply chain process is slowed down due to lack of on time activities of upstream [5].

2.1.4. Over Processing
Extra operation in the product or service is defined as over processing. It is defined as waste as the activities, doesn’t add the values to the product or service as the view of the customer. The over processing are reprocessing, more handling, additional storage and rework which happen to more inventory, over production and defects.
2.1.5. Inventory
Storing of finished product and work in progress (WIP) is defined as inventory. It doesn’t add the values to the product from the customer perspective, and which do not satisfy the customer demand [5]. So it should be considered as waste as no added value to the product or service.

2.1.6. Motion
The unwanted movement of materials, employees, equipment, extra production and excess inventory, which are not adding the value to the product or service is called the waste motion.

2.1.7. Defects
The finished product or service doesn’t meet the customer required specification is called the defect. Defect required the extra processing, time, resource and inspection to rectify. The correction of defect doesn’t value addition to the service or end product. And customer not ready to pay for this correction. Therefore defect is defined as the waste [5].

2.2. Management of information sharing
Production and manufacturing wastages are generally understood and visible. In the area of information sharing and management the concern of waste is tangible and less clear. The key barriers of the information management are the lack of clear view and definition [7]. Only very few previous research publications are analysing about the information sharing and management issue. They define the wastages to the section of lean information sharing. In the next section will describe the seven types of wastages in information sharing and management. A comparison of the definitions of the seven wastages is shown in table-1

| Seven Waste (TPS) | Waste in information sharing | Description |
|-------------------|-----------------------------|-------------|
| Over production   | Excess information          | Unnecessary information, redundant, too much data, over dissemination, pushing data |
| Transportation    | Information transfer.       | Incomplete information, communication failure, security threats, multiple sources |
|                   | Electronic transfer.        |             |
| Waiting           | Delay for information       | Unavailable information, late communication, quality of data suspect, waiting for information |
|                   | Waiting for Information     |             |
| Over processing   | Preprocessing/ more iteration. | Too much iteration, unnecessary serial communication and data conversions, format changing, too many verification, unclear criteria. |
|                   | Lack of information.        |             |
|                   | Extra steps to provide information. |             |
| Inventory         | Partial information         | Poor configuration management, too much information, complicated retrieval. Providing information too early will require storage |
|                   | Storing the information     |             |
| Motion            | Task Switching / wavering   | Indirect access, pushed to wrong sources, reformatting, manual intervention |
|                   | Searching for information   |             |
| Defect            | Wrong information           | Wrong information, conversion errors, lack of data quality, incomplete data, ambiguous, more verification required. |
2.2.1. Excess Information (Overproduction)
Generating and communicating the excess information is over production as the comparison of TPS concept. Unnecessary additional information leads the process of lack of finding the correct information and less efficient. The excess of information consumed the excess time and resource to find the appropriate information. [7]. The excess of information doesn't create the values to the customer requirement [8].
Excess information is simply producing too much sharing of information, where the value added information data is involved in the overload of information and has to be identified [7]. The waste is associated with the resources and process used to find the correct information from the overload information process. The creation and transfer of the excess information are described as the root cause of the waste. The resources used for identifying the required information in the over loaded information condition defined as waste, which utilized the resources without addition of value added to the information and customers' requirements. So the excess information is defined as the creation and maintenance of additional information and resource utilized for finding the valuable information.

2.2.2. Transfer of Information (Transport)
In a general manufacturing process transportation increases the processing time and non-value added to the product. It is defined as waste. Same concept in information sharing an electronic transfer doesn’t add the value to the information data. This brings into line with the explanation of the manufacturing situation. Transportation of information not defined as a waste because it does not consume the resources. And if the transportation and transfer of information occurs immediately, it doesn’t add the time to the process. The waste is not linked with the transfer of the information itself, as it occurs instantaneously, but the information receiver has to decide the received information provide the addition of value or not [7].
The waste of information transfer is associated with the information which is directly communicating with customers or supplier through the communication system like mail. In the case of excess information sharing, the information is not necessarily forced to send between communicator. Waste is characterized by communication data which is received and sent which no one uses. The communication of information sends to the wrong information user. In this wrong information transfer is not a waste of transportation, due to the immediate transfer through electronic. But if the data is not utilized by the receiver, then it is considered as the waste of information. And the delay of information transfer to the right person at the right time is the waste and increase the communication transfer time. The information transfer waste may be linked to the fact of how the information management and organized to communication flow might be wrong.

