DEPARTMENT OF MANAGEMENT AND ENGINEERING

SUCCESS FACTORS FOR LEAN IMPLEMENTATION

CASE STUDY OF LEAN AWARD WINNERS

2017-06-15

Ana López Fernández

TABLE OF CONTENTS

FIGURES AND TABLES

ANNEXES

RESUMEN EN ESPAÑOL

Contexto, objetivo y alcance

Lean es una filosofía empresarial que se centra principalmente en la eliminación de desperdicios o excesos (conocidos como *waste*, es decir, todo aquello que no añade valor al producto) en cualquiera de sus siete formas: sobreproducción, tiempo de espera, transporte, exceso de procedimientos, inventarios, movimientos y defectos (Stump y Baturdeen, 2009). Asimismo Lean persigue aumentar la productividad. Permite reducir el tiempo transcurrido desde que el cliente efectúa un pedido hasta que se produce la entrega del producto, reducir los inventarios intermedios, mejorar continuamente la calidad de los productos y procesos y reducir los costes (Fullerton, McWatters, & Fawson, 2003). Además, Lean se centra en satisfacer con mayor precisión las necesidades de los clientes, garantizando que la entrega de los productos tenga lugar en el momento y lugar que el cliente demande (Liker, 2004).

Lean es un largo camino que recorrer en el que hay que superar muchas dificultades, pero la clave está en seguir avanzando poco a poco, manteniendo una visión a largo plazo. Esta filosofía empresarial puede llegar ser muy eficiente, pero en realidad, muchas empresas fracasan en su implementación y por ello en muchos casos Lean no tiene una continuidad a largo plazo (Jorgensen et al., 2007).

El objetivo de este Trabajo Fin de Máster es identificar los factores que son importantes para conseguir el éxito de Lean y para su sostenibilidad a largo plazo. Finalmente, para aquellas empresas que estén interesadas en la aplicación de Lean, algunas recomendaciones relacionadas con los factores mencionados serán extraídas como conclusiones.

El alcance de este proyecto abarca cinco empresas en Suecia que han sido galardonadas en los últimos años con el premio sueco “Lean Priset”. Dicho premio se concede anualmente en Suecia a la organización que ha desarrollado más exitosamente su negocio con el apoyo de la filosofía Lean. Para conocer los detalles acerca de la implementación y el desarrollo de Lean en dichas empresas se realizaron entrevistas a los Lean managers de las mismas y se realizaron cuestionarios a grupos de empleados. A continuación se enumeran las empresas estudiadas:

- AstraZeneca. Sector bio-farmacéutico, productora de medicinas.
- Autoliv. Desarrolla y fabrica sistemas de seguridad automotriz para los mayores fabricantes de automóviles del mundo.
- Emballator Lagan Plast. Desarrolla, produce y comercializa envases de plástico para alimentos y productos químicos.
- Tetra Pak. Empresa líder mundial en soluciones de procesamiento y envasado de alimentos.
- Nolato. Desarrolla y fabrica productos hechos de materiales poliméricos como plástico, y

silicona. Son líderes mundiales en el moldeo por inyección.

Por otro lado este proyecto está destinado a orientar a aquellas empresas que desean implementar Lean y también aquellas que están ya en el inicio de su implementación y que puedan encontrar de utilidad la información que se proporciona en el presente documento.

Marco teórico

Para obtener conocimiento sobre Lean, la primera fase del presente Trabajo Fin de Master consistió en una revisión de una amplia extensión de artículos publicados sobre dicho tema. De la literatura consultada, se extrajeron más de cien factores que podrían afectar al éxito y sostenibilidad de la implementación de Lean en las empresas. Dichos factores fueron englobados en once grupos, que fueron los temas posteriormente considerados a la hora de desarrollar las plantillas para las entrevistas y los cuestionarios que se realizarían a los empleados de las empresas a estudiar. A continuación se enumeran y explican brevemente tales grupos:

- Cultura organizacional. Lean consiste en una filosofía empresarial, no es únicamente un conjunto de herramientas que implementar en los procesos de producción: implica un cambio en la cultura de la organización. Lean implica un cambio en el diseño organizacional que sólo se puede implementar cuando la cultura Lean se propaga a través de toda la organización. Por lo tanto, el cambio de la cultura organizacional y de la mentalidad es mucho más importante que las herramientas
- Liderazgo y compromiso de los managers. Los managers deben estar comprometidos con la implementación de Lean, y sólo una vez que lo están, pueden conseguir también el compromiso de los empleados.
- Conducta y compromiso de los empleados. La potenciación de la autoridad y la responsabilidad de los empleados son características de Lean y se basa en la idea de que darles competencias, recursos, oportunidades de mejorar y ascender, motivación, además de rendir cuentas de los resultados de sus acciones contribuye a su mayor satisfacción y compromiso y al éxito de todo el sistema.
- Formación y aprendizaje. Tanto managers como empleados han de formarse en Lean. Su conocimiento es básico para el correcto funcionamiento del sistema.
- Estrategia y dirección. Se necesita una estrategia, no sólo establecida, sino también plenamente comunicada, comprendida y expandida en toda la organización. Esto guiará a los trabajadores a enfocar el cambio en su actividad.
- Mejora continua. La mejora continua se basa en trabajar constantemente para lograr ciclos de producción más cortos, centrar los esfuerzos en aumentar el valor para el cliente y obtener una mejor calidad de producción. Siempre se puede mejorar.

- Medida del rendimiento. La medición de los sistemas de rendimiento ayuda a encontrar áreas de mejora, diagnosticar de áreas con problemas y realizar seguimiento del progreso de la mejora continua.
- Clientes. El cliente siempre es prioritario. Lean se basa en la premisa de que cada negocio puede ser cambiado para producir más valor para los clientes consumiendo menos recursos.
- Proveedores. Según la filosofía Lean, un proveedor debe convertirse en una extensión de la empresa, integrándolo también en Lean.
- Stakeholders. Maximizar el valor de las partes interesadas también es un objetivo de Lean. Por lo tanto, los cambios introducidos con Lean deberían satisfacer también el interés de los stakeholders.
- Disponibilidad de recursos. Se debe tener en cuenta el Momentum, es decir, la velocidad de implementación de proyectos en la organización, que ha ser moderada.

Metodología

La metodología desarrollada consistió inicialmente en la revisión teórica ya mencionada, y posteriormente en un estudio empírico, compuesto por dos fases:

- Un análisis cualitativo, basado en las entrevistas realizadas a los Lean managers de las 5 empresas estudiadas.
- Un análisis cuantitativo, basado en los cuestionarios realizados por los empleados de las cinco empresas estudiadas. Se completaron 31 cuestionarios y posteriormente se exportaron los datos de las encuestas desde la aplicación de Fluidsurveys a un documento de Excel en el que se realizaron gráficos para analizar los resultados.

Mediante el análisis y la comparación de las respuestas obtenidos en las entrevistas y los cuestionarios se extrajeron conclusiones sobre las cuestiones importantes a tener en cuenta para conseguir el éxito con Lean a largo plazo en una empresa.

Al igual que en todos los procedimientos de recolección de datos, en este caso existen algunos problemas de calidad al evaluar los datos recopilados, pero este problema puede considerarse superado con el apoyo de dos consideraciones: validez y fiabilidad.

Por un lado, se asume el problema de la validez externa. Este enfoque de validez intenta verificar si los resultados de un estudio son generalizables más allá de sus límites. Extraer una generalidad de una muestra demasiado pequeña podría ser en ocasiones demasiado atrevido.

Para reforzar la validez, se utiliza en este caso la triangulación en distintos ámbitos:

- En cuanto a los datos, ya que se tuvieron en cuenta 31 cuestionarios de empleados con

características diferentes,

- En cuanto a la metodología, porque se utilizaron 2 enfoques distintos para recolectar los datos (cualitativos y cuantitativos).

En este estudio de caso, las conclusiones extraídas no pueden ser generalizadas debido al reducido tamaño de la muestra, pero aun así, tales conclusiones pueden ser interesantes y útiles para los lectores si desean considerar su aplicación en sus negocios.

Por otro lado, la Fiabilidad se refiere al hecho de que lo que se mide sea realmente lo que se pretende medir, y en qué medida repetir la misma medición al mismo sujeto y en las mismas condiciones, se obtienen resultados idénticos, o al menos se minimizan los errores.

Para mejorar la fiabilidad en las entrevistas realizadas, se efectuaron preguntas de repetición y control para asegurar la repetidamente las respuestas, y que la comunicación era buena en los dos sentidos: el entrevistado entendía las preguntas y los entrevistadores las respuestas. Además, las entrevistas fueron estructuradas por naturaleza por lo que las preguntas planteadas eran similares a todas las empresas. Además, se grabaron en audio las entrevistas y se tomaron notas, lo que ayudó a evitar la falta de información interesante, malentendidos, y a mejorar de esta forma también la fiabilidad

Resultados empíricos

Estudio cualitativo:

Una vez realizadas las entrevistas, se estudiaron y clasificaron las respuestas para verificar si los factores elegidos tras el estudio teórico son verdaderamente decisivos para el éxito o fracaso de Lean en las empresas.

En la Tabla 1 se muestran los factores considerados más importantes por los managers de cada empresa según sus respuestas dadas en sus respectivas entrevistas.

Factores	Tetrapak	Nolato	AstraZeneca	Emballator	Autoliv
Cultura organizacional		X		X	
Liderazgo y compromiso de los managers	X	X	X	X	X
Conducta y compromiso de los empleados	X	X	X	X	X
Formación y aprendizaje	X		X		X
Estrategia y dirección	X				
Mejora continua	X	X			
Medida de la mejora de rendimiento	X				
Clientes					
Proveedores	X				
Stakeholders					
Disponibilidad de recursos					

Tabla 1: Principales factores para los managers

Todos ellos coincidieron en que el compromiso de los empleados y los managers es el factor más esencial. La formación y el aprendizaje también son de gran importancia, seguido de la cultura organizacional y la mejora continua. Destaca que los tres factores principales para los managers, consisten en las personas de la organización, y no por ejemplo en el proceso productivo.

Por mencionar cuestiones interesantes comentadas durante las entrevistas, uno de los managers hizo referencia a un primer intento de aplicación de Lean en su empresa, el cual fracasó. Había una carencia de cultura organizativa entre los empleados, así que éstos consideraron el cambio como trabajo adicional en vez de considerarlo como "la manera de hacer negocios". Es obvio que, al principio, debido al cambio, es necesario hacer un esfuerzo extra para recibir formación y crear nuevos estándares y procedimientos. Por un lado, las personas necesitan estar informadas sobre la nueva filosofía y, por otro lado, tienen que tener la mente abierta para cambiar los hábitos y comprender algunos procedimientos Lean, o como por ejemplo, que tener una reunión diaria no es un desperdicio de tiempo. Dos años más tarde, en la segunda implementación, los empleados sí entendieron que Lean es la forma de hacer negocios, y por lo tanto, la implementación tuvo éxito esta vez.

Otro manager explicó en su caso que en el comienzo de su implementación sólo se trataba de introducir las herramientas Lean en su proceso productivo, pero no sobre la difusión de la cultura Lean en la organización. Así, contrataron a algunos consultores que formaron a sus empleados para aplicar las herramientas Lean, pero tomaron tiempo para explicar y convencer a la gente sobre la filosofía Lean. Esto es un fracaso común: contratar a un consultor pensando que va a hacer todo el trabajo; que aplicando las herramientas que el consultor enseñe en la empresa se reducirán los costos y se resolverán todos los problemas. En lugar de eso, dichos consultores habrían sido más útiles si fueran contratados para formar a los managers, de modo que la cultura Lean pudiera ser difundida también a través de los

empleados como se mencionó anteriormente. Afortunadamente, años más tarde se dieron cuenta de la importancia del entendimiento de la filosofía Lean.

Sobre la mejora continua, la forma de trabajar hacia ella es similar en la mayoría de las empresas entrevistadas. Hay un equipo de mejora por área o departamento en la organización. Estos equipos se reúnen semanalmente o una vez cada dos semanas, compartiendo un objetivo común como por ejemplo encontrar la raíz de los problemas que hayan surgido y donde todos los trabajadores pueden comunicar sus ideas y sugerencias.

Estudio cuantitativo

En cuanto a los cuestionarios, después de haber recogido 31 encuestas, los resultados se extrajeron de la aplicación FluidSurveys a un documento de Excel. Una vez allí, toda la información obtenida fue traducida al inglés y se crearon diferentes tablas para clasificar y analizar las diferentes respuestas.

a. Motivos para implementar Lean

La siguiente figura contiene las principales razones que llevaron a las empresas estudiadas a empezar la implementación de Lean.

Como se puede ver, la mejora de la productividad (*Improve productivity*) y la reducción de deshechos (*reduce waste*) son las dos razones principales. Este resultado es lógico ya que según la propia definición de Lean esos son los principales propósitos del sistema.

Sin embargo, siendo la satisfacción del cliente (*Increase customer's satisfacion*) otro de los objetivos de Lean, este motivo sólo recibió el 22% de los votos, lo cual es un porcentaje pequeño respecto a los obtenidos por las dos cuestiones mencionadas en el anterior párrafo. Aun así la satisfacción del cliente es una de las tres razones principales.

Según la revisión teórica efectuada al principio del proyecto, uno de los objetivos de Lean es reducir los costes (*Reduce costs*). Sin embargo, uno de los managers afirmo en una de las entrevistas que tener ese objetivo es una de los razones que llevan a muchas empresas a fallar en su implementación y de hecho se observa en la figura que no es uno de los motivos que más impulsaron a la implementación de Lean en las empresas estudiadas, ya que sólo tiene un 14% de los votos. La reducción de costes es algo que viene tras la mejora en otros aspectos como la productividad o la reducción de los deshechos.

Figura 1: Motivos para implementar Lean

b. Importancia y grado de implementación de los principios Lean

En las siguiente tres figuras, podemos ver la puntuación que varios de los principios de Lean recibieron sobre la importancia que tienen para las empresas estudiadas y su grado de implementación.

Se puede ver que la mayor importancia se da a "Usar el control visual para evitar que los problemas permanezcan ocultos" (*Use visual control so no problems remain hidden*), y de hecho, según las respuestas obtenidas los trabajadores consideran que es algo que realizan correctamente en sus empresas.

Los dos siguientes principios más importantes según las respuestas obtenidas son: "Convertirse en una organización basada en el aprendizaje mediante la reflexión incesante y la mejora continua" (*Become a lreaning organization through ralentless reflection and continuous improvement*) y "Desarrollar líderes que realmente entiendan el trabajo, vivan la filosofía Lean y la enseñen a los demás" (*Develop leaders who truly understand the work, live the philosophy and teach it to others*). Según las respuestas obtenidas por los encuestados, en las empresas estudiadas se hace hincapié en la aplicación de ambos principios, pero en el caso del primero de los dos recientemente mencionados, los encuestados consideran que sería importante mejorar aun más ese aspecto.

Finalmente cabe mencionar "Ir y ver" (*Go and see*) y "Efectuar un seguimiento de la demanda para evitar la sobreproducción" (*Follow the demand to produce to avoid overproduction*), donde según los trabajadores encuestados, el primero debería ser mejorado. En el caso del segundo, el grado de aplicación es incluso mayor que la importancia que se le da (como ocurre con el uso del control visual).

Figura 2: Grado de implementación de los principios Lean

Figura 3: Importancia de los principios Lean

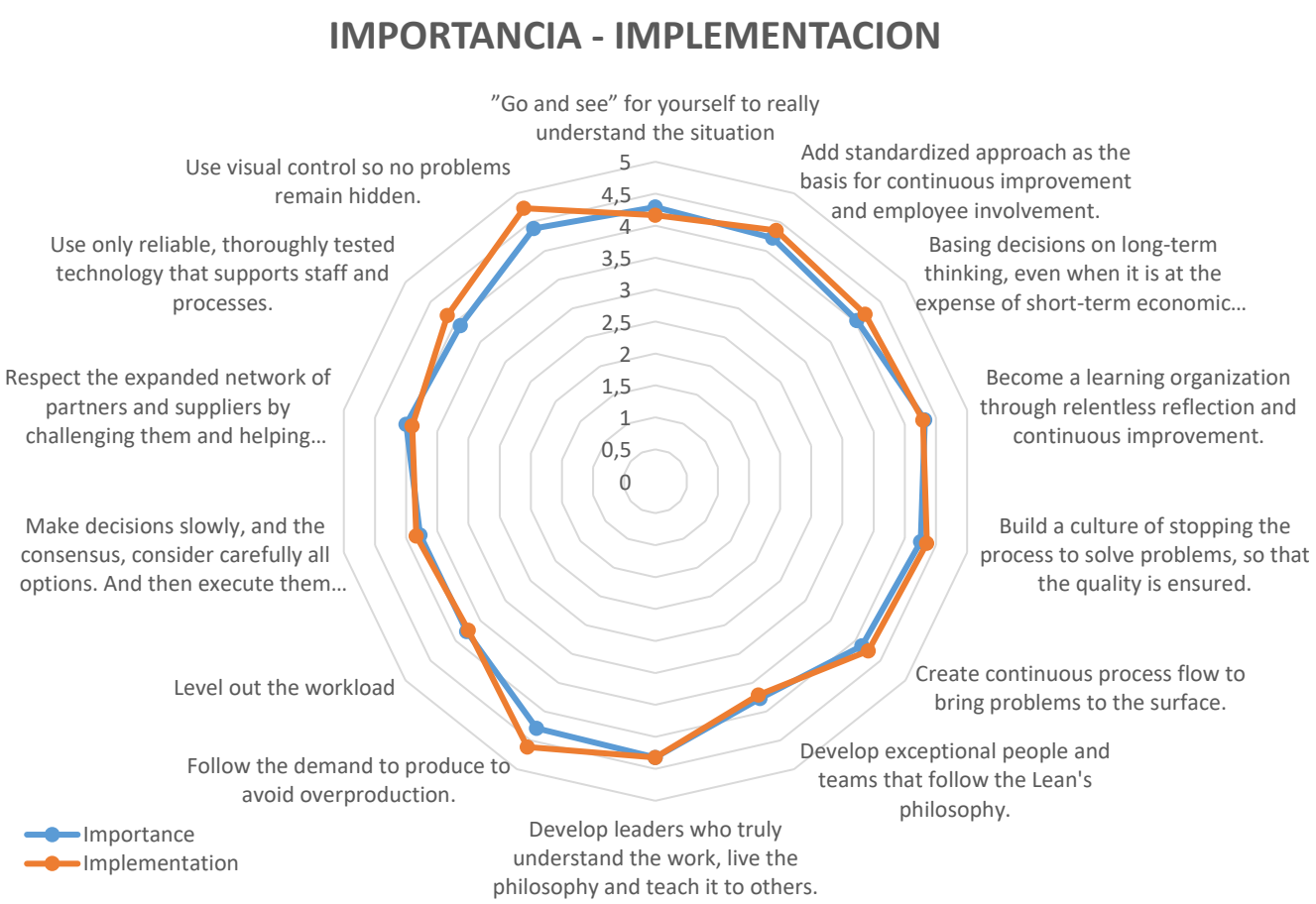

Figura 4: Comparación de la importancia y grado de implementación de los principios Lean

c. Características de los sistemas basados en Lean

En esta pregunta, se pregunta a los encuestados sobre el grado en que estas afirmaciones coinciden con la situación actual de sus empresas.

