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Lean Implementation into Risk Management Process

Ameneh Seddigh
Bardia Alimohamadi
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Lean Implementation into Risk Management Process

**Ameneh Seddigh
Bardia Alimohamadi**

Supervisor
Lars Ekström

Examiner
Roy Andersson

University College of Borås
Institution for Engineering School
Thesis for Graduation in
Master of Science in Industrial Engineering
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Summary

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Any business management process involves a relevant risk management process whereas proper integration of risk management process following the lean guidelines can result in an efficient risk management process. This is a vital advantageous character for successful companies of this era. However, in real world business, many cases have been observed with different types of hidden wastes associated with their risk management process. These wastes act as obstacles to create value for their customer.

Hence, the need for an integrated risk management process enabled with a lean perspective is growing in all levels of business and industry. Lean management and risk management process are in close interaction whether we see it or not. There would be two options ahead of organizations. First option is to ignore this mutual relationship between lean management and risk management process and the other option is to try to understand this interaction in detail with a continuous effort to make it more efficient. This conscious approach to the issue can turn into an efficient integration in successful cases. Integration process towards having a lean risk management is a tricky journey that requires proper understanding of the issue among the associated people and smart strategic decision making along with proper tactical knowledge and know-hows. In the current thesis work, we have tried to apply lean philosophy in order to recognize the wastes and non value added activities. This integration process starts with recognizing the context of risk management in a target organization. It is critical to recognize the risk management process steps because it is necessary to analyze the process steps one by one. Importance of following the flow principle of lean philosophy is a must in order to attain to a streamlined progress in the work. Consequently eight typical lean wastes should be identified in the relevant risk management process steps. In order to be able to eliminate the identified non value added activities, lean tools would be applied at this stage of the work. In other words, the root causes to the process wastes would be tracked down with the aim of eliminating or reducing them.

Through proper application of lean tools in the integration process, we would get to a level of improved effectiveness and efficiency in our organization. In a comprehensive lean risk management integration strategy, the future state of risk management process would be drawn following lean principles with an eye on extension work for developing the lean risk management policies throughout the supply chain. This lean extension program is a key to catch hidden synergies in risk management process of the whole supply chain. Inbuilt KPIs and process metrics would be the proper provision for enabling the organization be in a state of continuous thrive for perfection.

Applications of lean principles make a quick response enterprise with proper level of flexibility which results in an aware personnel attitude in a lean risk management working environment. Mixing the factor of improved internal efficiency with our risk management process, would help us have a better control over our associated risks. The result to this integration work would be a lean organization with continuously growing voracity to make improvements to the status of lean risk management process.

List of Abbreviations:

Mgmt: Management

RMP: Risk Management Process

KPIs: Key performance Indicators

QFD: Quality Function Deployment

VOC: Voice of Customer

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1 Introduction

1.1 Background

It has been for many years since risk management and lean management have been introduced to authorities and decision makers in a wide range of managerial fields but it is recently being investigated on a combinatorial technique of these two where lean principles and guidelines are consulted for risk management planning.

Nowadays the companies and global sourcing and providing corporations of products and services have to be much more precise and analytic when it comes to choosing a supplier or third party. In this very competitive market where being Lean is a necessity to remain in the market place, we have to outsource some goods and services globally which implies a high level of inherent risk due to the improved complexity of network. In many cases it has been observed some disruptions in processes with fatal effects on company business profile and fame. In order to overcome the associated risks in the lean era, one alternative can be gaining more visibility into the suppliers' detailed capability and reliability in order to have an idea of probable disruptions in their related processes. This is one way to become a pro-active planner in risk mitigation for such companies that want to grasp Lean advantages. (SAS Institute Inc., 2009)

One can say that Lean Philosophy supports the reductions and possible elimination of wastes in our processes. There is no need to mention that this can also apply to risk management processes within an organization or an enterprise. In these cases, the non-value adding activities of processes are targeted to be reduced / eliminated. It is good to know that lean policies take different priorities as their missions when they come to different sectors like manufacturing where the priority can be the lead-time or as in a financial service where the price would be the top issue to be targeted.

When it comes to risk management, it seems to be better to start with the definition of risk by itself:

“An uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives”. (PMBOK, 2004)

Knowing the risk definition, we need to have a risk management system that is defined as following:

Systematic method for identifying, assessing, mitigating, and monitoring / controlling unplanned events that may impact a project.

Hence, risk management and lean management techniques are two widely known and popular solutions for decision makers, especially those within the responsibility area of strategic management.

However the possibilities of integrating these two strategies are still vague.

What are the factors within these two management techniques that have positive /negative effects on each other? The area to be sought in this regard in our thesis work would be having an overview study of lean risk management, where a diversity of lean thinking, working and decision making factors would be studied on how they relate to a risk management system.

How effective would it be to apply lean rules to risk management systems in general and specifically into risk management process?

It should be of high interest of different organizations to know about the results of risk management with a lean philosophy as guidelines in establishing their risk management system throughout their organizations. Benefits resulted from integration of lean and risk management would be a motivation for organizations to take on this new strategy in future.

1.2 Purpose and objective

There exists an inherent close interaction between Lean methodology and Risk management process. Whether this fact is overlooked or looked thoroughly, involved authorities and personnel use these two management models in an intermingled manner. The important point is to catch this phenomenon in a conscious manner to take better advantages of this integration between Lean and Risk management. In this thesis project work we will try to improve the transparency in this regard where a lean risk management would be introduced to readers. As an outcome of this study, the quality and circumstances of implementing Lean elements and guidelines on Risk management process would be identified.

1.3 Definitions

- Risk: is uncertainty which will negatively or positively affect an activity, process or organization's objectives.
- Risk Management: can be defined as a method to identify, analyze and control the uncertainties which may affect an organization's objectives.
- Waste: is the use of resources without adding value.
- Value: “Value can only be defined by the ultimate customer. And it's only meaningful when expressed in terms of a specific product (goods or services, and often both at once) which meets the customer's needs at a specific price at a specific time. ” (Womack and Jones, 2003, p.16)
- Value stream: The sequence of steps and activities (both value added and non value added activities) to deliver an ordered product or service to a customer and fulfill customer needs.
- Value added activities: are the activities which create value and customer is willing to pay for.

- Non value added activities: are the activities which neither creates any value to the customer nor to the industry.
- EOQ(Economic Order Quantity): is a mathematical model. This formula is used in companies and organizations with the aim of estimating the quantity of products to be ordered. Thus we would meet projected demand while keeping inventory costs at the lowest possible level.
- Process metrics or KPIs (Key Performance Indicators): are financial or non financial measures to assess process and organization performance. Such as:
 - Process time: is the actual time needed for performance and completion of a process or operation.
 - Available time: is the amount of opening or working time of a company for execution of specific activities and processes.
 - Reliability: In lean working environment reliability is a process metric that implies the percentage of accessibility to the facilities when they are needed.

1.4 Literature review

Lean guidelines and philosophy has been applied to different sectors and processes. Similar to our focus area on integrating lean principles into risk management process, lean philosophy has been the subject of integration into other processes as well. Lean based management processes have been applied in industrial production initially. However it is widely believed that Lean philosophy is not confined to production sector and can be applied to many other sectors like service process management. The issue in this regard is that we would experience a much higher level of variability in service sectors. This variability would be destructive as it gets excessive. Hence, we need to analyze it more precisely and take actions for cases with excessive variations.

As mentioned in the last paragraph, Lean philosophy is applicable to many sectors and fields with some considerations and differentiations in implementation phase. For example Lean principles in industrial production involves factors like having linear flow arrangement in a closed “U” shape (processing stations are relatively arranged in a format that looks like the English letter “U”) where results in flexible cells in production line. The second factor is having small production batches. The other factor is rapid preparation of work specimen. Also grouping of tasks by workstations is an important point. The other factor is to have versatile personnel with the ability to operate in different processes as is required in a lean system. And the last factor in production area is that in each work-station we need quality assurance with suitable preventive maintenance. (Cuatrecasas Arbos, 2002)

However, when it comes to service sector for lean implementation, there are some key factors to note as well. These factors can be flexibility and agility, where the concern area is both the organization and human resource. It is assumed as a challenge for acquiring required flexibility for organizations and multipurpose capabilities of personnel to work as efficient and effective team. The other factor in this regard is that the organization needs to follow a horizontal structure because these lean principles are not likely to be applicable in non-flat organizations due to process-focused approach of Lean principles. Also the other factor to be remembered is about the managerial culture, where requires proper level of communication throughout the organization. It is good to note the importance of having an active formation policy in implementing lean principles to service sector, where the lack of it can lead to collapse in most cases. In general there are two lines of conclusion in lean service processes where one is that the lean application to service processes should involve the best attuning of tasks to workstations with the goal of eliminating the waste, balancing and saturating work stations so that the highest efficiency, best cost and time limits drawn by lean principles are attained. The second one is that due to inherent variability in service processes we need to take analysis steps regarding our line of service process in order to estimate and evaluate the consequential effects and on this basis we can take compensating measures to meet with the variations. (Cuatrecasas Arbos, 2002)

Nowadays companies are going global as a necessity to survive in competitive markets to become lean and therefore have the capability to offer goods and services of lower costs and better quality. This way companies can focus their energy and time on a limited number of fields and get better results out of them. The tricky issue in here is to have a proper monitoring and control over the whole supply chain as a major part of services/goods are being outsourced from participant around the world. The risk management strategy and planning should cope with the new conditions. Due to this increased level of complexity in modern supply chains, the risk management needs to be more intelligent and comprehensive. IT and online technologies play an important role in this regard to take better control over the supply chain and suppliers. With this extended network of suppliers, there would be higher risk of unexpected interruptions. In many cases, the purchasing departments of companies are assigned to selecting suppliers or in other words they play an important role in arranging their network of suppliers to face least amount of uncertainty. (Atkinson, 2006)

Alexander Monty, director of consulting for ADR North America in Ann Arbor, Michigan, recommends a six-step supply chain risk management process. (Atkinson, 2006)

- At this first phase, we are required to determine our important purchased items and consequently we make sales forecasts and revenues over specified period of time.
- This step is concerned with vulnerability assessment where deals with identification of supply chain risks covered in three categories: external, environmental and internal risks. The internal risk category for instance can be a disruption in internal manufacturing or business processes.