2.2.3. Waiting of Information (Waiting)
Waiting time of information as the time required to identify the right information to transfer through appropriate resources. The reason of the waste of information waiting happens due to discontinue processing or very simply because the information cannot be found [7]. The information user waiting for information because this ideal time happening due to unavailability or lack of right information [8]. Thus the information needs to flow, but the information not yet read or unavailability. This information waiting of information waste doesn't give any value added to the information and information user.

2.2.4. Lack of Information (Over processing)
The over processing is the state of processing linked with lack of information [6]. The waste of pre-processing or after processing is associated with action undergone to overcome the information unavailability. These actions may contain creating of right new information or non-value added information [6]. The additional information doesn’t create the values from the customer’s view [5,8]. Hicks et al. [6] Description could be argued to be somewhat incorrect. Additional processing and steps
of creating the information to overcome the lack of information and may create the additional support to the information user. As the information is new and irrelevant to the information, then it is considered as waste. At the same time, this is a process which initially should not happen, as valuable information should be provided to the information user in the first place. Providing the additional steps of information may indicate the missing of the process or broken communication in the information chain. So, additional processing is defined as actions which generate no value for the information user and resource due to absence of information.

2.2.5. Storing Of Information (Inventory)

Data of information is normally stored in the platform of digital storage. It doesn’t have the digital platform, which does not represent a major financial cost [7]. And the digital storage doesn’t take the physical space, when comparing with the manufacturing sector. So the inventory storage of information data is not considered by the cost. Hicks et al. [6] Defined storage of information as a waste by as well as the information user. And the waste is linked with the process of information, data retrieval from the electronic storage [7]. The inventory of information is described that in the situation of excess information than customer required at the specified time of instant [8]. So the collected information is stored, but not utilized by information user. It is similar like the excess information of over production, that waste can be defined as inventory. The stored information does not value or required at a given moment in time [8]. So the stored information may be relevant at a later point in time. The information created and available in advance also defined as the waste. Communicating the information in advance require the storage, which is not considered as waste as the cost is considerably less. Information is generated in advance and stored which increase the available information, which creates the process of finding value added information less efficient.

2.2.6. Searching of Information (Motion)

The unwanted motion is defined to be connected to the organizations assumption of “gatekeeper functions”. A gatekeeper job is formed when one individual is trained to use a specific software application [7]. Only the gatekeepers are skilled to use the specific software or applications. Thus, high dependability created to access the specific software or application. It creates the unwanted movements between the computers, which described as unwanted motion. In manufacturing environment, motion of people or material may have unwanted movements. But in the information sharing, motion describes as additional processes required to attain the information like the searching of files in the server, additional button clicks on the computer [8]. So the motion is described as unnecessary movements and procedures followed to attain the information.

2.2.7. Wrong Information (Defects)

The key cause of defects is wrong and inaccurate information [6]. The action of modifying and verify the information consider as the waste. Creating results on incorrect/wrong information can also outcome in wrong actions. This type of activities might not be shown if the information provided was right. Incorrect activities taken based on incorrect information are also defending as waste [6]. The defects are defined as error on work, incorrect information, and partial information [8]. Waste is also defined by unsuitable activities taken based on incorrect information. Incorrect information will not deliver value to the information user and can outcome in inadequate actions based on the incorrect information.

3.5 S (House keeping)

The Five 5S’s are some guidelines for maintaining the workplace organization which intends to establish each operator’s workspace for maximum efficiency (figure 1). A comparison of the definitions of 5S approach in manufacturing floor and information area are shown in table-2.
3.1. Sort
Categorized things that what is required and what is not required. so that the things that are repeatedly used are available nearby as easy to find as possible. And things which are less frequently used or not needed should be discarded or relocated.

3.2. Set in order
The required things should be arranged in systematic order for easy use. The aim is to reduce the unnecessary movement of works in his job. For example, files are stored in the rack as per the numerical label order for easy access. Using the tools in the shop floor can be used the separate tool kit for production and maintenance persons.