El hecho de que los grupos de afirmaciones sobre mejora continua (*Continuous improvement*) y gestión de operaciones (*Operations management*) son los que más coinciden con estas empresas resalta en los resultados. En general, tienen los mayores porcentajes de "Muy de acuerdo" (*I agree very much*) y "de acuerdo" (*I agree*) entre los encuestados.

Tres afirmaciones que llaman la atención fuera de los dos grupos previamente nombrados son "Los managers de todos los niveles muestran un compromiso activo con Lean" (*Managers at all levels display active commitment to Lean*), "Se habla sobre los problemas que surgen" (*We talk about the problems that arise*) y "Se tiene una buena estrategia y objetivos para enfrentar los retos y necesidades futuros de la empresa" (*We have a good strategy and objectives to meet the future challenges and needs of the company*), esta última con el 93% de los encuestados "Muy de acuerdo" (*I agree very muc*h) .

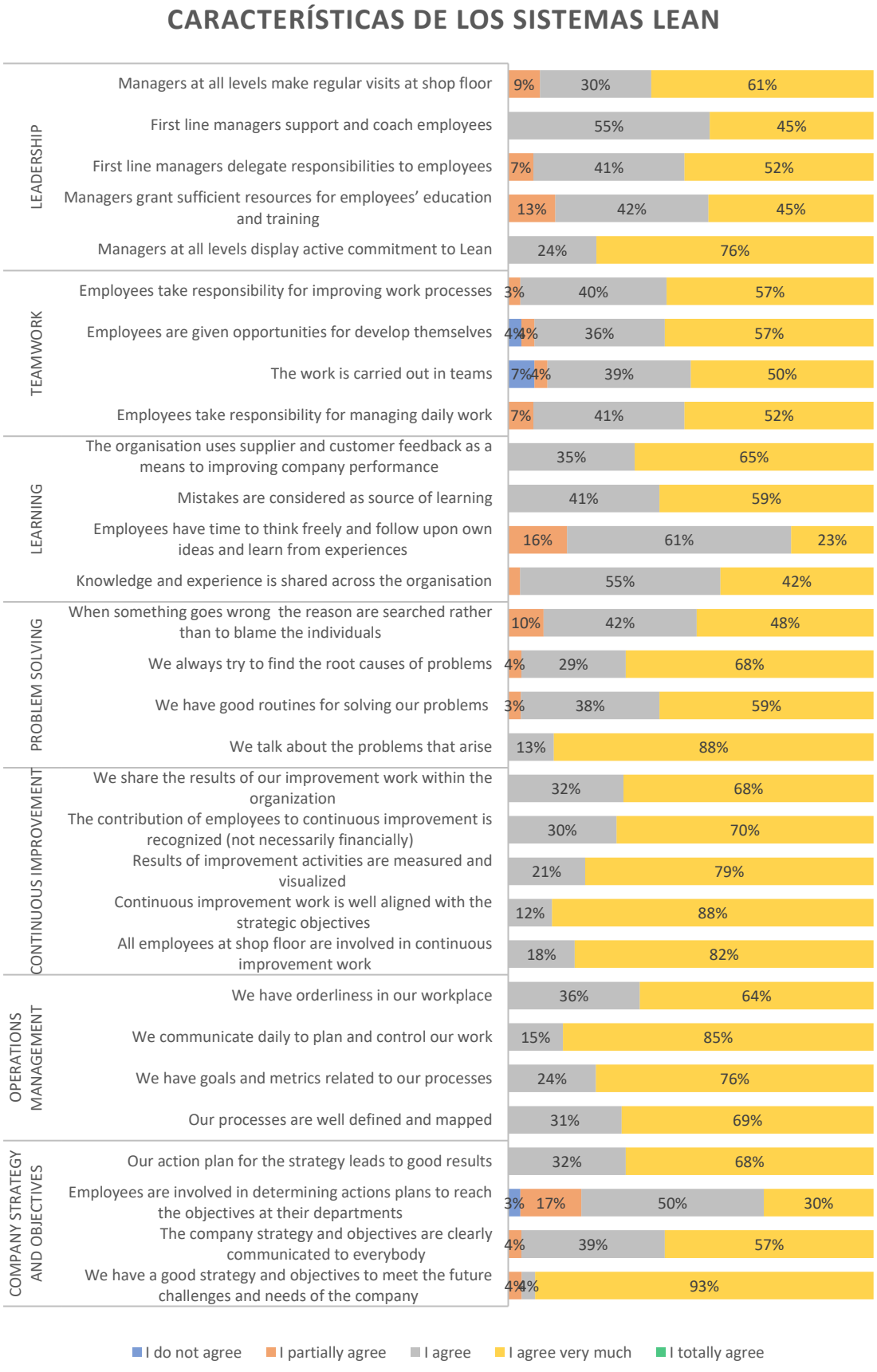

Figura 5: Características de los sistemas basados en Lean

d. Departamentos en los que se aplican actividades de mejora

En la siguiente figura explica con cuanta frecuencia se realizan actividades de mejora en cada departamento de las empresas estudiadas.

Destaca el hecho de que en mayor o menor medida, en todos los departamentos se realizan actividades de mejora, ya que ningún encuestado ha respondido que no hay actividad de mejora en un departamento, lo que es algo a tener en cuenta.

En particular, destaca el departamento de producción (*Production departmen*t) como aquel en el que las actividades de mejora se consideran como más integradas en el día a día en la empresa (*Improvement is integrated as part of daily life*). De esta manera se hace hincapié en el propósito de eliminación de los deshechos en el proceso productivo.

En los departamentos de mantenimiento (*Maintenance department*), logística (*Logistics department*) y actividades de mejora del desarrollo de nuevos productos (*New product development department*) se implementan al menos regularmente.

Como se observa, incluso en esta pequeña muestra no todas las empresas aplican las actividades de mejora en los mismos departamentos o con las mismas frecuencias o prioridades. Aun así, de igual forma todas esas empresas obtienen buenos resultados aplicando sus sistemas Lean mediante distintos caminos. Por ello cabe mencionar una vez más que esta información puede ser únicamente utilizada como referencia pero no es imprescindible para alcanzar el éxito en la implementación.

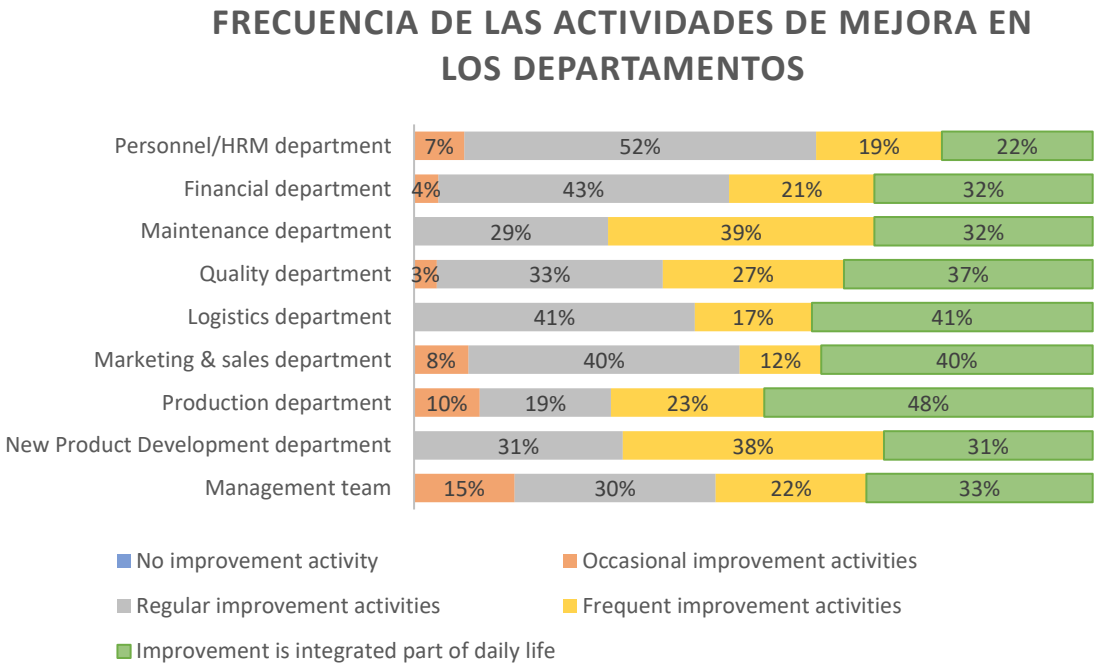

Figura 6: Departamentos en los que se aplican actividades de mejora

e. Obstáculos en el trabajo de mejora

En la siguiente figura, el gráfico muestra la frecuencia con la que las empresas se enfrentan a estos obstáculos en el trabajo de mejora.

El obstáculo más comúnmente encontrado es la falta de tiempo (Lack of time). Más de la mitad de los empleados cuestionados respondieron que este problema se encuentra con mucha frecuencia (*Very often*). Es muy común que la empresa no tenga tiempo suficiente para ejecutar un plan de formación entre los empleados, o para emplear en la implementación de Lean todo el tiempo y atención que necesita, ya que ya están bastante apresurados para cumplir los plazos con sus clientes y necesitan centrarse en su plan de producción más que en la implementación de un nuevo sistema.

Los encuestados señalan la falta de participación de los empleados (*Lack of employee involvement*) como el segundo obstáculo más comúnmente encontrado. Es completamente lógico, porque después de las entrevistas y su posterior análisis, se sabe que esta falta de implicación está muy relacionada con la falta de formación y conocimiento sobre Lean (*Insufficient knowledge/capabilities/experience*), que es el tercer problema más comúnmente encontrado. Además, la falta de apoyo de los managers (*Lack of support*) debe ser mencionado como el siguiente problema más frecuente, y esto también se desarrolla a partir de la falta de información y capacitación, y por lo tanto, de la falta de tiempo.

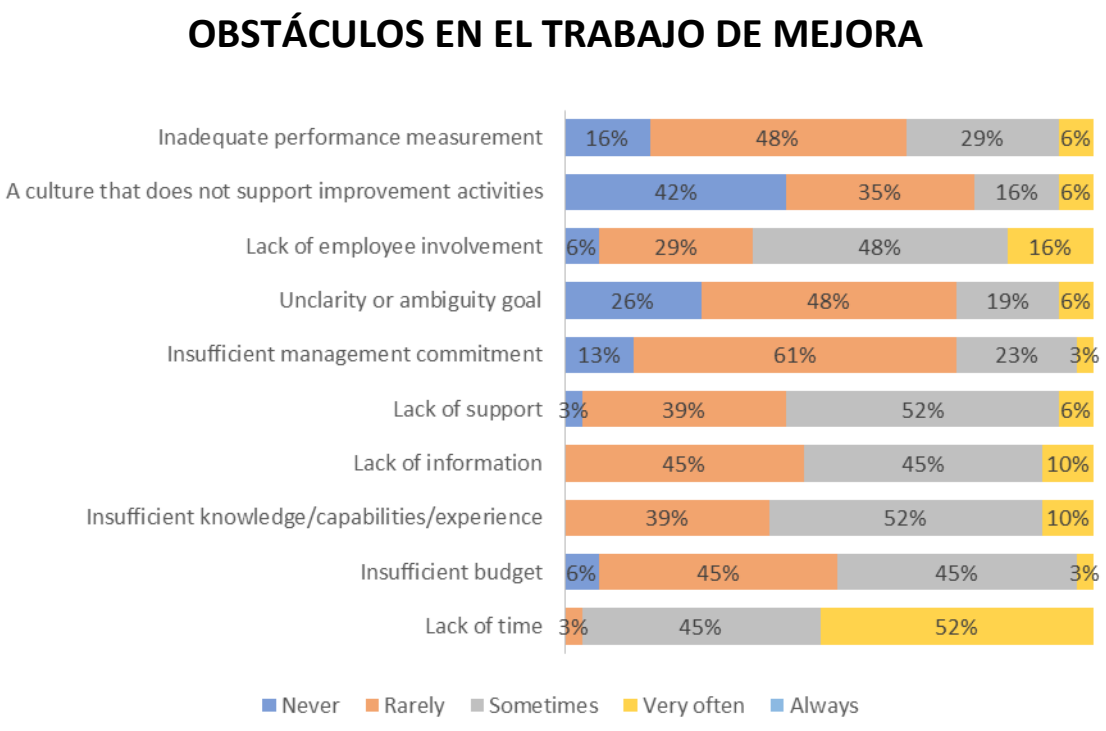

Figura 7: Obstáculos en el trabajo de mejora

Conclusiones

Tras el análisis de los resultados obtenidos tras las entrevistas y los cuestionarios se puede concluir que los factores más influyentes para el éxito y sostenibilidad de Lean son la formación y el aprendizaje de los managers y empleados, el liderazgo y compromiso de los managers y el comportamiento y compromiso de los empleados.

Los tres factores recién mencionados están estrechamente relacionados entre ellos. Formar a los managers y a los empleados significa proporcionarles nociones sobre la filosofía Lean, para que puedan entender la importancia de su implementación en la organización. Esta formación ha de efectuarse al inicio de la implementación y periódicamente tras dicha fase inicial: el aprendizaje nunca debe detenerse ya que la forma de trabajar puede cambiar según las circunstancias (actualización, nuevas exigencias, ajustes, nuevas tecnologías, etc). De esta forma, tanto managers como empleados podrán estar comprometidos con la filosofía Lean, lo cual es muy necesario, ya que de lo contrario la implementación no tendrá éxito.

Otra de las claves para que la implementación de Lean tenga éxito es tener un objetivo claro hacia el cual dirigirse y una estrategia que seguir bien definida.

El primer paso a seguir cuando una empresa decide implementar Lean debe ser la formación en Lean de los managers y los empleados, ya que el entendimiento de Lean por parte de toda la plantilla es absolutamente necesario. Tal y como uno de los managers afirmó durante su entrevista, "Lean no se trata de herramientas, sino de un fenómeno cultural basado en el sentido común, el cambio de mentalidad, el compromiso y el respeto". Ha de evitarse el fallo común de contratar a un consultor externo pensando que solamente implementando las herramientas Lean los costes se reducirán y todos los problemas serán resueltos. En su lugar, el consultor se debería contratar para centrarse en la formación en Lean de los managers. Algún tiempo tras el inicio de la implementación de Lean las empresas estudiadas en el presente proyecto aprendieron lo esencial que es dicha formación de los managers para el éxito de la implementación.

Por otra parte, sólo una vez que los administradores están comprometidos con Lean, pueden convencer a los empleados sobre sus beneficios, lo cual, como ya se mencionó, es también uno de los factores más importantes para el éxito de Lean. Para convencer a los empleados al inicio de la implementación es buena idea para mostrarles como referencia el ejemplo de una empresa que haya tenido éxito con Lean. Por supuesto, también es necesario entrenar y educar a los empleados en Lean, ya que, como afirmó uno de los managers en una de las entrevistas, “la incertidumbre debido a la falta de entrenamiento y por lo tanto de conocimiento, puede ser una barrera que podría significar la desmotivación y falta de compromiso. Los managers entrevistados están de acuerdo en que en el comienzo de la aplicación de Lean los empleados estaban descontentos porque no entendían el porqué de Lean ni su filosofía, y por lo tanto no lo vieron como “la manera de hacer negocios”. Los empleados son el factor que hace que las

cosas sucedan en la empresa, por lo que deben ser conscientes de lo que está pasando para trabajar hacia el mismo objetivo, y para ello ha de comunicárseles las estrategias y objetivos de la empresa. Una vez que los empleados han comprendido la filosofía Lean, su poder y capacidades en la empresa son potenciados, es decir, con Lean, los empleados tienen más responsabilidades y por ello están más implicados para mejorar la empresa, lo que incrementa su motivación y finalmente su satisfacción. Por ejemplo, durante las reuniones diarias que se efectúan entre managers y empleados, los empleados comunican todo tipo de cuestiones a los managers, lo cual no sucedía antes de la implementación de Lean.

Una empresa que trabaja con Lean trabaja con mejora continua: siempre hay algo que mejorar. Existe un equipo de mejora en cada área o departamento. Es importante llevar a cabo nuevas ideas para comprobar si funcionan y siempre intentar conseguir un sistema mejor, no teniendo miedo de posibles fracasos, ya que posible aprender tanto del éxito como de los errores. En caso de fracaso, éste puede conducir a tomar otros pasos distintos que pueden también ser ventajosos para la organización.

En cuanto a los proveedores, podría ser rentable para la empresa hacer negocios con proveedores que también trabajen con Lean y con sistemas de mejora continua. También se desea tener clientes exigentes, y que proporcionen feedback para seguir mejorando y cumpliendo sus expectativas y para descubrir lo que es valioso para ellos, y entender lo que se ha de considerar *waste*. Incluir a los proveedores y clientes en la cadena de producción es un objetivo que las empresas que trabajan con Lean intentarán alcanzar cuando estén en una fase de la implementación de Lean más madura, ya que primero han de centrarse en su propio sistema.

Por último, añadir que Lean es un largo camino. Por lo tanto, las empresas que se encuentran en los primeros pasos de la implementación de Lean no han de desalentarse: con algo de tiempo seguro podrán alcanzar sus objetivos.

1. BACKGROUND, OBJECTIVE AND SCOPE

Lean is an accepted business philosophy worldwide (Stump and Baturdeen, 2009). This philosophy focuses mainly on the elimination of wastes. The implementation of Lean increases productivity and allows to reduce the time between the order of the customer and the shipment of the product, or to reduce the intermediate inventories, continuously improving the quality of the products and processes and reducing the costs (Fullerton, McWatters, & Fawson, 2003). Moreover, Lean focuses on meeting more precisely the customers' needs, ensuring that the delivery of the products takes place at the time and place the customer requires (Liker, 2004).