- This step is to assess the implications of high risks. By mapping the quantitative and qualitative at this step, we would be able to create a baseline for our F-N diagram (frequency of occurring an undesired event versus the relevant number of loss) horizontal and vertical axis.
- At this step we should identify our required actions in order to mitigate the risks and their relevant costs.
- Here we need to point out the best options that lead us to the best return on investment.
- This step we need to gain management support for the whole process steps mentioned here. Some say that this step needs to be activated as the first step of the process where is directly dependent on organizational culture.

One risk manager with experience in supply chain risk management is John Marren, director of risk management for Henkel of America Inc. in Gulph Mills, Pennsylvania. Marren has identified four key success factors for supply chain risk management projects as they come in the following lines: (Atkinson, 2006)

- We need to make other important participants of supply chain about the potential risks.
- The second key success factor is to have a close collaboration with all involved members of the supply chain. Therefore better coordination would be obtained in decision makings.
- *“Third, you need to create a comprehensive contingency plan or business continuity plan. Marren recommends looking at supply chain risk management as a three-stage process: upstream supply (from suppliers), manufacturing (your own) and downstream distribution/fulfillment (to customers). If you don't address all three of these with a comprehensive plan, your efforts will fall short”.* (Atkinson, 2006)
- Obtaining full support of top management in a way that they understand the real value of the plan, so that the project can be a continuous and firm project instead of being a pilot plan.

Lean principles and guidelines have been very helpful for players of today's super competitive business environments. Lean applications are not only confined to production and manufacturing fields. Lean can be implemented in many other sectors like service markets, risk management, logistics, supply chain management, distribution and many other fields. (Cox & Chicksand, 2005)

Leaning out in different cases implies a common goal which is to go against the wastes of any type in the company and related processes. The tricky point in executing lean guidelines is not to compromise safety and security in many cases. With a low level of safety we would be more vulnerable to occurrence of wastes in human health, time and energy which imply the financial

waste as well. Thus we can't accept safety related activities as non-value added activities where is in contrast with lean goals like being faster, cheaper and better. Lean principles should also entail the safer flow of processes in addition to other improvement mentioned in the last sentence. In cases where we observe an optimization in either being lean or safe we would experience a sub-optimized condition in the other one. In order to address this problem it is advised to go for an overall system optimization where different issues like lean principles and safety principles are let in. However the standard ANSI B11 TR7 is worked out by experts to settle this problem. This standard can be applied to a wide variety of sectors though initially issued for manufacturing sector.

"The abstract to TR7 states:

Lean manufacturing includes a variety of initiatives, technologies and methods used to improve productivity (better and faster throughput) by reducing waste, costs and complexity from manufacturing processes. However, the effort to get lean has too frequently led to the misapplication of lean manufacturing principles in ways that result in significant risks to worker safety and to the goal of lean manufacturing. Safety is a critical element in the lean manufacturing effort to yield processes that are better, faster, less wasteful and safer. This document provides guidance for persons responsible for integrating safety into lean manufacturing efforts. This integration is only possible if lean manufacturing concepts and safety concerns of machinery are addressed concurrently.... This document also provides design guidelines on how to meet lean objectives without compromising safety" (AMT, 2007 cited in Main, et al., 2008, pp.38-39)

Lean thinking is subject to some limits when being fed into different fields and sectors. The character of these limits may vary case by case. It should be interesting to know what the weaknesses and strengths of lean adopting in supply chain are. The answer is that, though the internal application of lean guidelines and practices may be beneficial to all supply chain members but the inter-organizational application of lean thinking is somehow blocked in terms of efficiency and profit making. (Cox & Chicksand, 2005)

"For some participants — especially the multiple retailers—the adoption of lean principles may lead to a positive outcome with stable and/or increasing profitability. For the majority of participants in these industry supply chains, however, the adoption of lean principles may result in a high level of dependency on buyers and to low or declining levels of profitability". (Cox & Chicksand, 2005, p.648)

The reason behind this could be mainly due to the lack of power and leverage resources to provide the comprehensive adoption of lean supply chain management approach to the whole chain. In other words, this implies the lean supply is of a limited utility for many members of this supply chain. The crisis stems from many factors like change of consumer preferences to a much lower level of consuming the relevant process products in recent decades. (Cox & Chicksand, 2005)

“The critique of the lean way of thinking can be divided broadly into those that focus primarily on operational issues (agile and batch critiques) and those that focus on the limits imposed by the need to create a commercial and operational synergy before this approach can be used by buyers and suppliers throughout a supply chain (the power and leverage critique)”. (Cox & Chicksand, 2005, p.649)

“The findings demonstrate, however, that in this power regime lean inter-organizational supply relationships based on collaboration are only really appropriate for the multiple retailers, the integrated processors and their preferred agents in the chain. This is because it is only at these points in the chain that the power structures tend towards the buyer dominance and/or interdependence situations that support longer-term collaborative and lean approaches.” (Cox & Chicksand, 2005, p.660)

Thus, if lean management approaches have worked and been implemented appropriately in some fields, supply chains and industries, they do not necessarily would easily and thoroughly be applicable in other sectors. Lean management way takes different dresses in different sectors. It is not possible to copy the guidelines elsewhere in many cases. (Cox & Chicksand, 2005)

1.5 Assumptions and limits

There are many points considered in doing this project work. We assume that there is an organization under our studies which already has a risk management process at place. The leadership to this organization is willing for change and supports the changes toward lean. There is already proper training and knowledge to the lean team and proper understanding of lean thinking philosophy is available throughout the organization. We will try to avoid complexity in conducting this process in order to keep the procedure easy to understand and implement.

2 Theoretical frame of reference

2.1 *Lean management systems*

Lean production concept has been initially introduced by Japanese, mainly as Toyota production system. This issue has been welcomed world-wide and has been the topic for researches in many sectors. Lean basically is based on an element of fast and flexible responses which is believed to lead to efficiency with use of fewer resources.

Lean thinking and its key principles specifically have been extending in different perspectives since their birth date. They have been extended through industry/service sectors and also the geographical borders. Nowadays we have issues underway like lean purchasing, lean supply and lean enterprise in many places especially in advanced countries. (Lowson, et al., 1999)

2.1.1 Lean principles

Lean principles are generally categorized in a group of five which is mentioned in the chronological order in the following lines.

- **Principle One: Specify Value**

The critical point in lean journey is “Value”. We need to specify the value where it is highly stresses that should be defined by the ultimate customer. This step needs to be expressed in terms of many limiting factors; the specified value should be on specific goods or services or a combination of them. The other points are that this product-service should meet customer needs at a specific time with a specific price. The important point in this phase is to place ourselves as producers or service providers in our customers place and then we need to rethink value from their perspective. These lines imply that a successful lean journey commences with a conscious way of defining value through a close interaction by customer in terms of a specified quality of a specific product which is offered at specified prices. (Womack & Jones, 2003)

- **Principle Two: Identify the Value Stream**

At this phase we should focus on identifying the value stream. Value stream in a modern thinking way is known to be the specific set of activities needed to carry a specific product (goods, service or a combination of both) through the three critical management functions of any business; problem solving, information management and physical transformation. Problem solving task initiates with concept to detailed design to the engineering and the product launch. Information management deals with order taking that leads to detailed scheduling to delivery. The physical transformation task proceeds with the raw material and leads to a finished product in hands of the customer. In order to do this phase in a successful manner, we need to have transparency among firms to have a full view of related activities with an effect on each other despite the fact that the

activities are taking place in two different firms. Through this inter organizational arrangement and harmony, the wastes which are not usually identifiable in single firm analysis, tend to surface so that we can remove them. (Womack & Jones, 2003)

- **Principle Three: continuous Flow**

“Flow” is the third step in lean thinking. So far, the value has been precisely defined and the relevant value stream for a specific product is fully mapped. There is no need to mention that the wasteful steps have been omitted from the value stream. At this third step we need to reconsider our mental illusionistic way (common sense illusion) of perceiving “functions” and “departments” model of work processing as an inefficient and wasteful method compared to continuous flow method. With a continuous flow we can gain much higher levels of productivity and lower number of errors. (Womack & Jones, 2003)

“The lean alternative is to redefine the work of functions, departments, and firms so they can make a positive contribution to value creation and to speak to the real needs of employees at every point along the stream so it is actually in their interest to make value flow. This requires not just the creation of a lean enterprise for each product but also the rethinking of conventional firms, functions and careers, and the development of a lean strategy”. (Womack & Jones, 2003, p.24)

- **Principle Four: Pull**

“Pull” principle tries to tell us that we should avoid producing goods or services in upstream while we are not still asked for by the downstream customer. It is quite complicated to go after this principle, but with the substantial improvement made in the foregoing principle we have grown to be more flexible to customer demands. By following the above mentioned principles, especially by converting from departments and batches to product team and flow model, there is a huge gain in time and cost. This way we need less or almost no sale forecast to get done. It would be possible for customer to pull the product from the manufacturer or service provider as they need the good or service. Hence the demand of customers becomes more stable. (Womack & Jones, 2003)

- **Principle Five: Strive for Perfection**

“Perfection” is the fifth principle to lean thinking. It has been revealed for lean workers that there is no end to the process of reducing cost, time, effort, space and error while the customer requirements are being followed almost at a very close distance to them. At this wide phase we should look for perfection. For example it has been found that getting value to flow faster would expose the hidden waste in the value stream. Also it has been revealed that by harder pull in the value stream, more obstacles to the flow will be revealed for enterprise to remove them. Lean oriented product teams should be in closer contacts and dialogues with customers to specify value in a more accurate way and to learn ways of improving flow and pull. (Womack & Jones, 2003)

“Perhaps the most important spur to perfection is transparency, the fact that in a lean system everyone-subcontractors, first-tier suppliers, system integrators (often called assemblers), distributors, customers, employees can see everything, and so it is easy to discover better ways to create value. What’s more, there is nearly instant and highly positive feedback for employees making improvement, a key feature of lean work and a powerful spur to continuing effort to improve”. (Womack & Jones, 2003, p.26)