3.3. Shine
Maintain the workplaces, tools and machineries clean so as to avoid the issues related to poor work condition. This will confirm the presence of any non-conformity; such as split of oils in the floor and dust contamination on the work place.
The coating industries faced the issue of poor quality due to dust. Some companies are applying the light colours in their work place and floor to control and easy to identify.

3.4. Standardize
Makes the work place standardization through continuous follow-up and practice the first 3S of sorting, arranging and cleaning. Make the first 3 S’s a routine practice by implementing clear procedures for sorting, set in order and shine.

3.5. Sustain
Encourage, proper training and communicate the 5 S’s to confirm part of the organization culture. This should include assigning the 5S team to ensure the status of 5S practices and level in the organization to sustain the 5S advantages.

4. Information sharing waste reduction
If the organization is not up to the standard in the level of excellence in effective information sharing, there is a chance to reduce information waste through the help of 5S approach which is depicted in the table 3.
Table 2. 5S approach in the area of manufacturing and information sharing

| 5S        | Manufacturing work place                                      | Information sharing                                                                 |
|-----------|--------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Sort      | Segregation of needed & Not needed material (tools/part)     | Check and segregation of files, folders, images, software and unwanted application in the system. |
| Set in order | Arrangement of required Tools, Parts in systematic order    | Organize files and optimize the use of file folders. Create the specific shortcut icons for mostly using files, folder, softwares. Make the flow and Master file for guiding to search the files. Follow the change history to understand and avoid the duplication. Visual identification, control for easy identification of Hard copy folders. |
| Shine     | Clean the workplace & equipment on a regular basis          | Eliminate the duplication of files. Update the master file & Delete the duplicated file frequently. Stored the file in the master file path & avoid storing in a common storage location |
| Standardizes | Make the first 3 S’s a routine practice by implementing clear procedures for sorting, set in order and shine. | Establish the procedure to maintain the 1st 3 S |
| Sustain   | Keep to the rules to maintain the standard & continue to improve every day. Encourage, proper training and communicate the 5 S’s to confirm part of the organization culture. | Regular audit and competition to procedure follow up of 5S Regular training to the all levels of information sharing person. |

4.1. Waste from Excess Information (Overproduction)

Excess Information, where valuable is included and overloaded. And much information is non value added. And generating of excess information is considered as a waste to the process information. It may sound surprising, but many companies and supply chain partners are generating more than necessary information contained or communicating the less information because they are not aware about the information required, unavailability of data, storing of excess information data, poor storage method of information data, searching of data. Without any request, preparing of data and information sharing considered as excess information. In this case all the efforts are ending with waste of energy, time and manpower.

Eliminating the excess data and non-value added information by avoiding the excess information and communication of additional and shortage of information. Information management applies the 5S concept to improve the information sharing. And storing of required data and updated data in the correct storing method. The concept of 5S can be practiced to set up guidelines for data storage and describe data in location, size and space. The guidelines have to be widely emphasized to all. So everybody knows the detail of information data of where, what, why, how much and how long. Through this continuous improving the condition, the guidelines updated to the new level of position and follow up the rules.
4.2. Waste from Transfer of information (Transport)

The situation of necessary to transit and movement of information can be initiated by the earlier mentioned wastes. All the movement may not remove, but they have tried to minimize. There is chance in waste of information, when it is sharing from one person to another and multiple person through multiple communication system. Most of the people preferred the more information, but a proper guidelines, discipline and proper transfer system may be enforced to avoid waste and problem.

4.3. Waste from Waiting of Information (Waiting)

Waiting is a concern of lack synchronization among the communication process or lack of preparation of data. Waiting for data, IT application, tools, approval process, rules, itch can be triggered by a lack of guidelines about information, data storage places, when persons have to search everywhere. Are the element you are waiting for really essential? If they're not, if they do not add value to the information process, work or the product, it's wise to try to remove them or at least reduce the searching and waiting time of data. Waiting time occurs due to searching documents or files. The simple way to find the files or documents is sketching a coloured incline line on the back of the files:

- Easily visible the missing file.
- Wrong place of file shows a broken line

This method is better than the file identification number, which needs reading and translating the information. The color management is the part of visual management approach. It is simple and fast to search the files and reduce the searching time.