To achieve successful implementation, each organization needs to identify its own barriers according to its characteristics. The way of working under a Lean philosophy is long-term and with several difficulties to overcome on the way, but this should not discourage the companies to continue advancing. Thereby, this business philosophy is very efficient, but the reality is that in many cases it is difficult to implement and does not have a long-term continuity (Jorgensen et al., 2007).

The aim of this project work is to identify factors that are important for the success of Lean and for its sustainability in the long term. So, after a theoretical and an empirical study, the aim is to find out which factors are the main ones, and among them which are the most important ones to which the organization should pay more attention. In addition, some tips and advices related to the mentioned factors will be given to every company that might be interested in implementing Lean.

The scope of this project work includes five companies in Sweden that have been awarded in the last few years with the Swedish Lean Award. The mentioned award is yearly given to an organization in Sweden that has most successfully developed its business with the support of the Lean philosophy. As data collection methods interviews and a survey are used. In addition, a literature review was carried out to identify the success factors from previous studies.

This project work is intended to help those companies that want to implement Lean and those that are already in the beginning of its implementation.

2. THEORETICAL FRAMEWORK

2.1. Lean production

Lean aims to change the whole organizational culture and optimizes the production process, eliminating different wastes that do not add value to the final product or process carried out. This way, the value of the performed activities is increased and what is not required is eliminated (Hines et al., 2008).

Before introducing the core principles of Lean, it is interesting to know a bit of its framework.

Improving efficiency in manufacturing was applied in Japan by Taiichi Ohno and Kichiro Toyoda, respectively Vicepresident and CEO of Toyota Motor Corporation, who found in the company certain manufacture problems which needed to be fixed. According to what Sugimori et al. (1977) explained, in the 1950's the most distinguished Japanese work features were the following two facts: on the one hand, as an advantage, the labour environment in Japan was much better than in the European and American countries; and on the other hand, and as a disadvantage, productivity was much lower than in the USA and Europe, since it was difficult to get raw materials. In this situation, it was needed to find a tool to counteract this problem.

After the end of the Second World War, Ohno visited the United States, where he observed the pioneers in in mass production and economies of scale: Frederick Taylor and Henry Ford. Ohno was impressed by the overemphasis that the Americans put on mass production instead of variety and the low level of waste generated by industries in the richest country after the War. When he saw how the American supermarkets worked he found the idea of reducing inventories, eliminating unnecessary steps, controlling the primary activities and giving control to the customers as support for the value chain, producing exactly what and when they wanted. In other words, he developed the idea of Just in Time and pull flow (Sugimori, Kusunoki, Cho and Uchikawa, 1977), which are defined in the section 5. Manufacturing Tools of the present document.

Later, the researchers at Massachusetts Institute of Technolog (MIT) studied the evolution of production management systems, in particular, the development of the automotive industry during the last 50 years of the twentieth century and they defined the core principles on which Lean production is based. These concepts were spread by means of their books "The Machine That Changed The World" (Womack, Jones, & Roos, 1990) and "Lean Thinking" (Womack & Jones, 2003), to be applied to manufacturing companies and any kind of services so as in the United States as in the rest of the world. According to what Womack et al. (1996) wrote and also Hines, Holweg, and Rich (2004) mentioned, these **five core principles** of lean production are:

- **Identifying customer value** (eliminate waste). It means identifying those activities that the

customer is willing to pay for. The activities that do not add value for the customer are considered waste, also denominated *muda*.

- **Mapping value stream.** The flow of value consists in all the activities carried out by a company to satisfy the customer. By creating a map of the value stream, it is possible to identify those activities that do not add any value from the point of view of the customer, in order to eliminate them.
- **Create continuous flow.** A continuous movement of the product or service through the value stream must be achieved with no interruption. Therefore, it is needed to reduce the delays in the value flow by removing obstacles in the process.
- **Using pull mechanisms** which means, producing and delivering according to customer demand, not to the forecast. According to Liker and Meier (2006), pull systems produce only what the customer wants, with the highest quality and with no delays.
- **Pursue perfection** and continuous improvement. Always work in order to achieve shorter production cycles, and to obtain the ideal production in terms of quality and quantity, focusing the efforts on the value for the customer. As one of the founders of Toyota, Sakichi Toyoda affirmed, "No machine or process will reach a point beyond of which it cannot be further improved".

In a more recent context, Liker and Meier (2006) described the basis of Toyota's success with their **4P Model of Toyota way**, corresponding to four main concepts sub-grouped in 14 principles. These principles are Philosophy (long term thinking), process (waste elimination), people and partners (respect, challenges, and continuous evolution), and problem solving (learning and continuous improvement).

This 4P Model follows in some way a hierarchical order, from problems on the top to philosophy on the bottom. This means that without the implementation of the philosophy, the other Ps will not be successful. That's why many enterprises that tried to apply Toyota's model weren't successful, because they didn't understand the importance of following Toyota's philosophy.

Beginning then with the first of the principles, the **philosophical** sense is what drives Toyota along with a long-term thinking. All the workers in Toyota are aware of and share the same purpose or goal, which is to generate value for the customer, the society and the economy of the community where it works, and its associates (Liker and Meier, 2006). This goal is more important than just reducing costs or expanding benefits. The idea is to base decisions on a long-term philosophy, even at the expense of short-term financial goals, because in the long run it will be more beneficial (Liker and Meier, 2006).

With regard to the second principle, the **process**, in accordance to Liker and Meier (2006), when following the right process, the right results will be achieved. The main goal of this principle is the elimination of waste. A process based on Lean can be supported by different tools which will be described in the last part of this section.

Regarding the third principle, **people and partners**, it is important to challenge employees and partners to make them more involved and therefore grow, becoming more confident, (Liker and Meier, 2006). According to Sugimori et al. (1977), "making up a system where workers can actively participate in running and improving their workshops and be able to fully display their capabilities would be foundation of human respect environment of the highest order". Furthermore, leaders and managers in Toyota are workers that have grown in the company until reaching their current position, so they understand the work in a detailed level and they exemplify Toyota's philosophy in everything they do (Liker and Meier, 2006).

In respect to the suppliers, they are considered an extension of the company, so it is important to work with them and be physically close to them to obtain the highest quality in the products (Liker and Meier, 2006).

To end with the 4Ps, the fourth principle is based on **problem solving** from learning continuous improvement. According to Liker and Meier (2006), "problem solving is continuously solve root problems to drive organizational learning". It is important to highlight the idea of making decisions slowly by consensus and then to apply them quickly to the process. Besides, it is essential to have a deep knowledge and understanding of the situations before taking decisions, for that it is required to "go and see for yourself" what is going on.

In the following paragraphs some principles and tools, which characterize Lean, are explained.

First of all, production is based on **continuous flow**, which means a continuous movement of the product through the value stream without stopping from its design to its delivery, with no downtime and no buffers (or minimal ones) in between the steps.

One of the main Lean tools is **5S**, which intends to eliminate all the waste in the floor shop that exists because of the poorly organized area. The meaning of the S which compose the name of the tool is explained as follows:

- Sort: eliminate everything that is not needed and hence a waste (tools, materials, etc.)
- Set in Order: organize the items that were not eliminated in the previous step because they are needed or not a waste.
- Standardize: write standards for above so that everything can be kept in good trim.
- Shine: perform regular cleaning and inspection and keep the workplace safe and pleasing to work in.
- Sustain: apply the standards regularly.

To achieve the aim continuous flow, it is essential to introduce **standardization** in tasks and processes, which means to establish some patterns about what to do, when, in how much time and by whom. By standardizing, the timing and output of processes can be predicted and a feedback to learn and improve can be easily given (Liker and Meier, 2006). The technology should not be implemented before being

investigated not to endanger the stability, reliability and predictability of the processes (Liker and Meier, 2006).

A basic concept which is also commonly used in Lean is **Just in Time** (JIT), a method based on a pull system and which introduces the idea that "all processes produce the necessary parts at the necessary time and have on hand only the minimum stock necessary to hold the processes together" (Sugimori et al., 1977). By its application, problems as inventory unbalance, surplus equipment and surplus workers are avoided. JIT consists in the production and conveyance of one piece at a time, so that there is no extra stock between the processes, and the setup time and lot size is reduced (Sugimori et al, 1977).

A recommendable method to pace the production is **Takted production.** The takt time is the rate at which customers order goods calculated as articles per period (day, week, as required). This rate provides the speed at which the process must work to be able to satisfy the customers demand (Womack and Jones, 1996).

Also in favour of the pull system, another Lean tool is **Kanban**, which consists in the execution of signals, normally in form of signal cards returned from the following operations which indicate what is needed to produce because it has just been consumed, supporting the desired pull-system. It regulates both the internal flow of goods and the external one with suppliers and customers. Kanban helps eliminating waste since the inventory is reduced and the overproduction is deleted. This way, material and information move faster and processes and people are linked together, (Liker and Meier, 2006).

According to Liker and Meier (2006), to be able to have a JIT production with a continuous flow, it is necessary to have stability in the workload, that is to say, to level the production, or in Japanese terms, applying **Heijunka.** It consists in equalizing the volume and the product mix. It is based on producing more variety of products in smaller batches, whose production is alternated at a higher frequency. Heijunka reduces lead times, since each product is manufactured more frequently, and inventory, since batches are smaller, what makes the production smoother and levelled (Sugimori et al., 1977).

The machines need some time to change the production between different products. That time of changeover is a waste, so it is pursued to achieve what is called a setup time reduction. Shigeo Shingo developed tools to reduce the setup time to less than 10 minutes, Single-Minute Exchange of Dies or **SMED**. These tools include transforming the setup steps to external ones so they are performed while the process is running, eliminating this way the waste of time, simplifying the internal setup and eliminating operations that are not essential. SMED permits the production in smaller lots and the reduction of inventory.

To support JIT **visual control** is commonly used, which is a tool which permits every employee to quickly and easily see the status of an activity. In this way, they can see if they are in a standard condition or in a deviation from the standard (Liker and Meier, 2006), and in the last case, the employee will be able to take an appropriate action to redirect the process (Womack and Jones, 1996).

Another concept applied also in situations which are deviated from the standard is **Jidoka**, meaning according to Sugimori et al. (1977) "to make the equipment or operation stop when an abnormal or defective condition arises". It is about partially automatizing the manufacturing equipment and monitoring multiple stations, and stopping when defects are detected. Moreover, people is freer to handle multiple tasks at the same time with no risk of quality defects. In addition, the employees are empowered to solve the defects. This way, the process is improved and quality is built at the work station. Furthermore, **Andon** is a real-time communication tool for stopping production when problems are detected, so that they can be instantly solved.

To avoid defects another tool, which is named in Japanese **Poka Yoke** (Mistake proofing) can be implemented. This tool aims to achieve zero defects by designing automated checks and warning signals for error detection and prevention along the production process. It is cheaper to detect the error and solve it immediately than find all the defects through a final inspection when correcting the defects is more expensive, since the product is more complex.

In case the problems arise, the methodology of **5 Why root cause analysis** (Hadome) is useful to find their root, so that they can be truly solved. It consists in asking five times "why", each time moving a step closer to discovering the underlying problem until finding the root cause. This way, it is guaranteed that the problem is solved, not as when applying quick fixes to problem symptoms that appear.

To assure the consistent and exhaustive progress towards strategic goals there is a method called **Policy deployment**. Its implementation is intended to eliminate the waste because of poor communication between the different levels of an organization, thus it aligns the goals of the company (strategy goals), with the plans of middle management (tactic goals) and the work performed on the plant floor (action).

2.2. Success factors for implementing Lean production

After a broad study of literature that can be found in the *Annex I*, the factors or reasons that possibly most influence the sustainability of Lean in an organization in a long term were drawn and they are shown below. Each of these factors is based on other sub-factors or concepts that describe on a better way its meaning in relation with the implementation of Lean in a company.

Furthermore, it should be said that these factors were the basis for the development of the interview and questionnaire that were, respectively, done and sent to the companies that were awarded with the Swedish Lean Award to check their real degree of influence on the sustainability of Lean in the long term.

2.2.1 Organizational culture

According to Stump and Baturdeen (2009) and Beer (2003), Lean is a philosophy and a way of doing business, it is not only a set of tools to implement: it implies a shift in the culture of the organization. Hence, it is necessary to be able to change the way of thinking and working to success and maintain lean in the organization. Liker and Meier (2006) describes the Lean philosophy as follows: all workers in Toyota are aware of and share the same purpose or goal, which is to generate value for the customer, society and the economy of the community where it works, and associates. The decisions should be based on a long-term philosophy, even at the expense of short-term financial goals, because in the long run it will be more beneficial. "The Lean culture needs to be spread all over the organization, so everybody is coordinated and the efficiency of the company is increased and optimized, and there is accordingly an organizational efficiency" (Cherrafi, Anass, Elfezazi, Chiarini, Mokhlis, and Benhida, 2016).

Lean implies a change in the organizational design that can only be implemented when the Lean culture is spread through the whole organization. As some authors like Tortorella, Vergara and Ferreira (2016), Ketokivi and Schroeder (2004) and Leana and Barry (2000) note, the change in the organizational design means the need to shift from traditional models of mass production and Tayloristic organization to new models. The new form of organization should be less hierarchical and centralized, where the control is by stealth, the managers "set performance targets rather than impose direction" (Longoni, Pagell, Johnston and Veltri, 2013). Related to these less hierarchical relationships, the organizational climate is an important concept which, according to Blaikie, Cannon, Davis and Wisner (2014) and Tortorella et al. (2016) is associated to employees' motivation and reinforces a better interpersonal communication and relationship among employees and their managers.

Introducing the previous explained organizational change is not easy, so in accordance with Patel (2014), two are the key people needed for carrying it out: an internal expert in Lean, who is committed to and capable of implementing the change; and an external consultant, who is an experienced mentor that can inspire the company's people and help them to determine and implement the desired changes, this person is an outside facilitator who is specialist in change or Lean, he is not a specialist in the organization's industry, expert in the process and not in the subject matter.

According to Beer (2003), an organization working with Lean needs to emphasize in achieving co-operation across functional departments. This way, a better communication within the organization is achieved. The barriers placed between departments, functions and shifts can be obstacles to teamwork and co-operation and so to carry out successfully the strategy of the company.

Linked to the change in the organizational design and climate, the way of working in teams takes place. Working in teams is a characteristic of Lean and to make possible this change the employees need to understand that it is a good way of working, so therefore working in teams is directly linked to the

change of mentality implied by the change of the organizational culture. In addition, Moeuf, Tamayo, Lamouri, Pellerin, and Lelievre (2016), Vinodh, Arvind and Somanaathan (2010), Stump and Baturdeen (2009) and Tortorella et al. (2016) agree that by working in teams, employees learn from each other and share information and support each other.

Maasouman, Ali, and Demirli (2015), Choomlucksana, Ongsaranakorn and Suksabai (2015), Stump and Baturdeen (2009), Graetz and Smith (2010), Bateman and David (2002), Blaikie et al. (2014) and Tortorella et al (2016) complement the topic with the importance of acquiring flexibility. An appropriate degree of flexibility is required for balancing consumption needs and provision process capabilities, adjusting to different environments and demands.

2.2.2 Managers' leadership and commitment

Based on the ideas and studies of Dombrowski and Mielke (2013) and Kotter (1996a) it can be said that leadership, expertise and decision making are crucial characteristics that leaders in Lean organizations must achieve. Leadership encompasses activities as goal setting, action planning or review meetings. Moreover, a good leader defines how the future can be, aligns the employees with the organizational vision and inspires them to achieve it despite the obstacles. Lean requires top-to-bottom leadership, being the leaders firm and inspiring, relentless and resilient, demanding and forgiving, focused, flexible and prepared to review themselves critically, and the process, in order to push the business forward. Above all, they have to be smart and highly respected in the organization. These leaders must be a passionate part of the Lean leadership team. The mentioned authors agree that every successful company has at least one of these leaders.

Asif, Joost de Bruijn, Douglas, and Fisscher. (2009) highlight the importance of top management commitment and support. The top managers should be committed to the implementation of Lean, encourage the employees to be also committed showing with their own actions that lean works, and be mentors and supporters of the employees. According to them, three levels of performance for leadership can be differentiated:

1. Strong decisive leadership with Lean experience is needed in the early phases of the programme.
2. For sustaining Lean, the later phases require more dispersed or adaptive leadership that takes more hands-on responsibility and leads the incremental continuous improvement.
3. Continually develop Lean leaders at all levels, on all shifts and within all areas of the business and adopt a 'leading the Lean lifestyle' programme.

2.2.3 Employees's behaviour and commitment

According to Hines et al. (2008) the engagement of the workers on a Lean programme is essential, since it will predict their behaviour and the eventual success or failure of the organization.

Hines et al. (2008) describes the appropriate workplace where the employees can become engaged in twelve conditions which need to be accomplished:

- Clearly defined expectations
- Disposing the right equipment
- Workers have the opportunity to excel
- Work is timely recognized or praised
- Line managers care about the employees as individuals
- Workers are given encouragement
- Taking seriously suggestions and opinions
- Being part of the big picture
- Workers are proud of delivering quality output
- Mutual trust and supportive bonds with other employees and managers
- Regularly reviewing progress
- Learning and developing themselves

In regard to the involvement of employees Alhuraish, Robledo, and Kobi. (2016), Moeuf et al. (2016), Vinodh et al. (2011), and Jorgensen et al. (2007) point out that having them involved in decisions, can make a big influence in the results of the company, the decisions taken by the management teams, and also the motivation of the employees themselves about their job. According to Hines et al. (2008), this empowerment of employees is based on the idea that giving them skills, resources, authority, opportunity, motivation, as well holding them responsible and accountable for outcomes of their actions, contributes to their competence and satisfaction. The employees could be for example suggesting some measures or correction, or simply advertising about some possible risks arising. It is important that the employees take responsibility for their work, so that if one day the manager cannot come, the performance will be kept on going.

Motivation of the workers is also a requirement to a successful Lean system. High intrinsic motivation leads not only to increased employee participation and responsible autonomy but also to more meaningful work conditions (Coffey, 2000; Arslankaya and Atay, 2015; De Treville et al., 2005).

Furthermore, appreciation is a fundamental human need. That is why workers' recognition and reward is a key factor for motivation. Employees respond to appreciation expressed through recognition of their good work because it confirms their work is valued. When employees and their work are valued, their satisfaction and productivity rises, and they are motivated to maintain or improve their good work

(Tortorella et al., 2016). Therefore, it is essential to make sure that the finance and rewards and recognition system of a company appropriately encourages Lean activity and motivates their people (Hines et al., 2008).