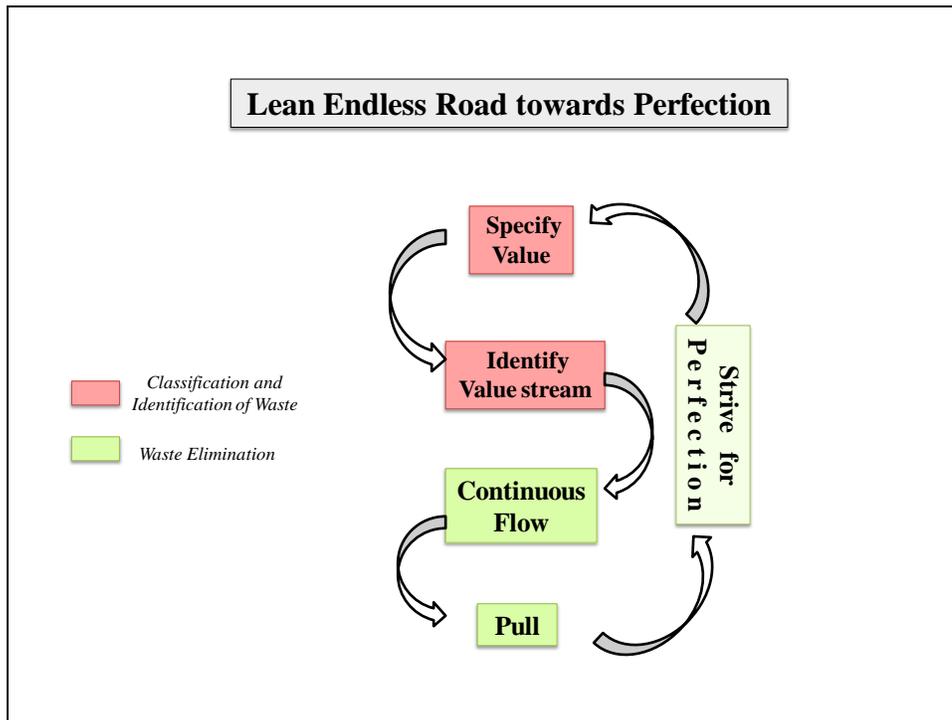


Figure 1: Cycle of Lean Principles

2.1.2 Lean tools

- **Five-why technique:** This technique is used for finding the root cause of a problem by repeatedly asking why for five times in a chain model cause and consequence. We need to keep in mind that we should stay connected to the original problem while going through these layers of finding the root cause. By this repetition, which seems to be sufficient to get to a root cause, the problem and solution are very likely to be gained. However, the five iteration of why questions can get to further levels of six or seven. In this technique we should avoid assumptions and biases. (Keyte & Locher, 2004)
- **Value stream mapping:** value stream mapping is also one of lean tools which is widely used from the beginning of transformation. The technique is focused on a specific product or service family. In this process, the current state of work and information flow is considered and analyzed thoroughly. As a consequence, wastes of the process will be identified. Having sufficient information and knowledge on our target process and related wastes, we can start designing a future state of value stream. Thus we would have a value

stream with decreased waste and improved flow with a customer focused mindset. (Keyte & Locher, 2004)

- **Standardized work:** This tool is the building block to continuous improvement and employees' empowerment. This tool is the foundation to pull and flow functions of lean management. By standardizing the tasks, we will have more stable and predictable process variables with regular output to our processes. To do this, we should use the collected experiences to use the best practices in standardization. The point in using this tool is that we should not suppress employees' creativity. Their expressions should be possibly incorporated into new standards. The learning culture would be enhanced as a result as well. (Imai, 1997)
- **VOC (Voice of Customer):** This tool is defined as a process of fully capturing the customer needs in detail. These requirements are organized into a hierarchical structure with a prioritizing order depending on their importance for customers. This process can be both qualitative and quantitative. The process starts usually at the beginning of a new product development process that a typical way of using this technique is with the aid of QFD (quality function deployment) which is a customer focused method of finding product specifications through close customer interactions. Quality of reports in this process should be reliable, accurate and also with the ability to predict the future behavior of customers. (Yang, 2007)
- **Kaizen:** This item goes beyond the characteristics of a technique. It is called a philosophy in most cases due to its holistic outlook as well as its detailed intervention with the working processes. Kaizen emphasizes on continual improvement through eliminating waste and creating value.
- **5S:** This is a philosophy and methodology of organizing and managing work place and related activities and processes. This way we would have a more efficient work flow with decreased waste, improved and smoothened flow of our processes and activities. (Imai, 1997)
- **Eight wastes:** Main categories of wastes in processes and projects are covered in these eight groups. Any activity or function which doesn't serve customer value is considered as waste. These identified wastes need to be removed or decreased in order to become leaner. These eight categories of wastes are overproduction, excess transportation, excess inventory, non-value added processing, waiting, defects, excess motion and underutilized people.

2.1.3 Lean implementation

After the introduction of lean thinking philosophy and finding appropriate tools mentioned in the above lines, it is the right time to start the lean journey in practice. So far we should have gained the ability to distinguish between values and waste through adopting this new thinking

philosophy brought by lean practitioners and theoreticians. Thanks to many years of global experiences on applying lean thinking in organizations, it has been found that there is only a specific sequence of steps, initiatives and combination of lean tools that yield best outcomes for the system. At this stage it is very crucial to find the appropriate leaders or change agents and appoint them with the right knowledge provided for them. However the starting action in operational stage of the process is to focus on value stream. As a result we will see serious changes on routine tasks which have been being done every day and mistakenly perceived as an efficient way of doing tasks. After successful conveying of pilot plans that leads to convincing and involving everyone in the transformation process, this wave of change can be spread throughout the whole organization. At this stage we need to persuade our suppliers and customers to follow same philosophy by marketing our own results and close negotiations. As mentioned before, lean philosophy is comprehensive and deals with inter-organizational relations as well. This means that having only one or a couple of lean enterprises in the supply chain are not sufficient. The whole supply chain should become lean in order to grasp the real benefits of lean implementation. Hence, every one's involvement in transformation process is a key success factor in lean implementation. (Womack & Jones, 2003)

There are many points which should be stuck in mind of people engaged with lean implementation at different levels. Some of these points are as it comes in the following lines: (Liker & Meier, 2006)

- As a foundation to start the lean journey we need to live on a long-term philosophy.
- With the redesign of work processes we should attain to a continuous process flow so that we will be better enabled to cut down on idle and waiting times. This includes both information and work flow that will make problems reveal right away.
- Heijunka (production leveling) implies that we must look upon overburden and unevenness of job tasks in different stages of processes as a waste which needs to be leveled out.
- The value of stopping/slowing down to fix problems at first time should be established for everyone associated with lean implementation. This way, productivity will be enhanced in the long run.
- We need to develop strong lean focused cultural bases in individuals and teams in order to have persistent followers of lean corporate philosophy over a rather long period of time. By building cross-functional teams, quality and productivity will improve through solving big problems that would lead to a better flow as well.
- As a management technique, it is emphasized to make decisions without rushing. It is highly advised to include everyone being affected and make decisions by consensus by considering other alternatives to the solution. As soon as solution/alternatives are identified and the solution is selected, we should go down the path quickly and carefully.

2.2 Risk management process

It is necessary to have process perspective in this role. Our process objective is to serve customers at the best level. Hereby we should pursue the goal of enhancing the probability and consequences of desired events while cutting down on the probability and consequences of undesired events at the same time.

The risk management process according to Project Management Institute's PMBOK Guide, 3rd edition, is:

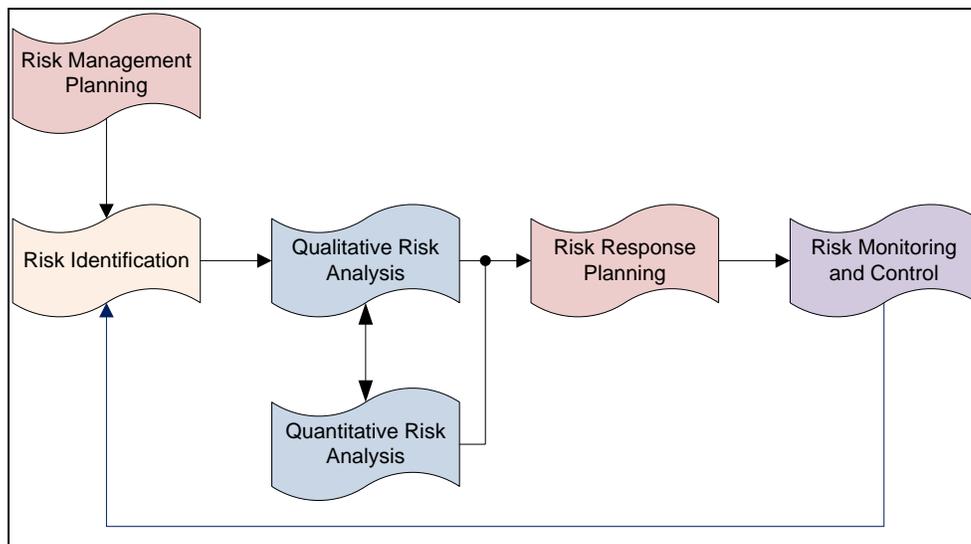


Figure 2: Risk Management Process

- 1) **Risk management planning:** This process step is very critical as the rest of process steps are very much affected by the quality and precision of this process step. In simple words, this step will tell us on how the risks should be managed. Roles and responsibilities should also be identified at this stage. At this step we should find the boundaries for risk management planning considering stakeholder requirements. It is highly recommended for a risk management plan to be consistent to different projects. The bottom line for risk management plan is to be consistent to the whole organization. Hence, flexibility is also a fundamental characteristic for a risk management plan when it comes to handling different projects, so that can adapt itself to new conditions. In other words, precision and complexity of a risk management plan should be scalable to the size and complexity of projects plus capability of that organization.
- 2) **Risk identification:** this phase is to point out the risks that can lead to an event. One typical method to identify risks is brainstorming. The other way which is more organized is using check lists. The information fed to the check lists comes through experience. At this process step, we can use tools and techniques like reviewing the documents, diagramming techniques like cause-and-effect analysis along side of taking help from the experts' judgments.