**Table 3. Influences of 5S approach in information sharing**

| Waste in information Sharing                          | 5S – Influence                                                                 |
|------------------------------------------------------|--------------------------------------------------------------------------------|
| Waste from Excess Information (Overproduction)        | Easy identification of Data from master file                                  |
|                                                      | Unwanted data reduced due to duplication avoided                              |
| Waste from Transfer of information (Transport)        | Time will be reduced due to clearing of unwanted document, application and software |
| Waste from Waiting of Information (Waiting)           | Organize files, folder, software and application the searching time will be reduced |
|                                                      | The easy identification of document for information through master file and visual tracking flow |
| Waste in Lack of Information (Over processing)        | Organize files and optimized arrangement                                        |
|                                                      | Reduce the searching time, waiting time.                                       |
|                                                      | Easy Identification of required data/information                               |
| Waste related to Storing Of Information (Inventory)   | Duplication and temp files cleared to avoid the complicated to data retrieval  |
| Useless Searching of Information (Motion)             | Due to organized information storage, searching, wrong data, format, multiprocessing will be avoided |
| Waste from Wrong Information (Defects)                | Identification of data and path will be cleared to avoid the wrong data selection |
4.4. Waste in Lack of Information (Over processing)

Procedures and rules which are not regularly updated are possible to let non value added processes be executed in the process. Sorting and ordering applies also in the sequential process and the associated documents. This waste is common in the process of office and administrative. The existing procedure still remains follow even the new updates are made due to unaware of new updates. As long as nobody will update the set of procedures, everybody will follow and use the old with application and discipline. Lack of proper knowledge sharing within the team, lack of backup history of the document, complicated communication process and lack of IT tools and knowledge leads to waste. These will influence the over processing

- Using more & multi technology and method to share the simple information.
- Excess information & passing the information to irrelevant people.
- Making more & irrelevant data collected to send the information sharing.
- More iteration and steps to transfer the data.

4.5. Waste related to Storing of Information (Inventory)

As per the 5S concept whatever that is useless is to be removed. In situation of storage of information, the advantage is the value of the information saves and recovers the data and spaces, which should be dedicated preferably to value adding activities. In the form of paper documents and their several copies, files, catalogues and calendars of previous years, and incomplete data, old back up data, unapproved document, etc. all excess inventories.

4.6. Useless Searching of Information (Motion)

The ergonomics of the workplace is certainly the most popular and "visible" application of the 5S. The layout and display of the area will follow the 5S logic, favoring the availability of necessary items, distance of reach, and ease for tending. Among useless motions, do not forget the walks to search for missing items, data, instructions, complementary information. Unnecessary steps and ask switching also the waste motion of information. It will not add the value to the communication process. Through the 5S can possible to improve the information management. Data should be stored in the constant location in the server with standard tracking method.

4.7. Waste from Wrong Information (Defects)

Defect data and insufficient information are considered as the defect of information sharing. It can be happened due to lack of understanding of customer requirements, insufficient product and process knowledge. Some requested communication doesn’t have the objective, due to that the sharing of information not satisfied the customer. Poor quality of information sharing due to lack of IT tools and technical skills, complicated approval process and lack of involvement. 5S will improve or avoiding the mistake of data collection and information sharing. Storing of right data in the proper location with identification is reduced waste. When the data has revised, there should have option with updating, revision number and date. Updated data with proper approval procedure and stored in the dedicated location for tracking. Hard copy of data source in the identified location with identification tag should be kept. The same process of communicating through electronic and IT tools has to consider the proper, suitable IT tolls for communication. Select tools have a need to supportable to other interactive partner.

5. Conclusion

This paper studies the concept of lean concept of Toyoto Production System (TPS) comparison with the supply chain information sharing. The study has also discussed the validity of the seven types of waste in the context of information management. Muda of seven wastages are described as in the manufacturing and the identified the equivalent wastages in the information sharing are identified through literature survey. Transfer of information (Transportation) lack a basis in information management because today’s organizations will usually transport information by electronic means.
Hence, transportation is an immediate transfer, which adds no time to the process. The study has also discussed the validity of the seven types of waste in the context of information management. And the 5S concept is described and the improvement of reduction of wastes in information sharing through 5S concept. Through this analysis, the possibility to apply the 5S concept to eliminate the wastes in the information sharing and management was addressed. In future research scope possibility for analysis the information sharing losses in the supply chain network through the lean tools. And reduce the waste through the TPS concept and 5S.

6. References

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