2.2.4 Training and learning

Moeuf et al. (2016) and Vinodh et al. (2010) agree that to start working with Lean, training the employees and managers is needed. This educational preparation for performing the job through Lean principles is typically provided by the organization with the help of external or internal consultants (Ankit Patel, 2014). Moreover, this training should be provided to every new employee that starts working in the company at any moment.

After that initial process, to achieve a sustainable Lean, the workers' learning process should never finish: by focusing on developing lean capabilities, the members of the organization should then become progressively better at doing lean while at the same time, creating a learning environment that supports a lean culture (Norrgren, Hart, and Schaller, 1996; Svensson, Aronsson, Randle, and Eklund, 2007).

Learning through experience, instruction, or study itself, cannot be measured, but nevertheless, the results after applying learning techniques can (Jorgensen et al., 2007). Therefore, so it is demanded a substantial effort by employees training on the Lean philosophy and tools (Powell, Alfnes, Strandhagen and Dreyer, 2013; Iris and Cebeci, 2014; Kumar, Antony and Douglas, 2009; Thomas, Barton and Chuke-Okafor, 2009; and Simons and Taylor, 2007).

According to Jorgensen et al. (2007), in the case of the leaders, continuous learning is achieved meeting three different phases of challenges:

- Inspiring leaders to aim at first relatively easily achievable goals and which results in a preference for quick action.
- A shift to a more rigorous, systematic and structure approach to problem solving and investigations to meet more complex challenges.
- The realization that the leaders cannot solve all problems themselves, but must involve other employees.

To help the continuous learning, feedback between employees and managers must be continuous too. Having feedback is necessary for the continuous improvement, for the learning of the employees and for the knowledge of the managers about the state of the processes (Halvarsson and Öhman-Sandberg, 2009; Brulin and Svensson, 2011).

2.2.5 Strategy and alignment

In accordance with Hines et al. (2008), many organizations fail to establish a coherent strategy, vision and purpose for their businesses, failing hence with the implementation of Lean. A strategy that is not only established, but also fully communicated, understood and deployed throughout the organization, is needed. It must describe what the organization wants and why it is important to achieve that. This will guide the workers to focus the change in their activity. A successful strategy usually begins with a realistic assessment of the current situation, and is followed by having a coherent and clear vision of the future: an aspiration, a clear concept of what the organization would like to achieve or accomplish in the mid-term or long-term future. That vision is intended to serve as a clear guide for choosing current and future courses of action and so, everyone will be aware of what it is being trying to achieve and why. All the levels of the organization must be aware of their contribution to the company, the strategy, the vision and the goal. Moreover, there must be a connexion between all the levels (Hines et al., 2008).

2.2.6 Continuous improvement

It is based on constantly work to achieve shorter production cycles, to focus on the efforts on the value for the customer and to obtain a better production quality and quantity, which can always be improved.

To support the process of continuous improvement many tools can be used. Hines et al. (2008) suggest using the PDCA cycle (Plan, Do, Check, Act). Using this cycle in each level of the organization to find the problems and solve them constantly can help to pursue continuous improvement.

To help in the persistence of the continuous improvement Vinodh et al. (2010) and Stump and Baturdeen (2009) agree in the use of visual methods. Visual methods are useful for the employees to understand the generation and flow of value and wastes during processes. It is a tool that permits every employee see the status of an activity, to verify if it is in a standard condition or in a deviation from the standard, so that the employee will be able to take an appropriate action.

Moreover, Arslankaya and Atay (2015) also point out in the way of achieving improvements the importance of a harmonization of the technologies with the employees and with the processes carried out in the organization. At the same time, these technologies must be able to perform production with zero defects, to reduce costs, to meet customer requests at the moment and amount desired, to avoid generating wastes, and in the end to continually make improvements.

2.2.7 Measurement of performance

Measuring performance systems help finding areas for improvement, diagnosing areas with problems (Kaye and Anderson, 1999) and monitoring the progress of continuous improvement (Jorgensen, Matthiesen, Nielsen and Johansen, 2007). These useful systems are a continuous challenge for both managers of the companies and researchers when choosing the right measures for the appropriate level of the organization (Booth, 1996). Different measurements need to be carried out to get a whole idea of the performance's state since there is no single performance indicator which can capture the complexity of a whole organization (Abernathy, 1999; Brown and McDonnell, 1995; Arora, 2002). The understanding of these measurements can lead the company's performance execution towards better results in any area (Frigo, 2003). However, if inappropriately chosen, the measures can encourage the wrong type of behavior and run against the strategy of the company.

Some of the measures carried out could focus on key strategies such as cash flow or growth, and so accordingly to these, the organization could take some actions. However, Wade (1997) proposes that the traditional emphasis on profit is short-termism: financial measures focus on the past. Survival in the longer term depends on customers (Smith, 1998). Frigo (2003) insists that many companies focus too much on measures of performance of internal processes, not paying much attention to customer needs. Neely (1999) on his side, identified a significant positive correlation between customer satisfaction and financial performance. Translating qualitative targets into quantitative metrics is a very common problem found at the companies.

According to Wade (1997), the most commonly used measurement categories are financial, customer satisfaction, employee satisfaction, productivity and growth and innovation. Kaye and Anderson (1999) explain that some of the tools or procedures for the measurement of performance in these categories are: customer satisfaction surveys, internal audits, use of self-assessment models, staff surveys, staff appraisals, quality improvement programs, flowcharting of processes, inspection systems, performance reviews at meetings or measurement of costs or delivery time.

Moreover, Kaye and Anderson (1999) suggest some practices that should be used to succeed in the measurement of performance:

- Regular and timely measurement of performance indicators should be carried out.
- All appropriate management and employees should be aware of the results of measurements to encourage on-going improvement.
- Performance trends should be identified and the appropriate actions taken.
- Successes, as well as poor results, should be highlighted and feedback to employees.
- A proactive approach to identifying problems should be taken to avoid reliance on customer complaints and inspection systems.
- Internal auditing should identify and highlight best practices as well as nonconformity

- Self-assessment techniques should be used.

About measuring the performance related to the progress achieved with Lean, these real benefits are difficult to quantify. As some exceptions, faster set-up, and shorter cycle time which normally are achieved with Lean can be easily measured. The better visual management also achieved with Lean improve the measurement of performance operations of a factory (Standard and Davis, 2000).

In direct reference to lean, Dimancescu et al. (1997) provide some measures to be reviewed quarterly by management:

- Earnings before tax and interest.
- The return on net assets.
- Gross sales achieved.
- Market share by product groups.
- Quality ratings.
- Price to product performance ratios.
- Delivery performances.
- The defect rates on critical products/components.
- Health and safety ratios per employee, i.e. accidents; absenteeism; and labour turnover.
- Employee satisfaction ratings.

One of the purposes of a Lean implementation could be to improve faster than the competitors of the company, in order to survive in the market. Khodeir and Othman (2016), Upton (1996) and Satya and Douglas (2016) support the importance of considering competitors' performance, studying them and comparing the organization's process with the best ones. External comparison through benchmarking is usually thought of as a diagnostic method for assessing to what degree the improvement is possible but it can even also stimulate improvement.

2.2.8 Customers

Lean is based on the premise that every business can be changed to produce value for the customers with fewer resources (Patel, 2014). Spending resources on anything other than creating a product or service a customer is willing to pay for is considered wasteful. To identify what is value and what is waste, it is firstly needed to identify who the organizational customers are, as they set what is value for them, it means what they would pay for. The Lean philosophy increases the chances of satisfying the customers and keep their loyalty in the long term.

However, Stump and Baturdeen (2009) and Beer (2003) noted that identifying who your customers are does not guarantee success, but its absence might mean failure.

2.2.9 Suppliers

According to the Lean philosophy, a supplier should become an extension of the company (Liker and Meier, 2006). Part of contributing to society is supporting partners so that they become better as a result of working with the company. It is part of making the most productive use of resources. When choosing a supplier, some important terms to take into account are delivery, prices, production capacity, quality of management, technical capabilities, and service.

Hines et al. (2008) suggest the use of technologies or software to a better communication between the factory, the suppliers and the customers, making the bridge between customer and supplier demand profiles. For example, by the use of web cams located in the factories, the suppliers will know when the delivery of the finished products to the customers are done, and therefore, when they have to deliver new stock of root materials to the factory.

2.2.10 Stakeholders

Some authors place special emphasis on the huge importance of stakeholders in organizations. Authors as Khodeir and Othman (2016), Langenwalter (2006), Verrier et al. (2012), Cherrafi et al. (2016) and Eklund's (1998) (also in EPA (2009) is featured) explain that Lean considers the project stakeholders as customers, and therefore, maximizing stakeholder's value is a Lean's goal too. Hence, the changes introduced with Lean needs to meet the stakeholders interest as well..

2.2.11 Availability of resources

Some companies succeed in implementing Lean, but after some time they are not able to sustain it. In accordance with Moeuf et al., (2016) this can happen because these companies invest more than they should in the beginning and later they have no more resources left. It is therefore important to always have available resources, understanding by resources the human resources, enough budget, etc.

Buchanan (2005) and Dawson (1994) agree with the importance of having the needed budget, that to say, the estimate of costs, revenues, and resources over a specified period, reflecting a positive reading of future financial conditions and goals. It is a great administrative tool: a budget serves also as a plan of action for achieving quantified objectives, as a standard for measuring performance, and as advice for coping with foreseeable adverse situations which could put in danger the development of the activity of the company.

In addition to the type of resources, it is also determinant the concept known as momentum. Momentum

means in this context, according to Patel (2014), the speed of projects implementation in the organization, which needs to be moderated. On the one hand, in case the Lean change processes' progress is too slow, the company will not have a big chance to achieve the goals desired and Lean will not be sustainable in the long run. On the other hand, if the Lean transformation is being executed too fast, it is possible that too many resources are consumed and, therefore, the company may not have enough resources to run its daily operations.

3. COMPANIES AWARDED WITH THE SWEDISH LEAN AWARD

3.1. Nolato Meditech

Founded in 1938, Nolato is a Swedish company which does also operations in Europe, Asia and North America.

Nolato develops and manufactures products made of polymeric materials such as plastic, silicone and TPE. They are world leaders in injection moulding of silicone. Moreover, they have extensive knowledge in injection moulding of thermoplastic medical technology products.

Their production system combines Lean principles with good manufacturing and documentation practices, and it has involved the entire company and increased the value of the products according to their clients. Their Lean manufacturing system guides their employees, through constant improvements (they have 25 now different improvement groups), teamwork and positive commitment, to create a world class business. Having the whole company actively on board adds real impetus to these efforts.

In 2015, the division of Nolato Meditech in Hörby and Lomma has been awarded with the Swedish Lean Award. In four years, among other things, this division conducted 3600 operational improvements, increased productivity by 50% and customer complaints have decreased by 60% and scrap has been cut by 65%. Moreover, security of supply is up from 95 percent to 99 percent.

3.2. Tetra Pak Packaging Solutions

Founded in 1951, Tetra Pak is the world's leading company for processing and packaging solutions for food, being present in more than 85 countries, with customers in more than 175 countries and employing more than 23,000 employees. The products the company offers are meant to be as economical as possible using the smallest amount of resources, focusing on minimizing the consumption of raw materials and energy during every process carried out in their activities.

After working since 2007 with the "Tetra Pak World Class Manufacturing", a system of continuous improvement, Tetra pak was awarded with the Lean Award in 2014. The purpose of this WCM system is to mindset the whole Tetra Pak team to continuously challenge and improve their production system, internally, and also with their module suppliers.

According to the production manager of the company, one the most important improvements that Lean

has brought Tetra Pak since its implementation is the fact the staff is more involved and it directly affects the operating results gotten. Moreover, the company has also seen an increased commitment to safety and environmental issues. Now the next goal for the company in terms of Lean is to work to expand the end-to-end, that is to say, to outward the Lean philosophy toward customers.

3.3. Emballator Lagan Plast

Founded in 1965, Emballator Lagan Plast's mission is to develop, produce and market plastic packaging in the form of buckets and cans for food and chemical products. They are part of the Emballator group, which consists of a number of companies with the shared ambition of developing packaging solutions and that has the widest range of packaging solutions in the Nordic countries. Emballator Lagan Plast has sales departments in Sweden, Finland, Norway and England.

In 2005 they started implementing Lean, and in 2011 they were awarded with the Swedish Lean Award. Since they started implementing Lean they operate following that philosophy: always aiming to achieve the maximum effectiveness by utilising the collected knowledge of all employees and eliminating all types of waste and problems. Emballator Lagan Plast's strong guiding principles are commitment, quality, environment, safety, service, availability delivery and economy. They work with short lead times, optimal delivery reliability and maximum flexibility. They argue that their prerequisites for their success are their competence in the market guided by their customer focus, as customer is considered the driving force in Lean.

Thus, the core values of the company are to consider the customers like family, to respect each other inside the organization, to take advantage of their workers' knowledge and commitment, and the quality in everything they do thinking long term rather than short term.

To improve the company's workplace, they focus on the root cause of the problems, they train and certify the workers to increase their technical skills so they have higher expertise to solve the problems. Each employee must have the skills to solve their problems so that the flow of production is smooth. In addition, through involvement and motivation, job satisfaction is created.

3.4. Autoliv Sverige

Autoliv is a Swedish-American company based in Stockholm, which in 1997 came from the merger of the Swedish company Autoliv AB and Morton Automotive Safety Products, Inc., a division of the American company Morton International.

Autoliv develops and manufactures automotive safety systems for the world's largest car manufacturers.

Together with its joint ventures Autoliv has over 80 facilities with 48,000 employees in 29 countries. In addition, the company has 17 development and engineering centres in 9 countries around the world, including 20 test tracks, more than any other company in the automotive safety sector. The company's shares are listed on the New York Stock Exchange and on the Stockholm Stock Exchange.

The company started its Lean implementation back in the 90s and then in 2010 their work was recognized when they were given the Swedish Lean Award. Autoliv Sweden AB created a Lean production system at a high level. Its main characteristic is a structured and standardized approach that follows the process from product development to production, with cross-functionality as a natural ingredient. Moreover, and not less important, they are a role model of employees' and managers' commitment to Lean.

3.5. AstraZeneca (Turbuhaler)

Being founded in 1999 from the merger of the Swedish Astra AB and the English Zeneca Group, AstraZeneca is a global, science-led biopharmaceutical business and which provides medicines to millions of patients worldwide. In 2008 they were awarded with the Swedish Lean Award.

The mentioned company develops, manufactures and sells pharmaceutical and biotechnology products to treat disorders in the gastrointestinal, cardiac and vascular, neurological and psychiatric, infection, respiratory, pathological inflammation and oncology areas. AstraZeneca's largest high-tech production and supply unit is located in unit in Södertälje, with about 3500 employees and which is dedicated to the manufacture, formulation and packaging of the final product.

The first steps with Lean were taken in 2001, when the company started working with some tools. In the later years up to now, the Lean work was continually developed until a production system in a similar way to Toyota was reached, taking their reference for implementing similar methods and principles.

The goal pursued with the Lean implementation was to respond to the emerging cost pressure and the dynamic market in the pharmaceutical industry. With this initiative, AstraZeneca installed a demand-driven supply chain approach based upon Lean planning methods, with 100% transparency, and strong process governance.

One of the most important improvements which were achieved with the Lean implementation was the fact that the key figures of the company such as working capital, lead-times, and asset utilization were considerably improved due to the higher efficiency and responsiveness of their supply chain organization. Moreover, their Lean supply chain strengthened their capability to provide higher customer service despite the existing uncertain market growth.

AstraZeneca's production manager has a very positive future vision and affirms that working with Lean

lets the company improve continuously.

4. METHODOLOGY

In this chapter the methodology used to carry out the project is explained. The first phase of this project corresponds to an extensive literature review about the concerning topic. In the second phase, it is carried out case studies of the Swedish Lean Award winners.

4.1. Literature review

To start with the present project, the first phase consisted in a literature review to get knowledge about Lean. This review should contribute to the general knowledge within the topic, seeking information from different sources in an attempt to gather the most important facts to make afterwards a summary about the subject (Rönnqvist, 2009). However, a literature review seldom covers the whole field but gives an adequate idea of the research done in the field (Walliman, 2008).

The references of the sources of information consulted for the development of this project can be found in the *Annex I: References*. They were found in academic databases with the help of keywords like Lean management, Lean management sustainability, Factors influencing success in Lean, Swedish Lean Award, Lean implementation, Why Lean fails, etc.

From these sources of information, more than one hundred factors, tools and procedures related to Lean implementation and sustainability in organizations were extracted.

To categorize all the factors that were considered as important, they were classified in groups forming a hierarchical tree, as it is represented in the *Figure 1: Main groups of factor influencing the sustainability of Lean.* These main groups of factors were named as: external performance, internal performance, production processes, people (referring to all the workers in an organization), managers and employees. For a better understanding, they are shown in the *Annex II: Initial factors from the research.*

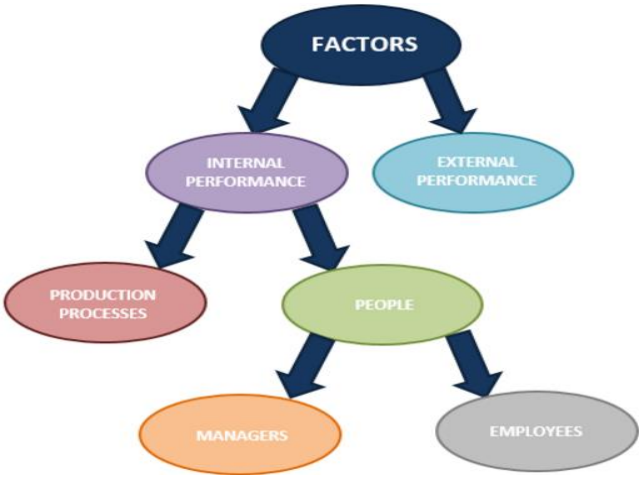

Figure 1: Main groups of factors influencing the sustainability of Lean.

After this step more sources of information, whose references can be found as well in the *Annex I: References*, were studied because it was desired to reduce the number of factors. After this second research, it was drawn that the reasons that mainly influence the success of Lean in the long-term were the ones related with the Lean commitment of the workers and the correct establishment of the Lean culture in the organization from the beginning of its implementation, what strongly influence in the way the workers develop their job and therefore in the achievement of a continuous improvement and the company performance. Although the reasons concerning the production procedures, as the Lean Manufacturing tools, should have been already implemented to the success of Lean in the short-term, to be able to keep on with Lean and to achieve Lean success in the long-term, the awareness of the employees about the importance of their daily implementation is essential. Hence, Lean Manufacturing tools cannot be forgotten in the long-term.