- 3) **Qualitative risk analysis:** Risk analysis whether it is qualitative or quantitative is focused on finding the probability of occurring risks versus their consequences. This would be used to analyze the risks in order to find their impact on our project metrics. Hence we can prioritize them and handle them at a later phase. Here we can also have access to the roots of risk or project areas which are exposing the project to severe problems and accidents that demands our particular attention to the matter. However it is good to know that, the current phase is subjective compared to its quantitative version which should be performed statistically (objective).
- 4) **Quantitative risk analysis:** As mentioned in the previous item, quantitative risk is also after finding the probability of occurring risks versus their consequences. This method would be performed through numbers and statistics. In this process, it is quite common to apply techniques like Program Evaluation and Review Technique (PERT), Monte Carlo simulation and decision tree analysis. As an output to this process we can gain the ability to numerically understand the probable outcomes to our projects with their probabilities. Data gathering, quantitative risk analysis and modeling would be our assistance to perform this process. Of course, expert judgment is also very helpful at this phase.
- 5) **Risk response planning:** This phase of the process is targeted at improving the developed opportunistic options while trying to remove the dangers threatening our goals and objectives. In simple words, at this phase of risk management process we should find out the available task options that we can do about the risks and we should also find what to do about them. After going through the previous steps, now we have enough at hand to handle the risks. Here we can consciously decide on how to address the risks identified and analyzed in previous risk management process steps. However, strategies like risk avoidance, mitigation, acceptance and transfer can be used as tools for handling negative risks or threads at this phase of the process. There exist also positive risks or opportunities that can be handled by tools like exploiting, sharing, enhancing and ignorance.
- 6) **Risk monitoring and control:** This phase is also directed at handling the risks like the previous phase of risk management process. This is also the reward of the risk management process like the previous phase. This part of the process can be identified by functions like keeping track of identified risks, monitoring residual risks, executing risk plans and evaluating the effectiveness in reducing risk. The other function of this process phase is to determine if the old assumptions made for the project are still valid and applicable to the project. In general, this process phase can tell us if we are following proper policies and procedures regarding our risk management plan.

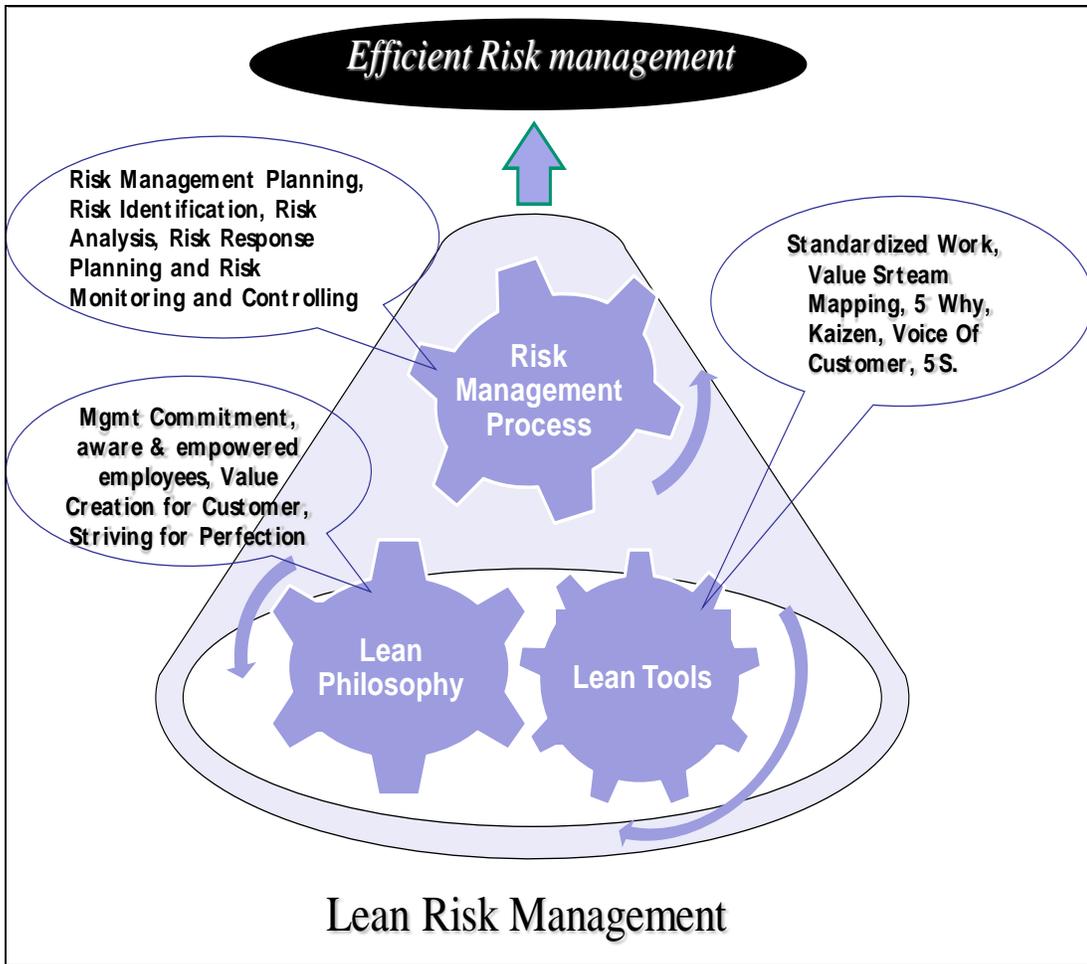


Figure 3: Lean Risk Management

3 Methodology and methods

In this section, the methods and techniques used to perform the thesis project are explained. Scientific sources and procedures of knowledge creation are distinguished from the non-scientific ones. Data collection method used in the current work is discussed in this chapter. Helpful guidelines in performing a successful literature review are discussed in this section. The selection of exploratory research and qualitative case studies methods are supported in this chapter as well.

Research methodology entails a wider scope compared to research methods and techniques respectively. However, the research method and techniques can be explained by the logic behind them which is determined by the research methodology. There are mainly two manners by which we usually get to our conclusions. These two approaches are the scientific knowledge versus non-scientific knowledge. The sources of scientific knowledge are:

- Systematic observations that avoid selective observation. Hence, we try to put away favoritism of our presumptions.
- Controlled manner of obtaining results through systematic elimination of alternative results.
- Repeatability where implies the necessity of replication of research outcomes by other independent researchers and scientists who confirm the same theory and relevant results. (Welman & Kruger, 2002)

The sources of non-scientific knowledge which are known to be the source of lay people's knowledge are as follows:

- Authority issue that indicates the necessity for examining the evidence and research process by which a claim is made in scientific associations. However in non-scientific associations people who accept a claim with only considering the authority by which a claim is made.
- Opinions of peers are trusted in obtaining knowledge in non-scientific societies where as in scientific world, the experts' opinion is referred as a source of knowledge.
- Traditions are the other source for non-scientific associations where the knowledge transferred from their ancestors are highly trusted. This is a naive source of knowledge in many cases like the commonly held belief that women are less logic thinkers than men. It is quite common for such opinions to dress in form of idioms.
- Debating is another source of non-scientific knowledge that apparently involves logic in arguments to get to the conclusions. Nevertheless, people can judge logical as illogical and vice versa depending on their own attitudes towards the argument. People can even use false premises in these cases, where leads to erroneous conclusions and judgments eventually.

- The other and actually the last source of non-scientific knowledge to be mentioned in here is the “Accidental Observation” that implies the acceptance of results from a single event without considering other conditions that the same event could happen with other results. In contrast to the information given here, in scientific way of sourcing knowledge we investigate phenomena in a structured and planned way. (Welman & Kruger, 2002)

3.1 Steps in conducting a literature review

The first point in conducting a research process in science is to be properly aware of the researches and findings related to our subject of research. This scrutinizing of previous researches would be very helpful for us to locate ourselves in research path. On this way, we need to trace and record relevant literature. Using keywords would be helpful in this regard. However we should be careful on choosing keywords as using very specific keywords wouldn't hand in sufficient results while using too general terms would result in irrelevant information. This issue is so important and determining that we need to have a structured plan to perform our literature searching. Sufficient time and patience should be allocated to literature searches. No compromise on obtaining relevant literature should take place. After finding proper literature, we need to go over them and compile our literature review. Our studies in this regard, should be integrated. The relationship among the explored studies and researches should be explained in addition to their connection to our own subject of research. The other point in literature review phase is to avoid excessive use of secondary sources of information. The reason behind this matter is that the authors of secondary sources may have expressed their own biases in the published material. Original sources are preferred over the secondary sources in many cases. To make it more clear, in defining primary versus secondary source of information, one can say that the secondary source of information is the second-hand information about the happenings while primary source of information is the written or oral document of an event made by a direct observer or witness. (Welman & Kruger, 2002)

3.2 Qualitative research design

Qualitative research deals with processes and concepts rather than numbers and statistics which are the focal points in quantitative research method. The qualitative research method is aimed at results with wider areas of understanding for the audience.

The researcher involved in a qualitative research method is supposed to experience the issues of his/her study in person. The researcher wants to experience by his/her bone to get to the conclusion point. The outlined personality in the last sentence is called the anti-positivist character within the research society. In qualitative research method, the emergent designs are popular compared to the quantitative research method that the research design should be determined before collecting the relevant data. (Welman & Kruger, (2002)

In the current thesis work, the qualitative research method has been preferred over quantitative method.

3.2.1 Exploratory research

This research model is used when we have a poor definition of a problem at hand. Exploratory research usually feeds from secondary sources of data such as reviewing available literature, or qualitative approaches like in-depth case studies or pilot studies. However the results of such researches are not the final answer to the topic of study. The role of such research is that their result can be helpful in giving a more detailed view of the problem under study. (Yin, 2006)

This model of research has been decided to fit best in our frame of work, where the subject of the study is quite new in a sense.

3.2.2 Qualitative methods

- **Case study research:**

Case study refers to a focused and intensive study of an individual, a group or a limited community to perform an analysis. In case study researches we are headed to find out about the uniqueness, exclusivity and peculiarity of a specific case while the full scale complexity of it is included. Case study research method is in contrast to hypothesis-testing method where we make general deduction in an ordinary manner. The tricky point in case study research is that the purpose of it is not limited to a single individual merely. When a single individual is under study, as a requirement to follow the line of a case study research method, we should assure that the single individual represents a population. The other condition is that the individual under study should be particularly uncommon to the phenomena under our focus of study. (Welman & Kruger, 2002)

- **Participant observation:**

“PARTICIPANT OBSERVATION requires the researcher, for an extensive period of time, to take part in, and report on, the daily experience of the members of a group, community or organization, or the people involved in a process or event (or whatever is being studied).” (Welman & Kruger, 2002, p.184)

In this case, the participant observer becomes a member of the group or event under study in order to gain first-hand experience and observation. This helps the participant observer to see the issues from the perspective of the real members of that specific group or event. Although the degree of participation may differ case by case, however the dual role of a researcher shouldn't be compromised in experiencing the activities of a group as well as observing/recording them. (Welman & Kruger, 2002)

- **Participatory research:**

Integration of elements such as educational work, social investigation and action in an interrelated process is the focus of this method in qualitative methods. In participatory

research method, the participants are required to be engaged in preparation and implementation of research results. This is an issue of participants' empowerment. In preparing for producing a social change, the researchers lean highly on participation of the community members under effect, political parties and state functionaries. In-depth interviews act as feeder to this section which is known as participatory research. (Welman & Kruger, 2002)

4 Analysis

After having a comprehensive look into lean thinking philosophy and risk management process, now we have the chance to implement our learning from lean philosophy and techniques in our risk process. In other words, we can use lean thinking in order to overcome different obstacles in flow of value in our risk management process. Hence as a cornerstone to this implementation work, we try to identify non value-added activities in our risk management process.

4.1 Implementation of lean philosophy into risk management processes

As we look at risk management process from a lean thinker's view point, it would be easily realized that our goal is to create value for our stakeholders. This wouldn't be possible unless we benefit from a committed leadership throughout the organization with proper trainings. This is due to a fundamental lean principle that is referred to as leading by example. This issue would result in an increased level of staff buy-in. After gaining the proper knowledge and the ability to distinguish between value and waste, we are ready to map our value stream in order to eliminate non value-added activities except the category of activities known as necessary wastes. However the leading criteria to distinguish value from waste, is to consider if the activity adds value to the stakeholders or not.

We should have a process view towards risk management issue because the basic unit of value creation in this regard is a process. Hence, there are many obstacles that would cause waste in a risk management value stream. Having processes of a high level of complexity can possibly lead to generation of waste. The other obstacle to flow of value is lack of commitment in higher management levels. Also in many cases the value stream is weakened due to the stop of a work at risk assessment phase without taking any action on the results of that risk assessment. In case there is disharmony between risk process and lean management processes and teams, we will have a wasteful risk management process at hand.

Following the information given in above lines, now we have a better view of implementation work in detail. Fulfilling requirements mentioned in above lines are necessary to start with rest of the program. These requirements are to assign the change agent, provide lean knowledge and trainings to personnel, and finding the critical section or department to start the work which leads to substantial improvements in that department or section. This step is also referred to as finding a lever due to the role it can play to convince others to follow the same change policies toward lean through proper marketing of the results. Afterwards, we start a comprehensive lean implementation into our risk process. This detailed information is presented in a step by step order in the following lines:

- We need to set the context before getting started with lean implementation into our risk processes. This step includes the proper recognition of stakeholders.
- Defining the risk management process steps should be considered as the first stage. The risk management steps are Risk Management Planning, Risk Identification, Qualitative/quantitative Risk Analysis, Risk Response Planning and Risk Monitoring and Controlling. It is critical to recognize the risk management process steps because it is

needed to analyze the steps one by one. It is good to remember the importance of following the “Flow” principle of lean philosophy in our risk management process to have a streamlined progress in our work.

- In the next step we have to consider 8-wastes in order to identify the wastes in the risk management process steps. We also need to find the root causes by using lean tools and other management tools such as cause and effect diagram which is an appropriate tool.
- Regarding the identified wastes in previous step, we start our job of eliminating non value added activities in our risk management process steps. Tools like standard work or 5S would help us in eliminating non value added activities.
- At this stage, we draw our future state of value stream in a way that the wastes are removed from our list of activities and new lean tools are considered for our new value stream. Application of the lean tools should also specify that, where we need to apply them and what tool we should apply.
- Now it is time to extend new lean policies and know-hows to the whole organization and supply chain. The resulted lean risk management process should be integrated with other relevant processes to gain the desired efficiency improvements.
- If we want to have an ever growing business, we need to build the business infrastructure in a way to support our continuous improvement. Hence, as a follow-up process to our improvement work, we need to consider a feed back of our results by process metrics or KPIs such as process time, reliability, number of people responsible for doing a work and available time.

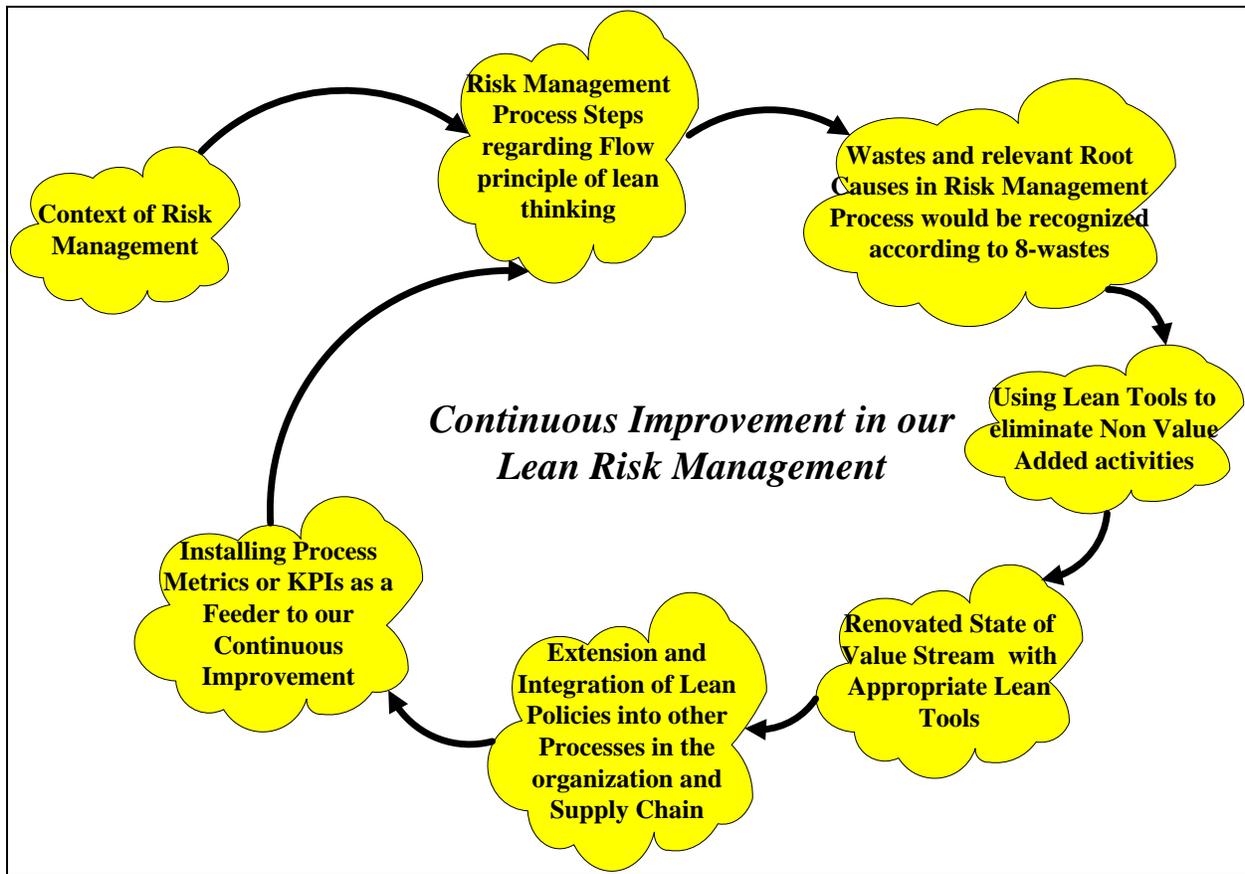


Figure 4: Continuous Improvement in Lean Risk Management

4.2 Outcomes of integrating lean elements into risk management processes

In this section of our work, we have tried to point out the corresponding of eight typical wastes recommended by the Lean philosophy in the Risk Management process. After our studies on risk management process steps and related issues relevant to the blockage of progression and efficiency, we made our brainstorming sessions to find these eight typical wastes in Risk Management process.

As the risk management planning phase is the foundation to the whole risk management process, we focus more time on this phase in this section of our work.

- *Identified wastes in Risk Management Planning phase of our risk management process:*
 - An initial phase of implementing lean management is to consider the training issue. The proper lean training would prevent inefficient movement of people due to their new lean mindset. The prevented waste in this regard, would be the **excess motion**.

- An important issue which is a source of many wastes in organizations is the improper or lack of integration among risk management process and other processes existing in those organizations. This issue can result in **non value added processing** where processes don't understand each other due to lack of integration and proper coordination between them. And also due to this lack of proper coordination and integration, there would be lots of paper work and associated **transportation** which is one of the typical eight project wastes. The other problematic issue in this regard, would be the risk of being short on supplies and demands due to the improper integration and coordination between processes. Hence organizations and process departments would try to keep excessive buffer stations which are a symbol of **excess inventory** in eight typical project wastes. This lack of proper integration can also lead to the waste of **over production** as it is not possible to have an online demand monitoring where the process departments rely of forecasting techniques as Economic Order Quantity in some cases.
- As the risk management plans are not properly flexible and updatable for many other upcoming projects, our processes would be exposed to new sources of uncertainties. Some parts of previous planning would not be effective in new projects. In return, this will result in **non-value added processing**.
- Many plans in the Risk Management Planning phase may involve too much of complexity which can lead to overwhelming sequences of activities accompanied with the tiresome bureaucratic work. This will expose us to the wastes related to **non-value added processing** like unnecessary or excessive reports and relevant extra energy spent on transactions. The other waste in this regard can be the **waiting** time for the approval from numerous authorities.
- As it was mentioned before, we need to have a clear assigning with the proper and clear authorities and their boundaries of responsibility and decision making area. When this important point is overlooked, we would be exposed to wastes like **non value added processing, defects** and **waiting**. The reasoning behind the occurrence of such wastes are quite obvious. When there exist some inappropriate overlaps of responsibilities, authorities and accountabilities, we would be exposed to the aforementioned wastes.
- In non-lean environments where we observe it more often in hierarchical organizations, the lower levels of organization have almost no right to make any decision. This would lead to some deficiencies which can be identified as the waste of **underutilized people** and **waiting**. The underutilized people would be a result of not using their ideas and creativities in process improvement and the waiting would be as a result of the time needed for a decision at top level and announce to a lower level in such environments.
- As it was described in Lean philosophy, the value should be created for the customer. Thus there should be a strong communication between the risk process and customers. In other words, customers should be integrated into risk process as well. When this important point is overlooked, we can be exposed to many wastes like **defects** that we are required to correct our product or service. In many cases, customers' integration into our

own risk management process will be very helpful. Missing this important point would be a sign of another waste which is called **underutilized people**.