Therefore, the initial more than one hundred factors were summarized to the eleven ones that are explained in the Theoretical Framework section: the organizational culture, the strategy and alignment, the continuous improvement, the measurement of performance improvement, the availability of resources, training and learning, the managers' leadership and commitment, the employees' behaviour and commitment, the customers, the stakeholders and the suppliers. So, it can be appreciated that they are related to the people involved in the organization and the way of proceeding the organization follows in general.

4.2. Case study

Case study is, according to the definition of Yin (1994) an empirical research that studies a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and its context are not clearly evident. Moreover, a case study research successfully deals with a situation in which there are many more variables of interest than observational data, and, as a result, it is based on multiple sources of evidence (whose data must converge). Also, as a result, the case study benefits from the previous development of theoretical reviews that guide the collection and the analysis of data (Yin, 1994).

4.3. Qualitative and Quantitative data collection

There are two different methods to collect and transform the information into useful data for the research: by means of qualitative or quantitative approaches (Bryman, 2004). In the present case study, the source of data consisted of qualitative interviews and quantitative questionnaire.

Qualitative approaches consist in words and are used to achieve understanding of underlying reasons,

perspectives, opinions, and motivations of people. It can provide insights into the problems or also can help in the development of ideas or hypotheses for possible future quantitative researches. Moreover, it is also useful to visualize trends in opinions or facts (Patton, 1995). There are different methods of qualitative data collection, which can be group discussions, individual interviews, and participation/observations. The sample size is typically small, and respondents are selected to fulfil a given sample (Patton, 1995).

Quantitative research consists in measurable data and it is frequently used to quantify the information transforming it into statistics. It is used to quantify attitudes, opinions, behaviours, and other defined variables, and generalize results from a larger sample population (Bryman, 2004). Quantitative surveys are used when it is not possible to interview all the individuals (Bryman, 2004).

In this case, both qualitative and quantitative methods were used. To corroborate the importance of the factors concluded as the most influential ones for the success of Lean, and as the five companies mentioned in the section 3 that have been given in the last few years the Swedish Lean Award were considered a good example of success in that matter, some workers of these companies were interviewed and surveyed.

After a brief study of these companies, the development of the pattern for the interviews and for the questionnaires took place. Ultimately, conclusions that are important points to succeed with Lean in the long term in a company were extracted from the analysis of the interviews and the questionnaires.

4.3.1 Interviews

There are different types of interviews ranging from structured to unstructured. In this study, a semi-structured interview was chosen because it combines the existence of pre-set questions in a pre-determined order, with questions that emerge as the interview develops, due to the interviewee's unique answers that require different follow-up questions from the interviewer (DiCicco-Bloom and Crabtree, 2006).

Some of the interviews were performed at the companies, such as TetraPak, Nolato and AstraZeneca, while others were accomplished by skype, as the case of Emballator and Autoliv. The managers accepted to be recorded and at the same time notes of the information were written down. Each interview took approximately one hour. In addition, the managers of the companies that were visited took the trouble to show the boards they use for tracking indicators, for continuous improvement and in daily management meetings and the managers that were interviewed by skype sent via email photos of their white boards and more valuable information about the implementation of Lean in their respective companies.

The interview contains questions about the personal opinion of the interviewed and also about his

knowledge about Lean. Most of the respondents work as Lean Managers, so they are the most indicated persons to give valuable information about the implementation and development of Lean in their companies.

The structure of the interview was designed taking into account the factors that had been previously identified from the theoretical study as possibly the most important ones for the sustainability of Lean in the long term: organizational culture, strategy and alignment, continuous improvement, measurement of performance improvement, availability of resources, training, managers' leadership and commitment, customers, suppliers, stakeholders and employees' behaviour and commitment. Therefore, the interview consists of the following sections:

- Information about the questioned. This section was created to help breaking the ice between interviewer and the interviewed. Additionally, the interviewed is asked about his role in the company, what helps the interviewer to understand the future answers.
- Introductory questions. This section consists in questions about the beginning of the Lean implementation in the company, but also about the role the interviewed had in it. Especially, interesting answers were gotten for example when asking about the existence or non-existence of external consultants, or the barriers that appeared with the implementation.
- Strategy and alignment. This part is not only about the goals and the strategy themselves, but also about their communication to the workers. Since there is no point in having a strategy and goals if the workers do not share them, there are some questions about this matter.
- Continuous improvement. Being one of the aims of Lean, many questions about how they organize their work to achieve continuous improvement are posed, such as how they prioritize activities or how employees are awarded for their achievements or suggestions to help to the continuous improvement.
- Daily management. Lean should improve the communication between managers and employees, so questions about the existence of team meetings are asked. The section also contains questions about tracking indicators and the way they visualize them.
- Partners. Customers, stakeholders and suppliers. Lean is supposed to improve the relationships between the company that implements it and its partners, so it is interesting to know if this truly happens in the companies.
- Success factors. This section contains questions about the personal opinion of the interviewed, as for example the factor he considers the most important to success in Lean, or about what he thinks it could have made the difference between his company and others

To further information, the interview template can be found in the *Annex IV: Interview*.

4.3.2 Questionnaires

Although the questionnaire was developed at the same time as the interview, it was sent to the companies some time later. After interviewed one Lean manager from each company, there was valuable information about each of the studied companies. However, although a lot of information has been collected from these interviews, the data comes from only one manager in each case, so it is interesting to collect information from more managers and employees to contrast it and to have more points of view. In addition, the questionnaire contains concrete questions about Lean that cannot be asked in an interview.

The questionnaire was created to encompass all the possible characteristics that can affect the success of Lean in the long term. In the beginning, two questionnaires were created for each company, one addressed to managers and the other one to employees. In those questionnaires, they were asked some common questions about their relationship at work, the existence of work recognition and the strategy of the organization to compare afterwards their answers. Moreover, employees were asked about themselves and the collective of the employees, and managers were surveyed about some indicators and activities related to Lean progress in order to have a deeper knowledge about the company development. Afterwards, the option of sending two questionnaires to each company was discarded because it would take a considerably long time for the companies and that would mean taking the risk of getting bad answers because of rush, or the refusal of companies to collaborate in the project. Thus, it was decided to create only one questionnaire addressed to both, managers and employees. After this decision, the process of creating the questionnaire started again.

Firstly, the new questionnaire was written in English, but then it was decided to be sent to the companies in Swedish to facilitate them their collaboration. The questionnaires in both languages were written in the first instance in Word documents, but to be sent to the companies, and to its posterior analysis, the Swedish version was written in the survey application FluidSurvey. A link with the questionnaire was sent to each interviewed manager, who distributed the questionnaire in his respective company.

In the questionnaire, firstly, the surveyed is asked when and why his company started implementing Lean. The surveyed can choose three motives among many given ones. This question is important because sometimes the companies just start implementing Lean because it is known as a good way of working. But it is needed to have clear goals, otherwise the implementation will not success, and hence, it is interesting to know the motives by which companies that succeeded decided to make such a big change in their production systems.

Secondly, they are asked about the use they make of the Lean tools and techniques but also about some Lean principles that are supposedly essential to the success of Lean. In the case of the Lean principles, they are asked about how important they consider them and about the degree of their implementation in their companies. This way, it can be found in which Lean principles these companies that succeeded

with Lean have focused so that a company that wants to start with the implementation of Lean should focus on as well.

Despite the fact that from the interviews it was learned that Lean is not about tools, but more about mind-set, asking about the tools used in the company was still considered interesting to get an idea of how these companies work.

Moreover, there is another question where the surveyed is asked about how several statements related to Lean principles based on the topics strategy and objectives, operations management, continuous improvement, problem solving, training, teamwork and leadership match the situation in his company. Thanks to this question it can be extracted the most important statements to success in Lean. Additionally, the respondents were asked for those factors they consider the most important to success in Lean in the short term and to maintain Lean in the long term.

Besides, daily improvement activities are a characteristic of Lean, so it is interesting to know in which departments of the companies these improvements could be more profitable. It may happen that a company that starts implementing Lean does not know in which area they should start, or it may happen that this characteristic is not as important in some departments, so making this question to companies that have succeeded in Lean could be very helpful for both, Lean-beginner companies and companies that are in the middle of its implementation.

In addition, it is possible that a company finds obstacles in the improvement work so the surveyed is asked about the frequency that different possible obstacles have appeared in his company. The answers can help a company that wants to implement Lean to prevent itself from the arousal of these possible obstacles, or at least to be aware of their existence to be more capable to deal with them.

The answers of the final questions can give an idea about the time that it will take to see the first measurable results and the performance a company which starts implementing Lean could achieve if they are guided by a similar way of proceeding as these interviewed and surveyed companies.

To further information, the questionnaires template, both in English and in Swedish, can be found in the *Annex VI: English Questionnaire* and *Annex VII: Swedish Questionnaire*, respectively.

Twenty days after sending the questionnaires to the companies their access was closed so the data were collected. Thirty one answers were obtained, being the number of respondents from each company shown below.

- AstraZeneca Turbuhaler: 1 respondent
- Emballator Lagan Plast: 6 respondents
- Nolato AB: 21 respondents
- TetraPak: 3 respondents

4.4. Research quality

There are many complex dimensions or quality criteria to consider when appraising the collected data. However, according to Bryman (2004), those quality issues can be enforced with the help of two requirements: validity and reliability. With those considerations, the problem can be often surpassed. This chapter summarizes those two essential requirements.

4.4.1 Validity

Validity determines the revision of the presentation of the content, the contrast of the results with the measured corresponding variables. The validity is an estimation of the fact of how a test is conceived, elaborated and applied to accurately measure what it is meant to measure (Bryman, 2004).

During the development of this project work, the problem of external validity is assumed. This approach of validity tries to verify if the results of a study are generalizable beyond its boundaries. This requires homology or at least an analogy between the sample (case studied) and the generalization to which it is applied (Yin, 1994). To extract a generality out of a too small sample might be in some cases bold.

This study is supported on inductive method, which creates general laws from the observation of concrete facts. It is a kind of generalization through logic, through which a demonstration of the set of conclusions can be obtained (Byman, 2004). The problem of the inductive method is that such conclusions extracted from a generalization could be false and, at the same time, the partial application of the logic could maintain its validity. Therefore, the inductive method needs an additional condition: its application is considered valid until there is no case that does not comply with the proposed model (Byman, 2004).

To avoid that in the greatest extent that the researchers could, in this project, the previous study of the area of Lean was carried out to apply the logic within the subject, and a sample of five companies was used to be able to see some contrast between them.

Triangulation is used in this study, combining qualitative and quantitative methodologies to strengthen a research design where logic supports the fact that a single approach is not enough to generate a solution, so it is needed to involve different perspectives to broaden the analysis (Patton 1995). Data, investigator and methodological types of triangulation are applied in this study:

- Data triangulation: 31 questionnaires were completed from workers with different characteristics such as different formation, different jobs in their companies, different years within the company, etc.
- Investigator triangulation: more than one researcher was involved in the process of gathering and interpreting data.

- Methodological triangulation: more than one method of data collection (interviews and questionnaires) were used to gather data.

However, the extracted conclusions cannot be generalized due to existence of the above explained weaknesses, but still, they can be useful for the readers if they consider applying them in their businesses.

4.4.2 Reliability

Reliability refers to the fact that what is currently measured is what you want to measure and in what extent repeating the same application to the same subject in the same conditions, identical results are obtained, or at least the errors are minimized (Yin, 1994).

In qualitative research, as the interview study in this case, reliability is related to human perception, the ability of recollecting, and reasoning to organize the data to promote understanding (Merriam, 1998).

Reliability in an interview study is about consistency. To improve the reliability, repetition and control questions help to ensure the matters repeatedly (Patton, 1995). In this research, that strategy was carried out during the interviews performed. Furthermore, these interviews were semi-structured by nature so the questions posed were similar to every company.

Moreover, the interviews were recorded and notes taken down, which helped to avoid missing some interesting information, or misunderstandings, and improving reliability. However, the character of an interview is subjective and the responses about the same issue may vary from one respondent to other.

5. EMPIRICAL FINDINGS

5.1. Success factors derived from interviews

Once the qualitative information from the interviews was collected it was necessary to analyse it to verify if the factors chosen after the theoretical study as influencers of the sustainability of Lean in the long term are truly decisive for the success or failure of Lean at the companies.

Therefore, all the information received in the interviews was summarized in three tables. One of these tables contains the information that the managers said during the interviews related to the factors which influence Lean sustainability according to the theoretical previous research. Since this table is considered to have a great density, it will be split in the next subsections when the findings for each factor are explained (*Table 1* to *Table 11*). Working with the information in this way was an in-depth study of the interviews that allowed to understand in detail each respondents' answers.

The second type of table, the *Table 12: Main factors for the managers* is shown after the analysis of the factors. It points out the main influential factors in each company according the explanations given by each interviewed manager. It is a visual summary of all the interviews performed.

Eventually, the third table created can be found in *Annex IV: Interesting interviews answers*. Although they are not directly related to the factors, the answers contained in this table were considered to analyse the factors and to reach conclusions, and moreover, they can be interested for those companies that want to implement Lean and those that are already in the beginning of its implementation.

5.1.1 Organizational culture

Every company which aims to succeed in Lean has to focus on spreading the lean culture through the organization. A briefly description of what the managers said during the interviews related to the organizational culture is shown in the *Table 1: Managers' responses about organizational culture*. In Nolato, they highlight that Lean is not about tools, but a cultural phenomenon based in common sense, a change in mentality, commitment and respect. The manager from AstraZeneca affirmed that the managers must be highly involved and committed: they take the initiative to spread the culture. Both managers from Tetra Pak and from Emballator explained that, the stream comes from the top and then it is pushed down to convince all the employees that Lean is a way of doing business which will be advantageous for everyone. After the phase of the implementation, it is more down-top because the employees make a strong push for the improvement as they are in permanent contact with the processes,

they detect the problems that arise, they make suggestions, etc.

All the interviewed managers agreed that Lean is not a short road to walk. There are several aspects to improve to make a whole Lean chain, it means a production chain that includes also suppliers and customers. For example, in the case of Emballator, in the first 3-4 years of the implementation the top level was engaged, they understood Lean and they started to push it down. During the next 3-4 years also the rest of the organization understood what lean was. Then, another 3-4 years were needed to be settled in the organization. They have been working with Lean for 13 years now and the interviewed manager affirms that they are in a right path, but just in the beginning.

In the case of Autoliv, they started implementing Lean in 1995. In the beginning it was only about introducing the Lean tools into their productive process, but not about spreading the Lean culture in the organization. They hired some consultants who trained their employees towards the application of these Lean tools, but they did not take time in explaining and convincing people about the Lean philosophy. It is a common failure to hire a consultant thinking that he will do all the job: to reduce costs and to solve all the problems. These consultants would have been more useful if they were hired to train the managers instead so the Lean culture could be spread also through the employees as it was mentioned before. Thankfully, years later they became aware of the importance that the understanding and the culture have. In 2010 they took a bigger step which consisted in the formalization of the culture: the creation of principles for the behaviour in the production system. They have now a global and sustainable perspective which is based on long term thinking. Moreover, now they are also aware of how important is to train the people, and so nowadays they have training programs of different levels for managers and employees.

The manager from TetraPak referred to a first trial implementation of Lean in 2007, which was a failure. There was a lack of Lean organizational culture among the employees, so they considered the change as an extra work instead of considering it as the way of doing business. It is obvious that in the beginning because of the change it is needed to do an extra effort to receive training, to create standards and new procedures. On the one hand, people need to be informed about the new philosophy, and on the other hand, they have to be open-minded to change the habits and to understand that some Lean procedures like for example having a daily meeting is not a waste of time. Two years later, in the second implementation, the employees understood that Lean is the way of doing business, and hence, they succeeded in its implementation.

	Organizational culture
Tetrapak	Involvement and knowledge of Lean are key factors. Lean is a way of doing business. The implementation of Lean has top-down direction, and after that first phase, it is more down-top because the employees make a strong push for the improvement.
Nolato	It is about mindset and commitment, not about tools.

	Organizational culture
AstraZeneca	It is absolutely necessary that managers and employees understand Lean. First the managers have to be committed with Lean so that they can convince employees.
Emballator	For the success of the implementation it is very important that all the employees share that Lean philosophy. Every worker needs to be convinced and committed so they can work towards achieving the goals. There is a long road to walk.
Autoliv	The culture is that all employees naturally respect all standards in their area. Employees have a high degree of motivation and respect for each other. They know how to "think" and follow proven methods which leads to kaizen.

Table 1: Managers' responses about organizational culture

5.1.2 Managers' leadership and commitment

All the companies participating in the interviews agreed that the first step to take when a company decides to implement Lean is to train and educate the managers, since the existence of a committed management team that effectively understands Lean is necessary. A briefly description of what the managers said during the interviews related to managers' leadership and commitment is shown in the *Table 2: Managers' responses about their leadership and commitment.*

The manager from Nolato believes that leadership, being a good communicator and having the skills to convince employees are important skills that a manager must have. The manager from AstraZeneca affirmed something similar; he considers that the most important factor to sustain lean in the long term is the commitment of the management team, so training the management teams to understand what Lean is, was for AstraZeneca the first step. It was also the first step taken in Autoliv. The manager from the mentioned company thinks that the training of managers is essential, since the leadership of managers is a key factor for the success not only of Lean, but of every plan meant to be implemented in a company. All the managers need to understand "why" and "what" the aims of the plan are. The manager from TetraPak thinks that the involvement, motivation and training of everyone in the company is the key factor for the success of Lean. Furthermore, she related that it was easier to convince managers than employees. The manager from Emballator asserted something similar, the most important thing is to count on leaders who understand the philosophy and work with it. And from his point of view, probably many companies did not success in Lean because of the lack of committed leaders.

All the interviewed agreed also that only once the managers are committed with Lean, they can convince employees about it.

As it was mentioned before, both Tetra Pak and Emballator's Lean managers explained that, the stream comes from the top and then it is pushed down to convince all the employees that Lean is a way of doing

business which will be advantageous for everyone. The manager from Nolato affirms that first the managers need to be trained in Lean and committed to be able to convince the employees later. The manager from Astrazeneca agrees with that: in his company only when the management team started to understand "why" Lean and they saw the benefits of reducing wastes, the operators started getting involved. Since then, the whole team is very committed to Lean.

The manager from TetraPak also said that the communication system has been standardized, so the communication between managers and employees has improved, what makes the managers feel very positively that the employees talk and suggest ideas for improvement. She also mentioned that thanks to Gemba (go and see), the managers have a better understanding of what is going on, and also, the employees feel that the manager is with them.