- In some cases there would be a problem of not benefitting from a third party from outside of our organization to audit our risk planning quality. Without having this challenge, we will probably miss some points in the risk planning phase. Hence we will a less effective job in this regard which would consequently affect the quality of our service/product to our customers. The typical wastes in such cases can be **defects** due to lack of on time feedback and lack of supervision from other parties.
- In many cases risk analyst team focus on topics with almost no connection to the risk management process boundaries. The decisions and provisions resulted from such distractions would cause us many damages by the unnecessary costs and time on these issues that hand in non-applicable analysis results which may even pass to next steps of risk management process in more severe cases. This is an obvious sign of the typical waste called **overproduction**.
- *Identified wastes in Risk Identification of our risk management process:*
 - When it comes to risk identification, depending on the method being used in this regard, we can face many shortcomings. As a sample when we want to perform a what-if-analysis we need to hold brainstorming sessions. In the brainstorming sessions we can face the problem of low-level expertise on an issue which is a sign of the waste called **defects**. The reason behind this matter is that the outcome of these brainstorming sessions would result in decisions with problematic consequences that need to be corrected soon or late. However when some points are missed out in these sessions and brainstorming team is not focused on real risk issues, we would be exposed to the waste of extra processing which is also called the waste of **non value added processing**.
 - In our organizations, we need to have expert and intelligent risk analysts to analyze different situations and accidental events to properly track down the cause or causes of events and accidents. This is a potential and strong cause of two typical wastes which are known as **defect** and **non value added processing**. The reason is that the main problem is not solved yet and our process efforts to solve it are useless while we can have products/services of defective quality. This would also imply the lack of a proper embedded process to keep proper history and tracing data of an accident to learn from them and according to lean principal instructions to refer to them periodically as backlogs in the recorded documents of the organization. In theses process, we needs to have some channels to better use other peoples' experience in this regard and record them properly. According to these explanations it is quite obvious that we are also exposed to the waste of **underutilized people**.
 - Mainly in traditional organizations where the proper online communication and transparency is missing at first hand within our own organization and also throughout the whole supply chain, the organization can not obtain a proper view of processes within their partner, sub-supplier and upper/lower hand members in supply chain. This issue

would make us blind in seeing risks associated with the processes within other partners especially those with a serious effect on our internal processes. This can be one reason that the lean operations should be extended beyond our own organization to the whole supply chain. One obvious waste predictable in such cases can be **overproduction** due to lack of sight on demands at the fear of keeping up with demands. The other waste in these cases would be **non value added processing** due to the lack of on time and unified/integrated database available to avoid duplicate works. Also due to lack of proper communication in such organizations, people with relevant abilities to specific issues at specific time can not be summoned, where one can say that the waste of **underutilized people** has occurred in this case. **Defect** can also be the other waste related to this issue as the defective products to processes and their steps can be quite frequent in a working environment with poor communication and lack of informative culture.

- *Identified wastes in Qualitative/quantitative Risk Analysis of our risk management process:*
 - Risk prioritization is a tricky and critical issue inside an organization and beyond an organization or the whole supply chain. If the experts and professionals who carry on the task of risk prioritization are not qualified enough and their arrangement is not properly matched, we will be at risk of many types of wastes. When the issue is related to the organization, we would be exposed to the waste of **non value added processing** due to the ineffective work of attacking some sorts of risks that are of trivial magnitude versus the energy and time being spent on them while other important risks are not well treated. The other type of waste in this context would be the **defect** due to the underestimated severity and probability associated with that risk. Hence, we would have the problem of frequent accidental events. When the risk prioritization is discussed over a supply chain, we need to have a holistic view over this issue. In such cases, whole member of supply chain should be involved and aware of the risk management process that is associated with their relevant processes. The reason behind this issue is that in a lean risk management process, we should have companies and organizations with integrated risk management process into their processes. In such cases we may face irrelevant risk analysis methods among these organizations. This can lead to the wastes of **excess motion** and **waiting**. The excess motion is due to the disharmony among the multiple players, that requires multiple and frequent arrangements on different issues and decisions that relates to both or many parties. The waiting is due to the time spent on the other party to confirm any action by the other side/sides on performing some tasks or functions with bilateral or multilateral effect.
 - As mentioned before in section 4.1, we need to have a flexible risk management process with the ability to adapt itself to different projects and cases. This is also true when it comes to the method we use to perform our risk analysis. Risk analysis process of risk management process should be capable of shifting between qualitative and quantitative methods. In many cases we need to handle some simple cases which only require a simple qualitative risk assessment method instead of some complicated mathematical calculations which is overkilling. This in cases where we use complex numerical methods

for simple cases, the waste of **overproduction** and **non value added processing** and **waiting** can take place. Overproduction is because of the extra scrutinizing into the matter. Non value added processing is due to the extra work done for a simple case where much less work on the case could be sufficient. Waiting is a result of the expecting period for the next level to receive the answer of analysis step in our risk management process steps. Also in some cases, we may perform too simple assessment methods, i.e.; a simple qualitative method, to perform an assessment case which requires a comprehensive and precise assessment. In this case, we confront the waste of **underutilized people** and **defects**. Waste of underutilized people is due to the excluding of peoples' expertise to be applied in such comprehensive analysis and the waste of defects is due to the increased chance of accidents and defects due to a decreased level of certainty about the process under control.

- In some cases the risk analysis is performed at different departments by different authorities and teams that makes the task too burdensome and the collecting of these sessions' and meetings' outcomes is problematic and exposed to risk of losing or mixing the information. In these situations we may confront the waste of **defects** due to probable loss or misinterpretation of some of these results. The other waste in this regard is the waste of **overproduction**, because people at different levels and departments may do the same task and function repeatedly.
- *Identified wastes in Risk Response Planning of our risk management process:*
 - In some cases, the roles and responsibilities are not directly and exactly assigned to the risk treatment option. Such cases may produce some controversies on accepting the role of conveying the risk response plan among the involved people. Here we can see a sign of **non value added activity** as many people may spent time and energy on taking same responsibility separately.
 - Improper budget and time frame for a risk treatment plan leads to non-progressive risk management process. Therefore, we would expect the waste of **defects** and **waiting**. Defect is a consequence of non treated risks and waiting is a result of the spent time to upgrading of a decision on how to treat a risk where the implementation of an initial decision has been for so long as to be expired and non applicable to the current situation.
 - In cases that risk treatment plans are not supported by the organization's management system, we will face ineffective and inefficient execution of a risk management decision plan. This happens in organizations with improper integration of risk management process with other processes in there. However this problem would be a source of **non value added processing** due to the efforts done to develop a risk decision alternative without being properly executed. The other waste in here would be **defect** as a result of not executing the risk treatment plan. Also we may expect the other waste which is called **transportation** due to the need for gaining multiple approvals.
 - In some cases the decisions made on avoidance, mitigation, transfer or living with the risk are not properly calculated through economic factors like the proper return on investment estimation for case of mitigating an accident consequence. This would result

in **non value added processing** and **overproduction**. This is due to the extra energy and cost offered for some results and gaining with less value in terms of our customer perspective.

- In traditional management systems, there is a lack of scientific view towards the risk management process which includes the risk treatment plan as well. In these cases, the decisions are usually based on individualistic views and prejudgments which mean less expert brainstorming and decision support systems are available for the risk treatment decision making. This is a strong indicator of a waste within that organization. This waste is called the **underutilized people** which is a result of relying on hopes when it comes to such an important decision making process.
- In many cases the shortcoming on recognizing residual and secondary types of risks is difficult and missed out in our risk response planning phase. Whether this ignorance is consciously or unconsciously exerted, we should be expecting the waste of **defect** in many cases which happen to involve the occurrence of a secondary risk.
- Leaving the risk response planning phase in the middle of way to finalization can be a serious source of problems. This may happen on details of an avoidance plan, where we need to offer some alternatives to the activity which is to be avoided. In other cases, we can also refer to the mitigation or transfer process in handling the risk. In all these cases, it is necessary to have a predetermined plan with detailed information to follow in practice and execute the decided option in full scale to benefit from the predetermined results for the organization. In such cases, we may expect the wastes of **non value added activities** and **correction**. The reason is that the efforts are fruitless and the probability of happening and accident is increased due to the lack of action in harnessing the probability of accidental undesired events and their consequences.
- Although the risk response planning phase is apparently performed strictly to the end point in some cases, but the effects of executing the risk response plans are not inspected thoroughly. We need to have an audit process at place to record the effects and feed backs of executing the plans and keeping them as metrics to improve the possibility of applying better response plans for related risks. The associated waste categories in such cases can be the **defects** and **non value added activities**. These wastes are the result of not learning from past and not upgrading our decisions on risk response planning and strategies.
- *Identified wastes in Risk Monitoring and Controlling of our risk management process:*
 - In cases where there is an insecure and unorganized method of recording the track of identified risks, monitoring the residual risks and effectiveness of risk plans in reducing risks, serious problems can occur. This way, we may lose the performance indicators concerning our risk process. We will miss the strategy of learning from past in our organization. This can lead the organization to a level where many types of wastes are expected. These wastes can be **defects**, **non value added processing**, **overproduction** and **underutilized people**. These wastes occur as consequences of insufficient corrective data for the defect type of waste. Extra processing or non value added processing due to

lack of proper vision can lead to non value added processing type of waste. Producing more or sooner than required to keep up with unpredictable changes in demands is a sign of overproduction waste as we do not benefit from a proper recording system. The overlook of the role of people's experience in these cases can lead to the waste of underutilized people.

- Applicability and validity of risk plan assumptions should be periodically updated through the results given by the monitoring and controlling phase. If this issue is not well respected, we would be exposed to waste of **defects** due to incompetency in coping with new demands.
- A critical role in risk management process is the authority in the risk monitoring and controlling phase. This role needs to be clearly defined and assigned because this process phase can tell us if we are following proper policies and procedures regarding our risk management plan. In case of an unclear definition of roles and responsibilities in this phase, we may expect the waste of **waiting**, because we should wait for responses, approvals and feedbacks from customers and others.