	Managers' leadership and commitment
Tetrapak	Lean includes Gemba. Going to the shop floor and see what is happening is a fundamental change that the managers have to adapt to, and which is an impressive benefit. The managers have now a better understanding of what is going on, and the employees feel that the manager is with them.
Nolato	First the managers need to be trained in Lean and committed to later being able to convince the employees. This first managers' training takes around one year. Managers must be trained and educated continuously, the training never finishes.
AstraZeneca	This is the most important factor to sustain lean. Training the management team to understand what lean is was the first step. When the managers understood "why" Lean and they saw the benefits, the operators got involved. Since then, everyone is committed to Lean.
Emballator	The most important thing is to have leaders who understand the philosophy and work with it. These leaders have to follow the path so everybody else does it too. The lack of leadership must have been also the problem of those companies who failed in Lean.
Autoliv	The training of managers is essential and it is the first step that should be done. Leadership is a key factor for the success of every plan that is wanted to be implemented in a company. All the managers need to understand "why" and "what" the aims of the plan are.

Table 2: Managers' responses about their leadership and commitment

5.1.3 Employees' behaviour and commitment

A briefly description of what the managers said during the interviews related to employees' behaviour and commitment and that will be analysed in this subsection can be found in the *Table 3: Managers' responses about employees' behaviour and commitment.* All the managers from the different companies

agree in the need of having committed employees and hence, in the importance of their training and education in Lean. In accordance with this, the manager from Autoliv affirmed that the employees are the factor who make things happen in the company, so they need to be aware of what is going on to work towards the same goal. Therefore, training, educating and convincing them about Lean is an important matter.

In the case of Nolato, the manager said that it was easy to convince the employees and get them committed. They didn't see lean as something negative because they understood it would be profitable.

However, in the beginning of the Lean implementation in Emballator, TetraPak and AstraZeneca the employees were a barrier to succeed.

For example, in Emballator, the manager explained that they failed in their first implementation of Lean because the culture came from the top and they pushed the Lean philosophy down but the employees were not convinced. Afterwards, back in 2005, Lean improved the economy of Emballator in only six months, what made the employees accept it and become engaged with Lean. The manager mentioned that the most important thing they changed is the employees commitment.

The manager from TetraPak explained that in their case the employees were a barrier because they considered the change as extra work instead of considering it as the way of doing business. She explained that people need to be open-minded to change the habits and to understand that some Lean procedures as having a daily meeting is not a waste of time. With Lean the employees have bigger responsibilities, as for example reporting a problem when it appears, making suggestions for improvements, attending meetings, etc. All these changes make the employees feel part of the organization, that their opinion counts and that they are listened. Therefore, the way of working changes with Lean and they had to adapt to it, but now everything is better than before Lean for them. She said something similar as the manager from Emballator, the implementation of Lean has top-down direction, and after it, it is more down-top because the employees make a strong push for the improvement.

In the case of AstraZeneca the employees thought they were being just pressed, it took time to convince them. But the manager said that actually it is the opposite case, the goal is to make them feel less pressure and to produce more. The employees started getting involved and being committed after the management team understood Lean.

	Employees' behaviour and commitment
Tetrapak	Barrier: the employees considered the change as extra work instead of considering it as the way of doing business. With Lean the employees have bigger responsibilities: the way of working has changed and they had to adapt to it, but now everything is better than before Lean for them.

	Employees' behaviour and commitment
Nolato	First the managers were trained, and afterwards they trained the employees. Their training never ends. It was easy to convince the employees and to get them committed. They did not see lean as something negative because they understood it would be profitable. They considered having power of decision positive.
AstraZeneca	In the beginning, they thought they were being just pressed, and actually it is the opposite case, the goal is to make them feel less pressure and to produce more. The employees started getting involved when the management team understood Lean and started being committed to Lean
Emballator	In the first implementation, which failed, the culture came from the top and they pushed the lean philosophy down, but it didn't work because the employees were not convinced. Back in 2005 we had quite red numbers in the company, but with Lean, in 6 months, we turned our numbers into black and then they became engaged.
Autoliv	The training of employees is an important matter. They are the factor who make things happen in the company, so they need to be aware of what is going on to work towards the same goal

Table 3: Managers' responses about employees' behaviour and commitment

5.1.4 Training and learning

A briefly description of what the managers said during the interviews related to training and learning and that will be analysed in this subsection can be found in the *Table 4: Managers' responses about training and learning.* In some of the companies, like in TetraPak, the initial training in Lean was seen by the workers like extra-work, so it was seen as something negative, being a barrier in the initial implementation of Lean. In other companies, like in Nolato, the employees had already a goal in training certain hours per year, so they did not see the Lean training as an extra work.

The training is never finished. The employees need to be trained an educated not only in the beginning, but continuously: the way of working might change with the circumstances (updating, new demands, adjustments, new technologies). Additionally, a lack of training could result in employees feeling unmotivated or uncommitted because they may be insecure about their work, due to the limited amount of knowledge they have acquired.

The manager from Autoliv explained that since the employees are the factor who make things happen in a company, they need to be aware of what is going on to work towards the same goal. Moreover, it is important to try new things out to see if they work, and if they do not do it, to learn from mistakes. By training the employees they will not be afraid to try new ideas or to introduce changes. These new ideas

can lead to take next steps which can be advantageous for the organization.

In the case of Emballator, they did not train the people in the beginning. But, nowadays they are aware of the importance of that matter and they have an organization plan in charge of training and teaching the employees. In that program goals are set for everyone about what they are supposed to have learnt by a determinate time.

The same as employees, the managers must also be trained and educated continuously in leadership.

In AstraZeneca they started implementing Lean in 2003 and during ten years they did a lot of training and education to the employees, but it was in 2013 when they truly started training and educating managers, so they started seeing really good results and Lean got fully integrated. They have a whole program of continuous training for leaders. The program has three steps:

- Individual development plan to increase their Lean level.
- 24 questions the leaders are asked to rate themselves in a scale from 1 to 5.
- Individual goals for each manager to improve their own performance.

Moreover, there is a program called AIM (Accelerated Implementation Method) where OPEX (Operation Excellence) trains the first line managers on how to be a leader, and also the operators. The training consists in 12 weeks of a very intensive training. The organization has all the education within Lean packed in 10 blocks.

Furthermore, in AstraZeneca every worker has access to a computer where they can read and learn about Lean and in the case of the new employees that arrive, they are provided a couple of days of special training until they are incorporated to their jobs.

	Training
Tetrapak	Operators are trained in groups except in specific circumstances.
Nolato	The training is never finished. The employees need to be continuously trained an educated because the way of working may change with the circumstances (updating, new demands, adjustments). A lack of training could result in employees feeling unmotivated or uncommitted.
AstraZeneca	We have a whole program of continuous training for leaders. The employees have a continuous learning by doing and they are trained by managers every day. Every worker has access to a computer where they can read and learn about lean. New employees have a couple of days of training until they go to the workstation.
Emballator	We did not train the people in the beginning because we did not have enough time. Now we have an organization plan in charge of training and teaching the employees. We have set goals for everyone about what we want them to have learnt by a determinate time.

	Training
Autoliv	It is important to try new things out to see if they work, and if they do not do it, you can learn from mistakes. You do not have to be afraid to try new ideas or to introduce changes. They can lead to take next steps which can be advantageous for the organization

Table 4: Managers' responses about training and learning

5.1.5 Strategy and alignment

A briefly description of what the managers said during the interviews related to training and learning and that will be analysed in this subsection is shown in the *Table 5: Managers' responses about strategy and alignment.* The manager from TetraPak was very explicit with the objectives of the company. Their goals in order of importance are: customer satisfaction, good quality and costs reduction. They have the strategy divided into three levels: company strategy (goals worldwide, reduction of defects, increase of the production, etc.), group strategy (in charge of the filling machines, process machines and containers, they operate to achieve the goals of the company strategy) and factory strategy (working with the indicators and checking that everything is on track to achieve the goals, it supports the two previous strategies). For Autoliv producing with high quality is also one important goal, they have restrictions not to allow products with poor quality.

The manager from Nolato explained that in his company the goals for each year are set, and so, they are a reference that continuously challenge them to improve. They aim to improve the KPIs (Key Performance Indicators) of the previous year, or to achieve a determined percentage, it depends. And in the future, they desire to keep the continuous improvement and to achieve a whole production chain in Lean management, including suppliers.

The strategy of Emballator is to sell smaller batches to a greater number of customers.

Furthermore, the managers manifested the importance of communicating the goals and the strategy to every employee. The manager from AstraZeneca explained that their strategy is communicated through the management system. They have a cascade information system. During the daily meetings, the managers give information to the workers, and the values and the strategy of the company are discussed, so it is a way of sharing the strategy and all the information the workers might know. The manager from Emballator explained that they visualize their goals in different areas in the plant, and they talk about them in their meetings. "It is very important that everybody knows what our pursuits are", he declared.

	Strategy and alignment
Tetrapak	Goals: customer satisfaction, good quality and reduction of costs. Company strategy, group strategy and factory strategy.
Nolato	The aim of the company is to improve the KPIs of the previous year, or to achieve a determined percentage. Goals for each year are set and they are a reference that challenge us to improve. In the future, our goal is to achieve a whole production chain in Lean management, including suppliers.
AstraZeneca	We want Lean to be a way of working and we want to improve our work through Lean. The results will arrive because we are working in a good way.
Emballator	We visualize our goals in different areas in the plant, and we talk about them in our meetings. It is very important that everybody knows what our pursuits are. Our strategy is to sell smaller batches to greater number of customers.
Autoliv	We have restrictions not to allow products with poor quality.

Table 5: Managers' responses about strategy and alignment

5.1.6 Continuous improvement

Continuous improvement is considered one of the main pillars of Lean for many of the companies. A briefly description of what the managers said during the interviews related to continuous improvement is shown in the *Table 6: Managers' responses about continuous improvement.* It is an infinity loop, as the manager from TetraPak explained, there is always something to improve even when everything seems to be already efficient: things can always be a little bit better. However, although the companies try to prioritize the continuous improvement work, the manager from TetraPak admitted that sometimes if they are in a situation where they are late on delivery, the deliver is always prioritized. In addition, since their Lean journey started, a lot of improvements were achieved in all these companies: the delivery time, the lead time and the costs were reduced, the quality of their products was highly improved and the number of customer complaints was reduced. Ultimately, they all became more efficient, so currently they do not usually have to face the situation of being under pressure for meeting the deadlines with their clients, so they normally do not have problems to focus on improvements.

The way of working with continuous improvement is similar in most of the interviewed companies: they work in improvement teams. There is one improvement team per area or department in the organization. These teams meet weekly or once each two weeks, sharing a common target as for example to find the root cause of the problems that had arisen (it is common to use check lists, including a lot of questions regarding standards and procedures and how to follow them, and also methods as 5Why and 4WH), or to improve the current situation using tools like the PDCA cycle to make sure that the improvement is

lasting, or like experimenting loops for different type of improvements. The manager from Autoliv mentioned 5S-audits and 5S-walks as a tool for identifying deviations or improvement possibilities.

The manager from TetraPak explained that in their meetings the indicators of the processes are followed up and when they show some losses, these problems have to be solved following some of the pre-established methods of problem solving previously mentioned. The manager ensured that these methods are perfectly understood and implemented by all managers and employees who make up the team. She also explained that the development of the continuous improvement activity in her company follows standardized process: they classify the improvements, the problems and the mistakes and they put them into framework in their database. Additionally, TetraPak counts on what they call WCM champions, a worker with a lot of Lean experience that visits the plants of a closter (denominating by this the joint of plants of TetraPak in each continent) performing an assessment, evaluating the status of the factory, and checking if they need help for improving or not. They are also responsible for doing benchmarking with all the factories.

In the case of AstraZeneca, they use a method called Lean Maturity Review to measure their progress in Lean and to challenge themselves. This method has four states of Lean maturity: foundation, intermediate, advanced and ideal state. Nowadays they have some areas in intermediate and advanced levels, but others are a bit more delayed. They hope that in a couple of years all the operation factories will be at foundational level.

Generally, when Lean is implemented the employees are given more responsibilities. Apart from reporting all the problems they find by following a standardized procedure, they have to give suggestions for improvements. In all the companies interviewed except from Emballator, there is not a monetary reward for these suggestions. The incentive is to improve the business, what shows the engagement of the employees. The monetary reward system was suspended over the years because it was considered unbeneficial. The manager from TetraPak said that they often hold social events within the companies (such as a *fika* or showing some video thanking the best suggestions for improvement, or holding no claims, etc.). All the workers at the companies share the belief that doing well their job things will go better, so that, over time workers will feel more comfortable and their work will become simpler, and that is what they make their effort for. Moreover, as it was mentioned before, in TetraPak the system of making suggestions for improvement has been standardized with Lean, reducing the frustration because of the bad communication that existed before.

	Continuous improvement
Tetrapak	Continuous improvement means being always better, it is an infinity loop. When the indicators of the improvement team show some losses, they have to be solved following a methodology that the WCM Manager ensures is perfectly understood and implemented by all managers and employees of the team. The WCM champion visits the companies of a cluster assessing the factory.
Nolato	There are 8 improvement teams, one for each department. Once a week each improvement team has a meeting where they classify the improvements, they decide who should work with which improvement and they put it into framework in the database.
AstraZeneca	There is always something to improve. We try to prioritize continuous improvement work, but sometimes if we are in a situation where we are late on delivery, the deliver is always prioritized. We use a method called Lean Maturity Review to measure our progress and to challenge ourselves.
Emballator	We have 7 improvement groups about different areas which meet 30 minutes each two weeks. The rewards for improvement suggestions are 50 KR each. We use tools like PDCA, or Experiment loops for different type of improvements.
Autoliv	We are a workshop where a cross functional group has a common target to find the root cause of a problem, or to improve current situation, and where standardized processes are followed. 5S-audits and 5S-walks lead to identify improvement possibilities or deviations. By fulfilling the PDCA-cycle we make sure that the improvement lasts.

Table 6: Managers' responses about continuous improvement

5.1.7 Measurement of performance

A briefly description of what the managers said during the interviews related to measurements of performance and that will be analysed in this subsection can be found in the *Table 7: Managers' responses about measurement of performance improvement.* KPIs are used to monitor the performance of the companies and processes. Automatic and computerized intelligence systems measure indicators like the production time, maintenance time, number of defects, delivery time, etc. Every employee constantly documents his work with the machines so that the processes can be controlled. These KPI's results are shown on whiteboards so everyone can see them to be aware of how the business is going and they are discussed in the daily meetings that the teams have during about 15-30 minutes. In these meetings, they follow up the performance of the indicators and they check if the goals set have been achieved.

In the case of AstraZeneca, the most important KPI they follow is schedule adherence, checking if the settled goals are daily reached. They use OEE (Overall Equipment Efficiency) as one of the KPI to measure the wastes that are afterwards discussed in the daily meetings. By measuring OEE and

the underlying wastes, an important insight on how to systematically improve the manufacturing process is gained. The four-daily measured KPI areas are: safety health, quality measurement, delivery measurement and economical measurement. Usually, the more advanced lines with Lean in the plan reach it. The other lines have often more problems to get them but these goals are still useful for challenging the operators.

	Measurement of Performance improvement
Tetrapak	Automated and computerized machines measure the production time, maintenance, defects, delivery time etc. The results of the performance indicators are shown at whiteboards so everybody is aware of how the business is going.
Nolato	We have an automatic system that measures the KPI's results and every employee constantly documents his work with the machines. The KPI's results are showed on whiteboards so everyone can see them.
AstraZeneca	We use OEE (Overall Equipment Efficiency) as an indicator of wastes, then the wastes are discussed in the daily meetings. The most important KPI we follow is schedule adherence
Emballator	We have an agenda on the whiteboards. In our meetings, we follow up our performance and the goals we have set. It is difficult to document all the improvements that we are doing because we are doing a lot more than we get on the paper.
Autoliv	We follow our performance indicators to check our improvements.

Table 7: Managers' responses about measurement of performance improvement

5.1.8 Customers

A briefly description of what the managers said during the interviews related to customers and that will be analysed in this subsection can be found in the *Table 8: Managers' responses about customers*. Lean seeks for eliminating wastes, so the manager from AstraZeneca explained that to understand what the wastes that want to be eliminated are, first it is necessary to understand what the value for the customers is. All that they do not give value to is considered as waste. The manager from Emballator also agrees that knowing what is valuable for the customers is needed. He said that their CEO arrived at the company in 2004 and he asked their 30 greatest customers what they really wanted, and from that moment they built a different relationship with them. The manager affirmed that the customers must be in their mind all day long. In addition, he mentioned that Emballator wants to increase the turnover rate, and that to achieve it, the customer has to make smaller offers, but customers' behaviour is difficult to change.

Continuous feedback is another point where TetraPak, Nolato, Emballator and Autoliv agree. The manager from Tetrapak declared that they want a claimant client that gives feedback every time they

consider the service or product provided can be improved. The manager from Autoliv said that their customers do not pass on poor quality, and when something is not as good as it should be they give feedback to the company. The manager from Nolato mentioned that they get feedback from customers through the logistics department which is the one in contact with them. The manager from Emballator explained that they follow up the greatest customers in their improvement meetings to know how they feel and how it is going with them, so at the same time there is a feedback and they understand their philosophy better.

However, the manager from AstraZeneca said that they do not have that close connection with their customers in the sense that they do not directly ask them what they want or ask them for feedback. But he agrees that getting closer to their customers could be a future goal for the company.

	Customers
Tetrapak	The client should give feedback. A claimant client is needed.
Nolato	Our company gets feedback from customers through the logistics department that is the one in contact with them.
AstraZeneca	All that the customers do not give value to is waste for us. Our customers have seen the good results of Lean because now we are much faster in our deliveries, but we do not have that close connection with them in the sense that we do not talk Lean with them, but it could be a future goal.
Emballator	The customer must be in your mind all day long. Our CEO arrived in 2004 and he asked our 30 greatest customers what they really wanted. From that moment, we built a different relationship with our customers. We follow them up, so there is a feedback, and also, they understand our philosophy better.
Autoliv	Customers give feedback, they do not pass on poor quality.

Table 8: Managers' responses about customers

5.1.9 Suppliers

A briefly description of what the managers said during the interviews related to suppliers is shown in the *Table 9: Managers' responses about suppliers.* All the companies agree that it might be profitable to have suppliers that also work with Lean and to include them in their production chain. However, although they think this way, currently it only happens in Tetrapak and Autoliv. The manager from TetraPak declared that they always ensure that their partners work with continuous improvement systems, since otherwise, the suppliers could launch the product badly, affecting the company's activity. They want to have Lean expanded in their whole production chain. According to this, the manager told that after the Lean implementation, they had to reject some suppliers they used to work with because they did not work with Lean. The manager from Autoliv explained that they do not accept suppliers that provide products with poor quality, so in 2005 they initiated a supplier development program in Lean to

train their suppliers to be more efficient in manufacturing within a certain period of time. This way the company challenged its suppliers for improvement getting the best of them.

For example, the manager from Nolato admitted that until now they have not focused Lean to their suppliers, but they all believe it could be a good future goal. The manager from AstraZeneca hopes that they will reach a level where they will do it with both, suppliers and customers, to make the whole flow better. The manager from Nolato also thinks that achieving a whole Lean chain could be a source for improvement in the future. The manager from Emballator shares the idea that it might be a goal, but once Lean is more settled down in their company, because the behaviour of the suppliers is difficult to change.

	Suppliers
Tetrapak	Our company must also ensure that our partners work with continuous improvement systems, since otherwise the suppliers could launch the product badly, affecting the company's activity. After the Lean implementation, we had to reject some suppliers we used to work with because they did not work with Lean. We want to expand Lean in our whole production chain.
Nolato	Our suppliers do not implement Lean yet, so maybe it could be a source for improvement in the future achieving a whole Lean chain.
AstraZeneca	We do not talk Lean with our suppliers, but hopefully we will reach a level where we will do it with both, suppliers and customers, to make the whole flow better.
Emballator	The behavior of the suppliers is difficult to change, but once Lean is more settled down in our company we could try to expand it further.
Autoliv	In 2005, we initiated a Supplier Development Program in Lean to prepare our suppliers to be the most efficient in manufacturing within a certain period of time. We do not accept suppliers that provide products with poor quality.

Table 9: Managers' responses about suppliers

5.1.10 Stakeholders

A briefly description of what the managers said during the interviews related to stakeholders is shown in the *Table 10: Managers' responses about stakeholders.*

On the one hand, the managers from TetraPak and AstraZeneca share the opinion that the stakeholders should be committed to Lean too. Both managers agree that the stakeholders want the company to grow and to have benefits, and since both companies have achieved their goals thanks to Lean, their stakeholders are happy with its implementation and, therefore, they have never stood against Lean.

On the other hand, the managers from Nolato and Emballator explained that their greatest stakeholders, the shareholders, are the owner families of the companies. They also agree with the managers from TetraPak and AstraZeneca that the stakeholders should also believe in Lean. In both cases they do, so they have never been in a risk of capital because of a lack of their commitment with it.

	Stakeholders
Tetrapak	The stakeholders should be committed to Lean too, and if necessary they will allocate resources (personnel and monetary resources) and support to achieve what the company wants. If our company has benefits, our stakeholders have them too. Since we have them thanks to Lean, they have never stood against it.
Nolato	Our biggest shareholders are the owners of the company, a Swedish family, so we do not have a very high risk of capital.
AstraZeneca	I think our stakeholders are also interested in lean because they want the company to grow. They are happy with our outgrowth in Lean.
Emballator	It is not such a big company, so we are not in the sharehold market. It is a family-owned business. It is needed that the owners also believe in Lean, and they did. The coworkers are important too, and of course the customers.

Table 10: Managers' responses about stakeholders

5.1.11 Availability of resources

The *Table 11: Managers' responses about Availability of resources* shows what the manager from TetraPak said related to the availability of resources.

In general, the companies did not give much importance to the availability of resources. Only the manager from TetraPak said something relevant about it. She explained that the most important resources for her company are money and workers, and that sometimes they need to prioritize them in case there are many existing losses that the company cannot solve at the same time because of a lack of those needed resources.

	Availability of resources
Tetrapak	Money and workers. In the case of losses in many areas (meaning by losses that some values of the processes are not in the level that are pursued). Priorities are established, since in the company there are no resources to solve all the existing losses.

Table 11: Managers' responses about Availability of resources

After the analysis of the qualitative findings from the interviews related to the factors under study, it is shown the *Table 12: Main factors for the manager* previously mentioned. This table is a visual summary of all the interviews performed. It shows what was more emphasized by each manager.

As it can be appreciated, the factors of managers' leadership and commitment and employees' behaviour and commitment are considered important for the managers from all the companies. What makes think that they are the two most important factors for the success and the sustain of Lean in the long term. The third most important factor, considered important for three out of the five interviewed managers is the training and learning of managers and employees. These three main factors are all related with the people that form the organization.

It stands out that the factors of customers, stakeholders and availability of resources were the ones the managers talked less about.

Factors	Tetrapak	Nolato	AstraZeneca	Emballator	Autoliv
Organizational culture		X		X	
Managers' leadership and commitment	X	X	X	X	X
Employees' behaviour and commitment	X	X	X	X	X
Training and learning	X		X		X
Strategy and alignment	X				
Continuous improvement	X	X			
Measurement of Performance improvement	X				
Customers					
Suppliers	X				
Stakeholders					
Availability of resources					

Table 12: Main factors for the managers

5.2. Quantitative findings

Regarding the questionnaires, after having collected 31 filled surveys, the results were extracted from the FluidSurvey application to an Excel document. Once there, all the information obtained was translated to English and different charts were created to classify the different answers and so, to make some analysis that will be shown and explained in the following subsections.

5.2.1 Motives to implement Lean

The *Figure 2: Motives to implement Lean* shows, according to the answers from the survey, the main reasons that leaded the companies to implement Lean. As it can be seen, improving productivity and

reducing waste are the two main reasons that made the companies take the decision of implementing Lean. This result makes sense, since one of the main Lean purposes is to reduce wastes. However, Lean aims to achieve the customer satisfaction, everything that is done should be done thinking on the customers, so it is surprising that only the 22% of the answers belonged to this motive, but at least, despite all it is among the three main reasons. In addition, it is comforting to see that for example reducing costs is not one of the reasons that has led these companies to implement Lean. This confirms what some Lean managers explained in the interviews. More concretely, one of them expressed that in his opinion one of the reasons that leads many companies to fail in their implementation of Lean is that they do it with the principal objective of reducing costs and thus there is no way to convince the managers and employees and to create a Lean culture. So, the studied companies share this opinion. Therefore, it can be said that according to the companies that have been awarded with the Swedish Lean Award, the three reasons that should lead a company to take the decision to implement Lean are: to improve the productivity, to reduce wastes and to increase customer satisfaction.

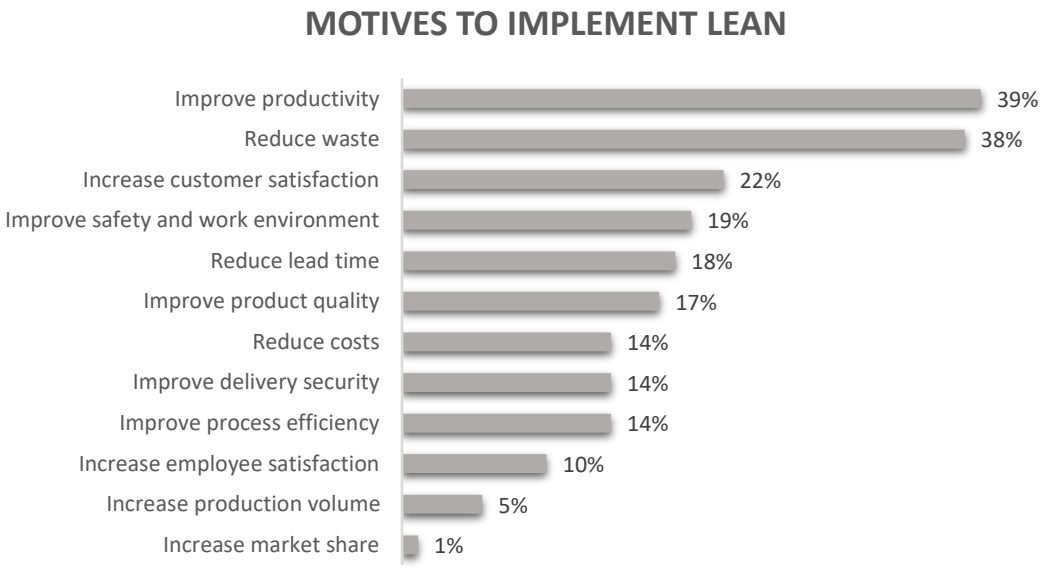

Figure 2: Motives to implement Lean

5.2.2 Use of Lean tools

As it is seen in the *Figure 3: Use of Lean tools*, the most commonly used tools are the execution of daily control and the visual control, overwhelmingly used over the other tools in all the companies “to a great extent”. 5S belongs to the group of the most used ones whether to take into account the "to a great extent" and "to a fair extent" options, or whether the third option "to a certain extent" is also included. In a second degree of importance, taking into account only the "to a great extent" and "to a fair extent" options, it can be said that other tools also quite used by the companies are 5 Why and Just in Time. But

if considering "to a certain extent" together with the first two levels, the second most scored tools would be 5Why and standardized work. So as a general conclusion it can be said that six are the most implemented tools in the companies: daily control, visual control, 5S, 5Why, JIT and standardized work.

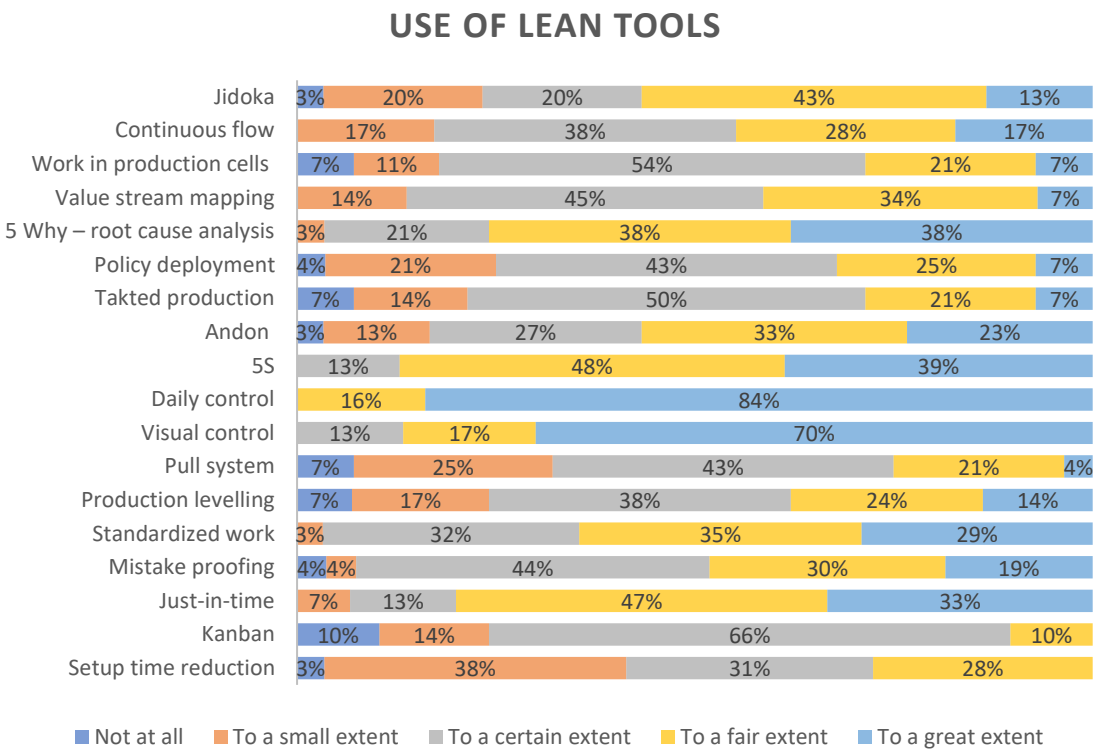

Figure 3: Use of Lean tools

5.2.3 Importance and degree of implementation of Lean principles

The collected data from the answers of the question about the importance and the degree of implementation of Lean principles was meant to be compared. Theoretically, both concepts should be in line, however, analysing the data from the different companies separately, different tendencies were identified. For this reason, on the one hand the *Figure 4* and *Figure 5* were created from the total average (being rated by the surveyed from 1-5), reflecting the general degree of implementation and importance given to these principles, and on the other hand the next 4 figures, from *Figure 6* to *Figure 9* show the different deviations observed in each particular surveyed company.

Regarding the *Figure 4: Importance of Lean principles* and *Figure 5: Degree of implementation of Lean principles*, the most important Lean principle is to avoid remaining hidden problems by using visual control, and actually, the studied companies seem to be very successful accomplishing it.

The next two most important principles, both with a score of 4,30 in the *Figure 4*, are becoming a

learning organization through relentless reflection and continuous improvements, and the development of leaders who truly understand the work, live the philosophy and teach it to others. However, although both of them are well accomplished by the companies, the respondents feel that they could be performing a bit better the learning and continuous improvement to get better results.

It draws attention that the following two most scored principles, with 4,27 points of importance in the *Figure 4*, "Go and see" by the managers and to follow the demand to avoid overproduction, have different results in the *Figure 5*. The first of these principles would need a bigger improvement according to the respondents, while the second one is more implemented than the importance it is given.

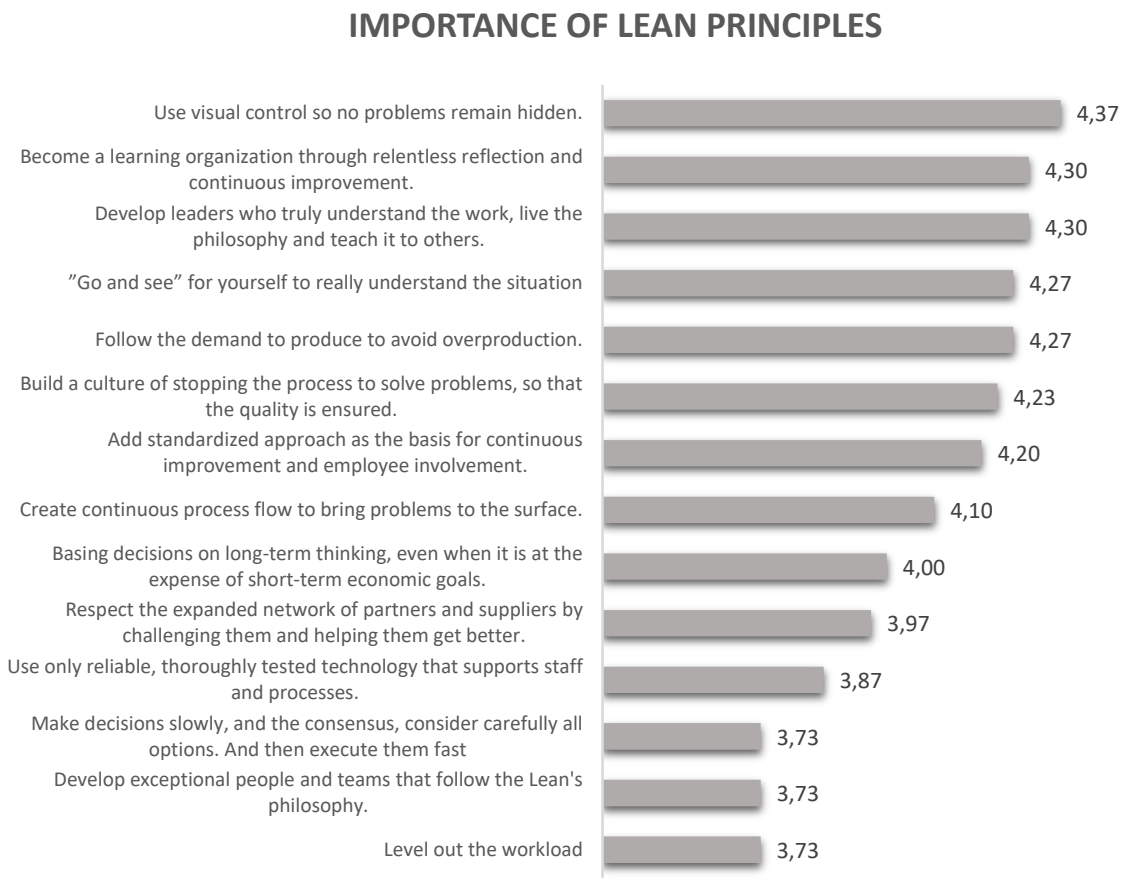

Figure 4: Importance of Lean principles

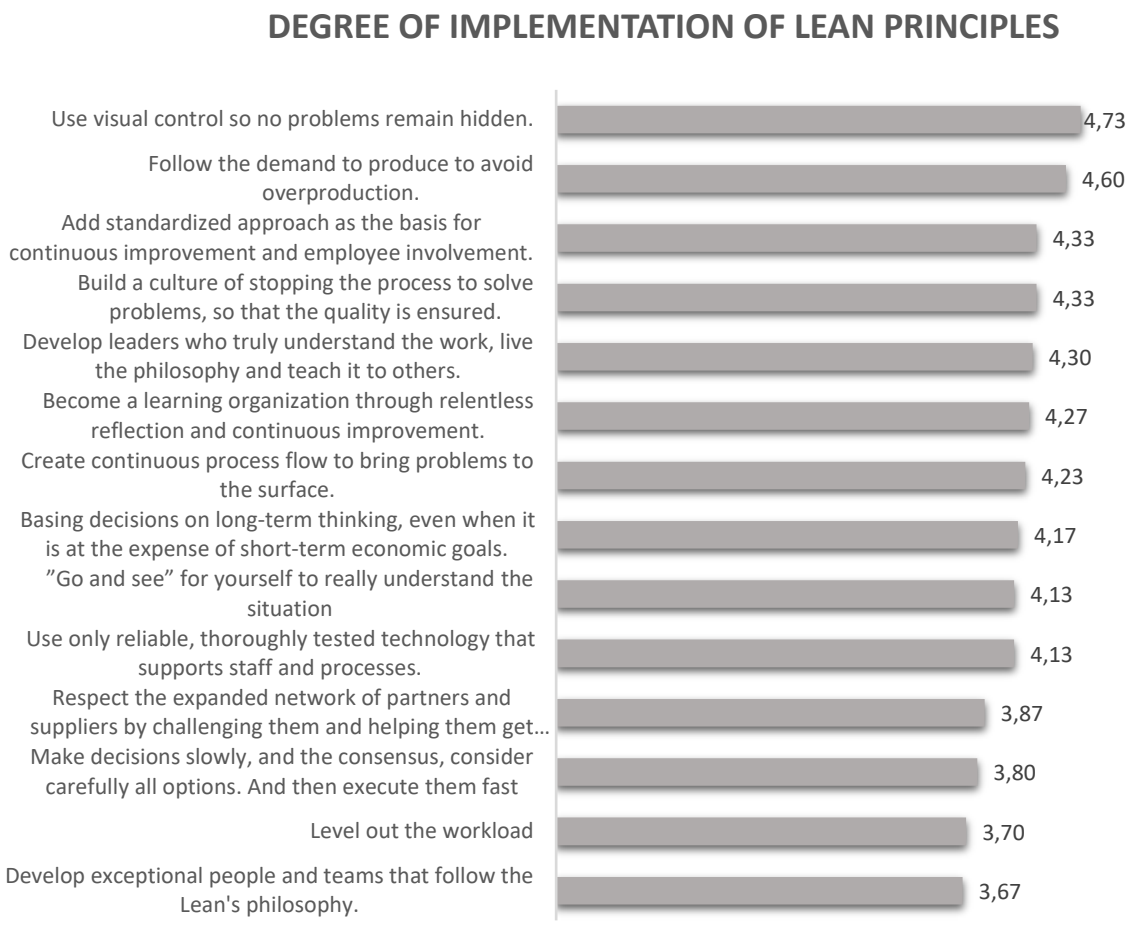

Figure 5: Degree of implementation of Lean principles

In the following figures, *Figure 6* to *Figure 9*, the graphs for comparing the importance and the degree of implementation of each principle in each studied company are shown. The name of the company of each graph is not revealed since particularizing is not the objective of this study. However, although each company prioritizes different aspects as it is seen in the graphs, all of them are carrying out a successful Lean management system.