In the following diagrams, there is an abstract to the result of brainstorming session in form of cause and effect diagrams. There is a cause and effect diagram for each waste and ultimately we observe that the accumulation of eight wastes would play the role of eight causes to a non progressive risk management process.

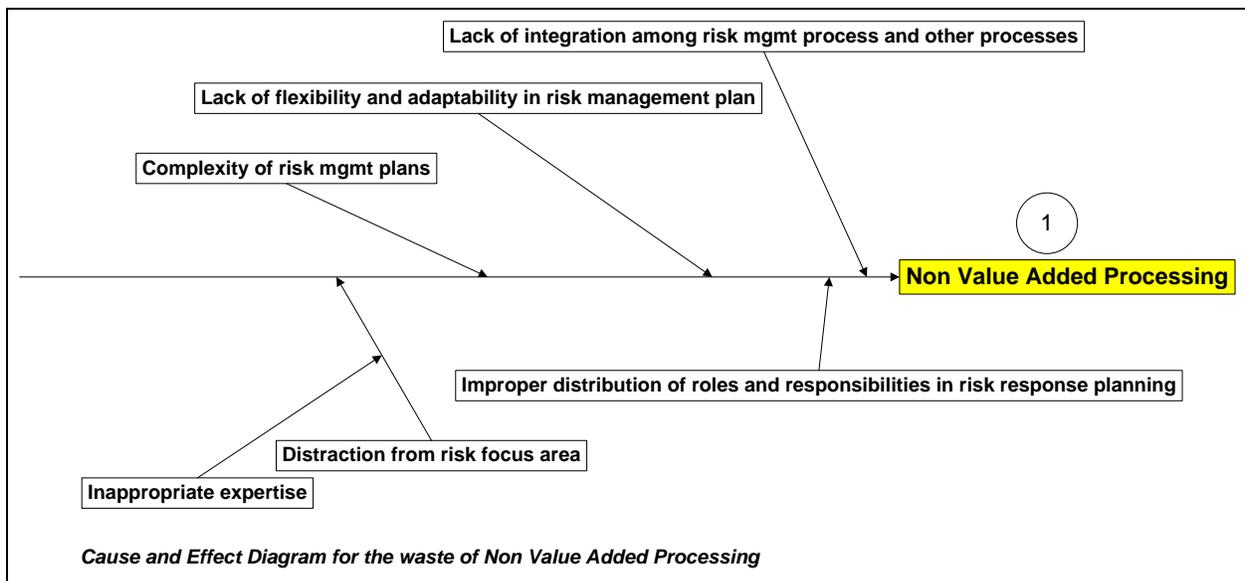


Figure 5: Cause and Effect Diagram for the waste of Non Value Added Processing

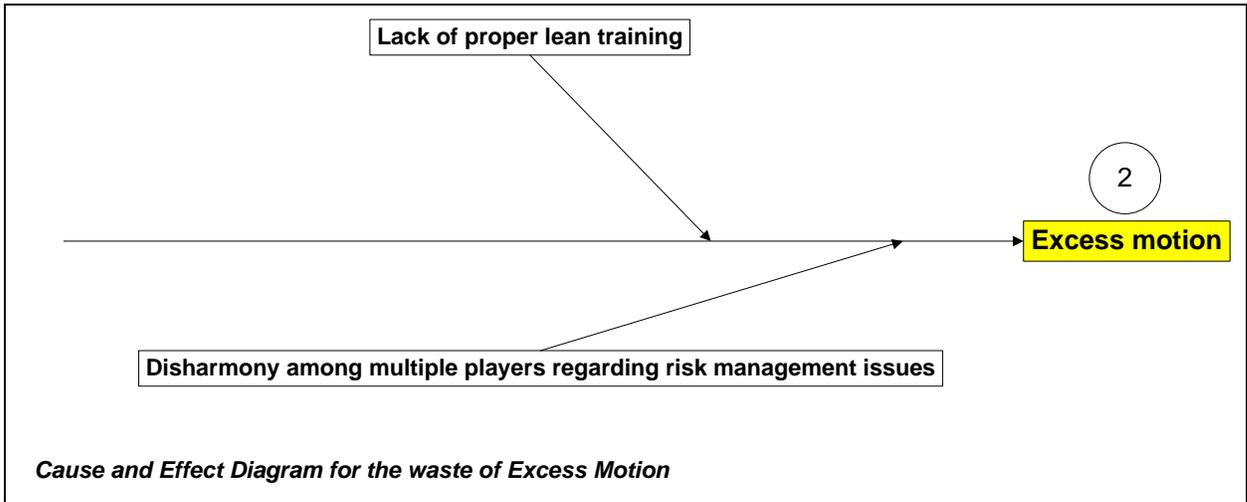


Figure 6: Cause and Effect Diagram for the waste of Excess Motion

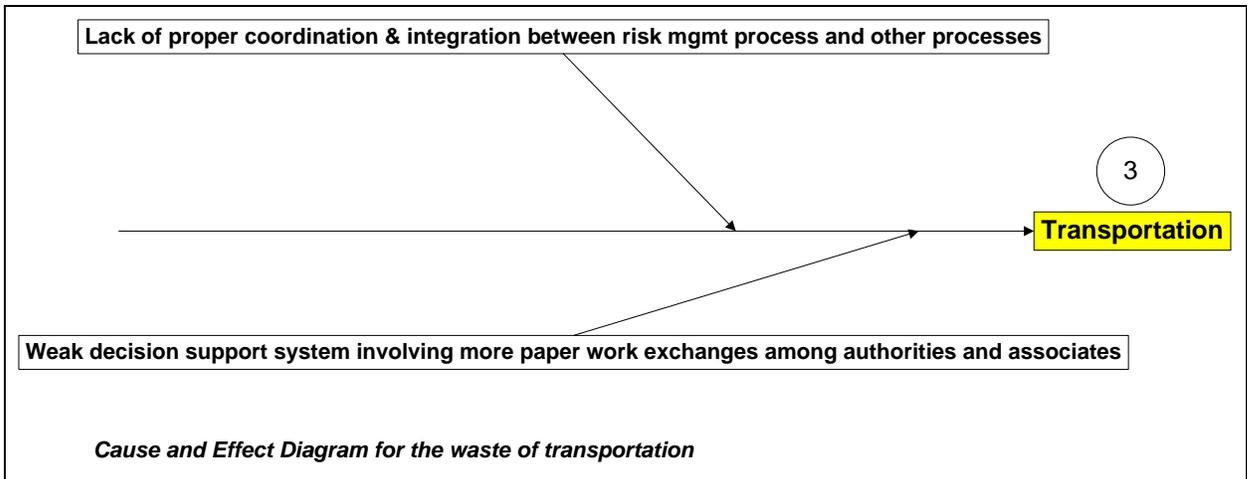


Figure 7: Cause and Effect Diagram for the waste of transportation

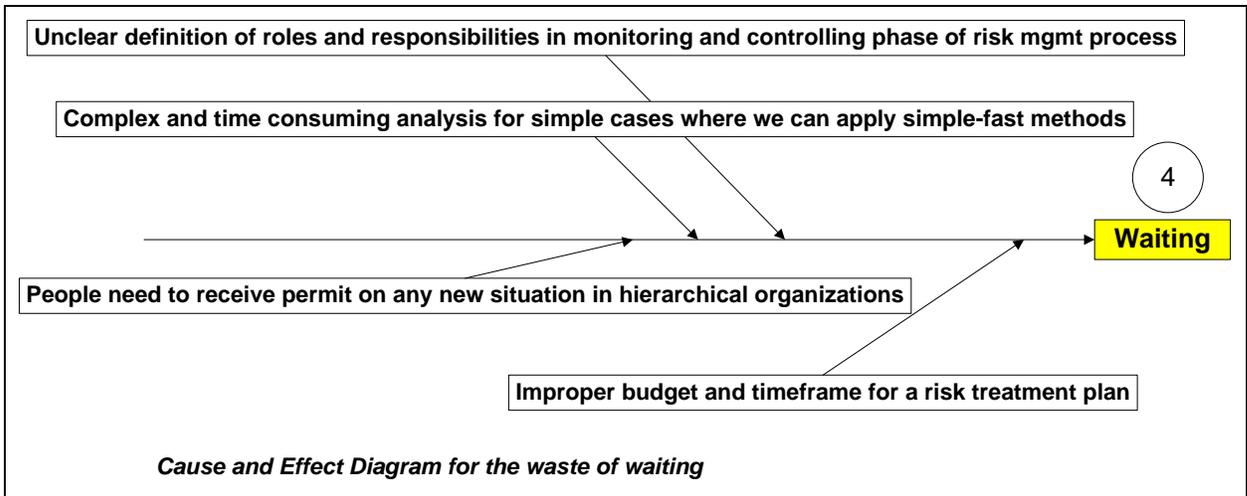


Figure 8: Cause and Effect Diagram for the waste of waiting

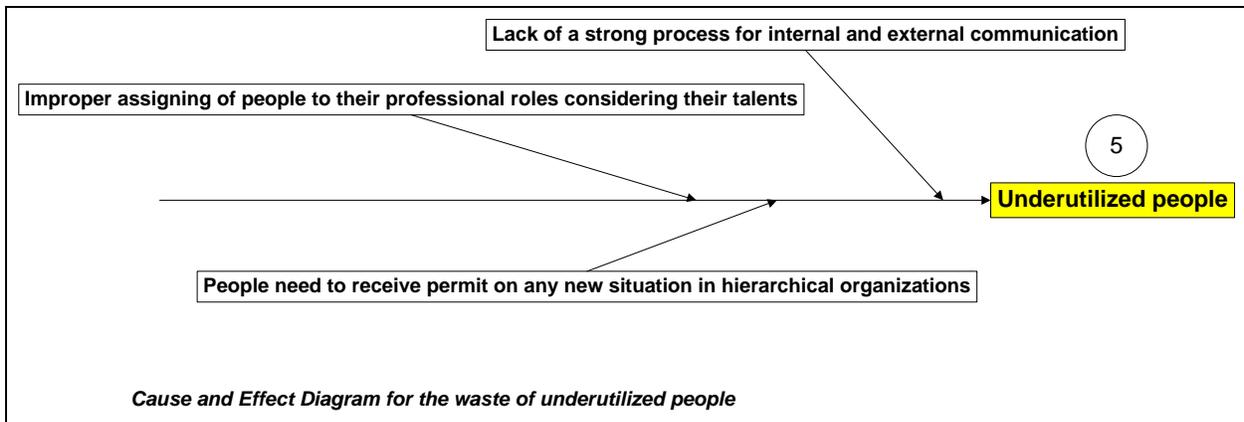


Figure 9: Cause and Effect Diagram for the waste of underutilized people

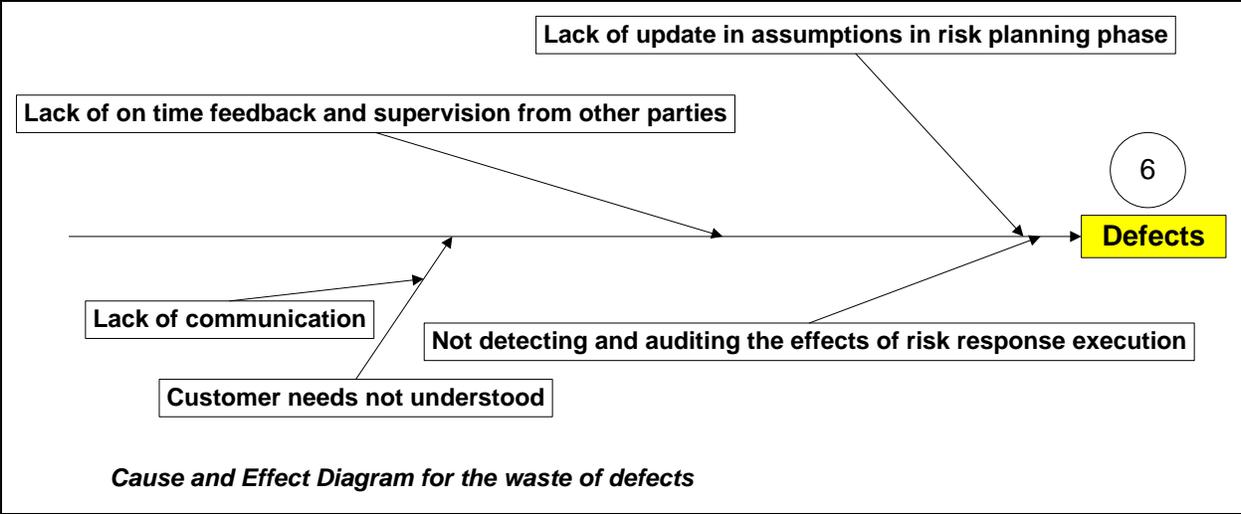


Figure 10: Cause and Effect Diagram for the waste of defects

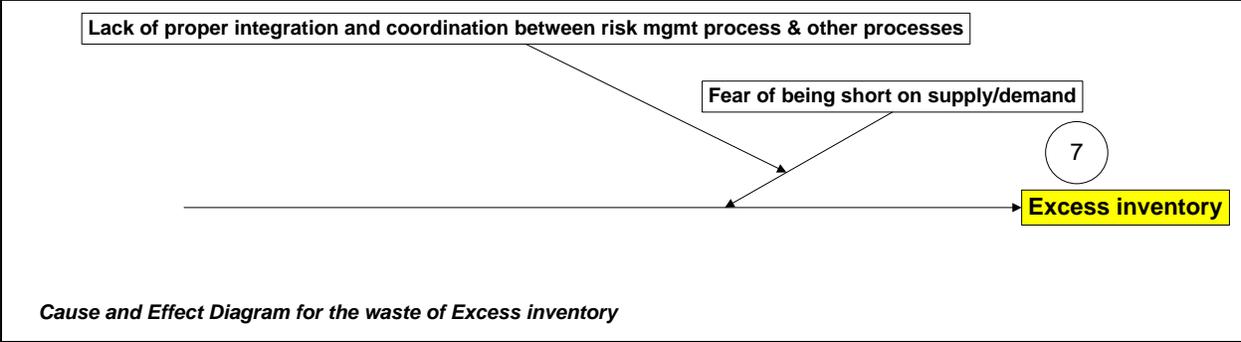


Figure 11: Cause and Effect Diagram for the waste of excess inventory

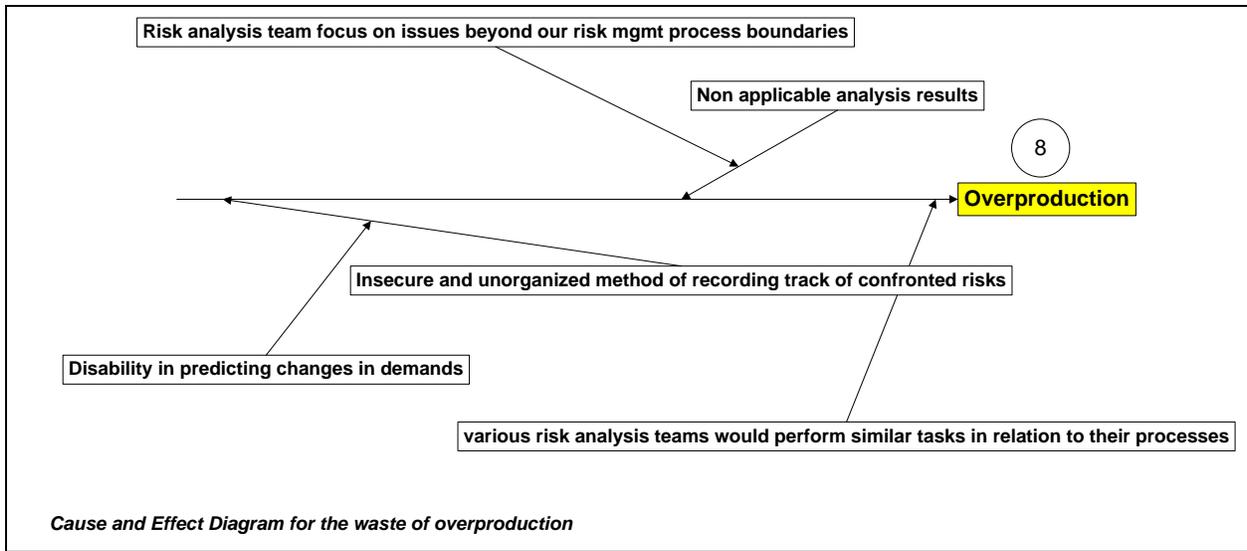


Figure 12: Cause and Effect Diagram for the waste of overproduction

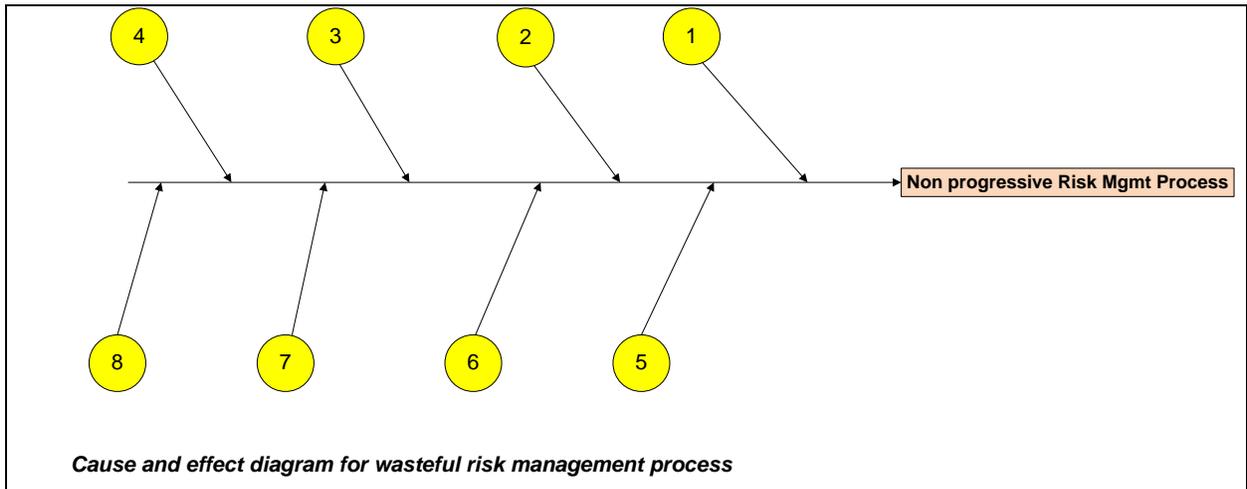


Figure 13: Cause and Effect Diagram for wasteful risk management process

5 Conclusion

Lean thinking and risk management process have natural coexistence whether we understand the relationship or not. As we understand this correlation between risk management and lean thinking, we can better integrate them and upgrade our organization or company in terms of efficiency as well as safety and security. In lean thinking alone, we need to cover the whole company regarding personnel involvement, but when these two concepts are well bonded together we will benefit an ever improving enterprise. Applications of lean principles make a quick response enterprise with proper level of flexibility which results in an aware personnel attitude in a lean risk management working environment. Mixing the factor of improved internal efficiency with our risk management process, would help us have a better control over our associated risks. Process of integrating lean principles into risk management process would be practicable with the aid of appropriate tools. These lean tools can vary depending on the nature of the organization and the focus sector, whereas integration work requires different tools in a manufacturing environment in contrast to the service sector. However through proper application of lean tools in the integration process, we would get to a level of improved effectiveness and efficiency in our organization. The result to this integration work would be a lean organization with hunger and thirst to make more improvements to the status of our lean risk management process.

Criteria of ease of understanding and ease of implementation in our plan are an important facilitator for companies and organizations to grasp the benefits of integration. With integration we refer to the integration of lean policies into risk management process. This would be a cornerstone in avoiding wastes in implementation process in addition to the improved acceptability and satisfactoriness among the associated personnel and managers.

6 Future research

It is recommended to investigate on KPIs and process metrics as future work in lean risk management. As mentioned before, lean risk management-integration can be applied in different sectors and departments like a manufacturing company, a service organization or an office place. A universal, dynamic and customizable system for process metrics and KPIs would be very helpful in making the lean risk management even leaner. Process metrics and KPIs are thus used to feed our continuous improvement and produce better flow of our risk management processes.

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