In the first two shown figures, *Figure 6: Comparison between importance and implementation for company 1* and *Figure 7: Comparison between importance and implementation for company 2*, it is visible that both companies think themselves some steps delayed from what they want to achieve with Lean in every aspect, especially in leadership, continuous improvement and “go and see”. It is normal to have this challenging vision, especially when all of them consider that Lean is such a long way and they are just in the beginning.

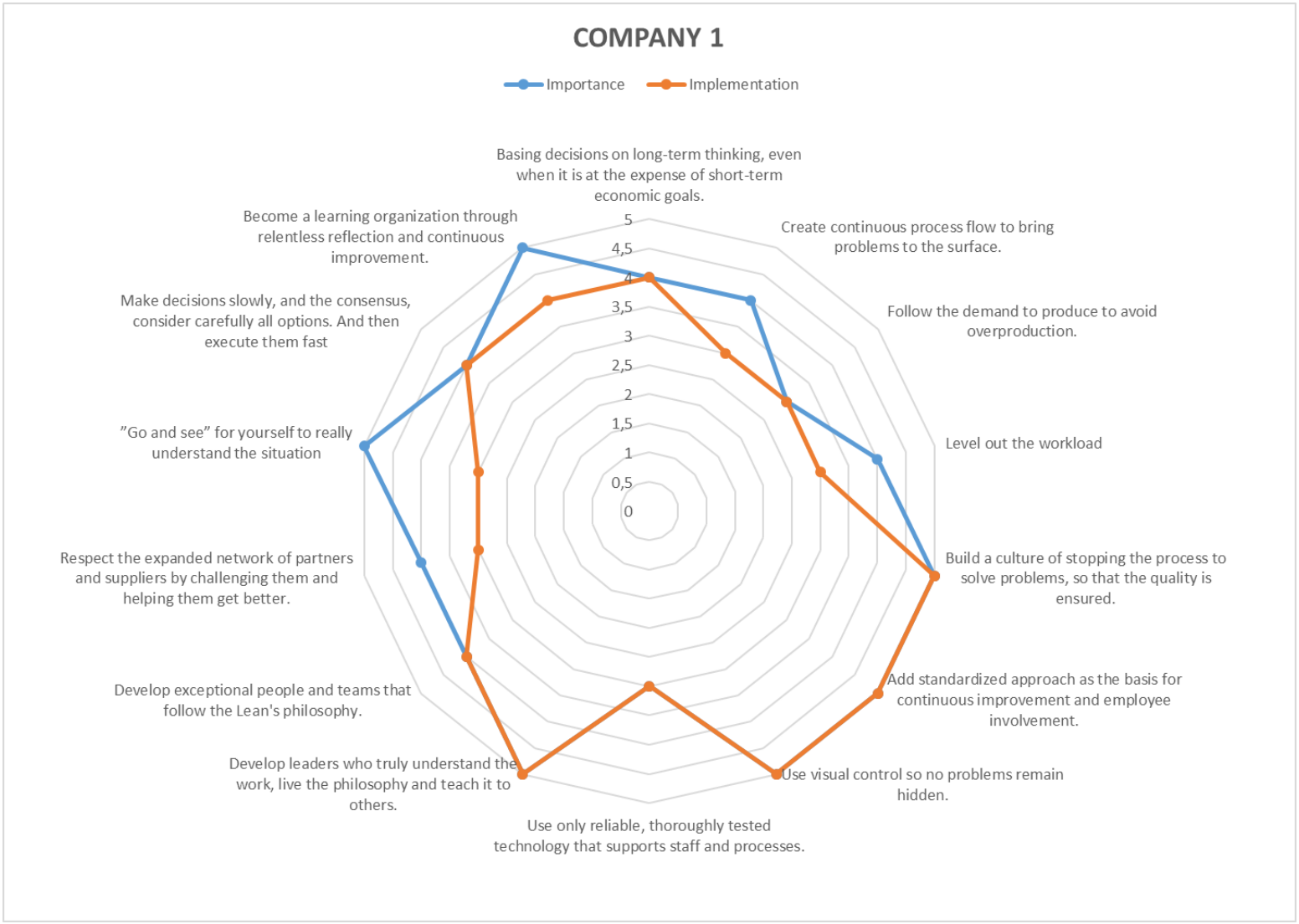

Figure 6: Comparison between importance and implementation for company 1

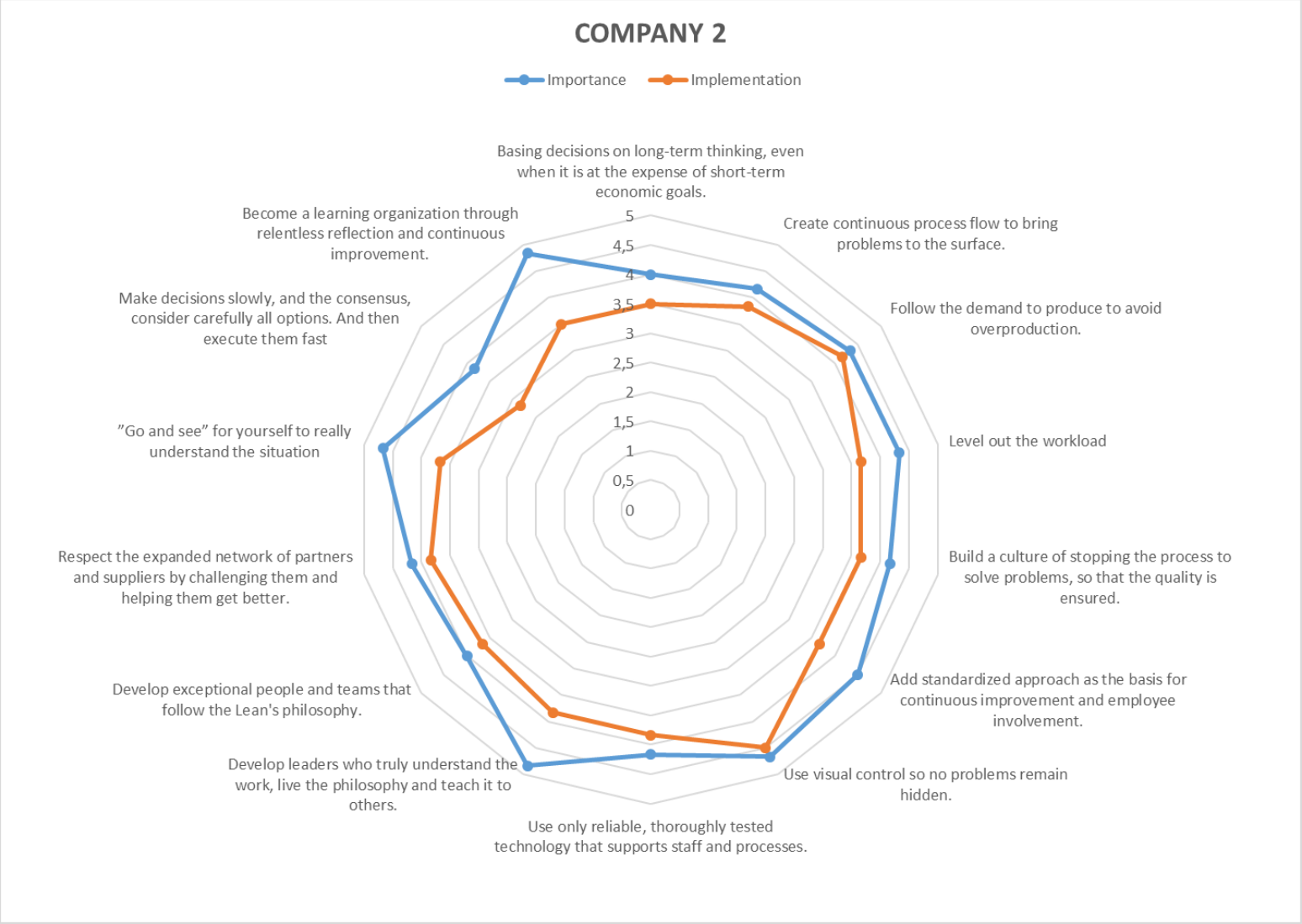

Figure 7: Comparison between importance and implementation for company 2

In the third case, *Figure 8: Comparison between importance and implementation for company 3*, the respondents see themselves close to be following to a good extent the mentioned Lean principles, but they still need to improve in some of them like creating a continuous process flow to detect the problems, levelling out the workload, and especially, like in the first two cases happen, they need to emphasize in learning for continuous improvement and "go and see".

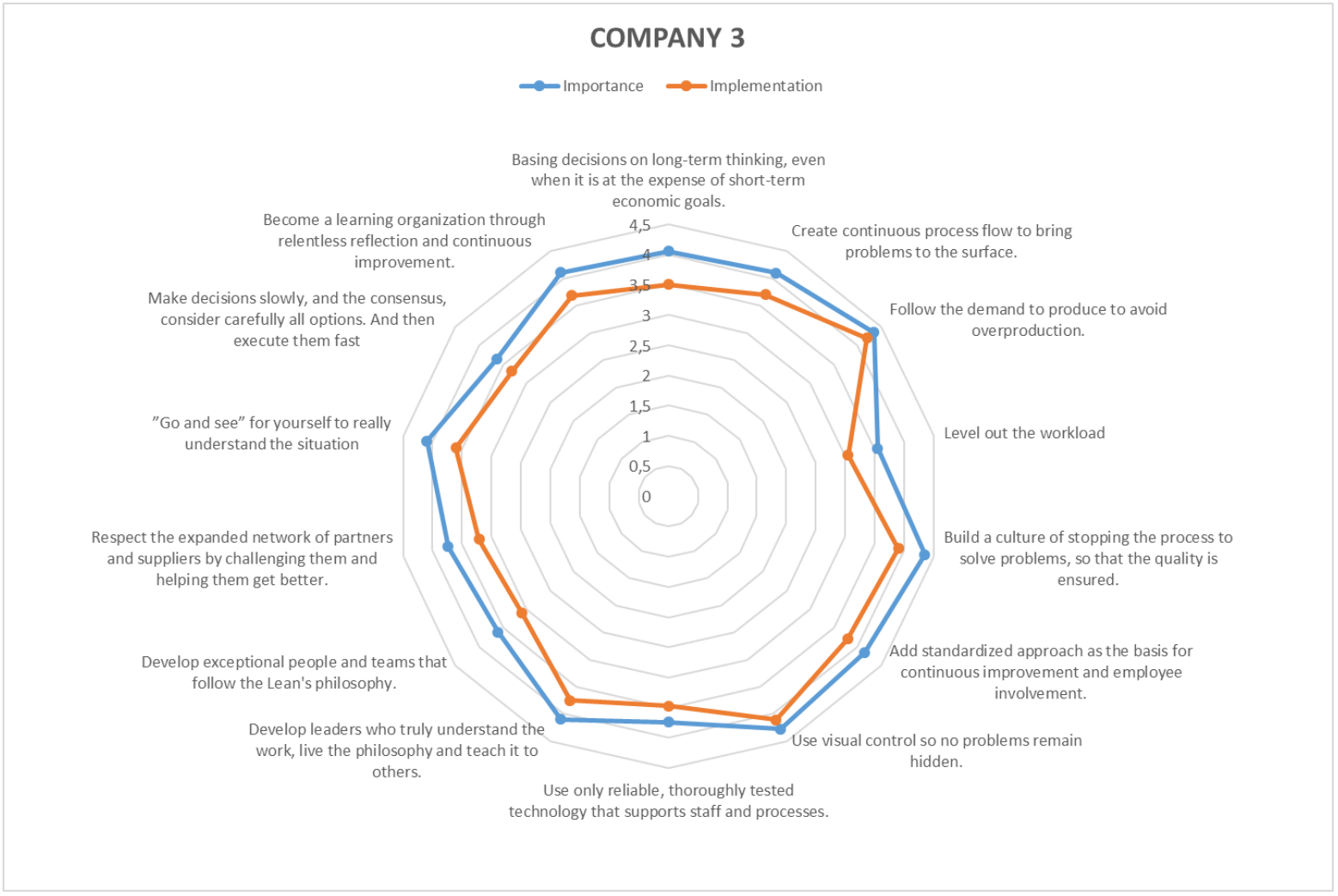

Figure 8: Comparison between importance and implementation for company 3

Ultimately, in the *Figure 9: Comparison between importance and implementation for company 4*, the forth company considers that where they mainly need to improve is in making a whole Lean chain, including their suppliers and partners. This company considers itself especially good in decision-making and in using visual controls in the manufacturing process.

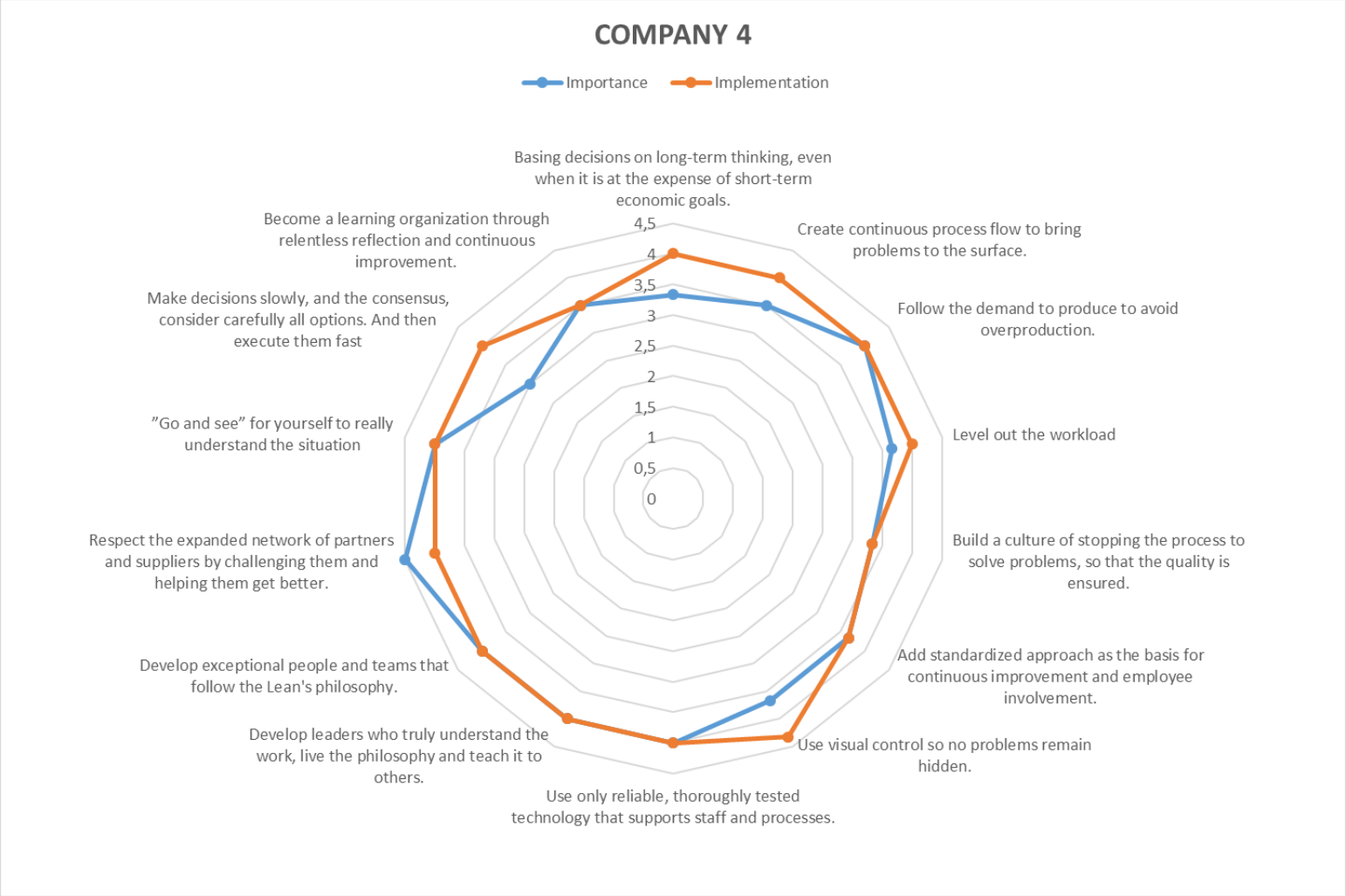

Figure 9: Comparison between importance and implementation for company 4

5.2.4 Statements about Lean

As it is observed in the *Figure 10: Statements about the companies*, the respondents mainly agree or agree very much that all the statements match the situation of their companies. The fact that the groups of statements of continuous improvement and operations management are the ones that match these companies the most is highlighted in the results. They have in general the biggest percentage of very much agreeing and the rest of the percentage of the respondents agree.

Three statements that draw attention outside the two-previous appointed groups are "Managers at all levels display active commitment to Lean", "We talk about the problems that arise" and "We have a good strategy and objectives to meet the future challenges and needs of the company", this last one with 93% of respondents who very much agree.

In addition, it is seen that no statement has received a total agreeing by the respondents, what may mean

that, as some of the managers said at the interviews, everything can always be improved.

Moreover, three statements have received a percentage of "I do not agree", but it is too small in comparison with the agreeing those same have received, so it may not be taken into account.

As a conclusion, all these statements are important and they are all present in the companies that were awarded with the Swedish Lean Award, so a company that wants to implement Lean should consider them.

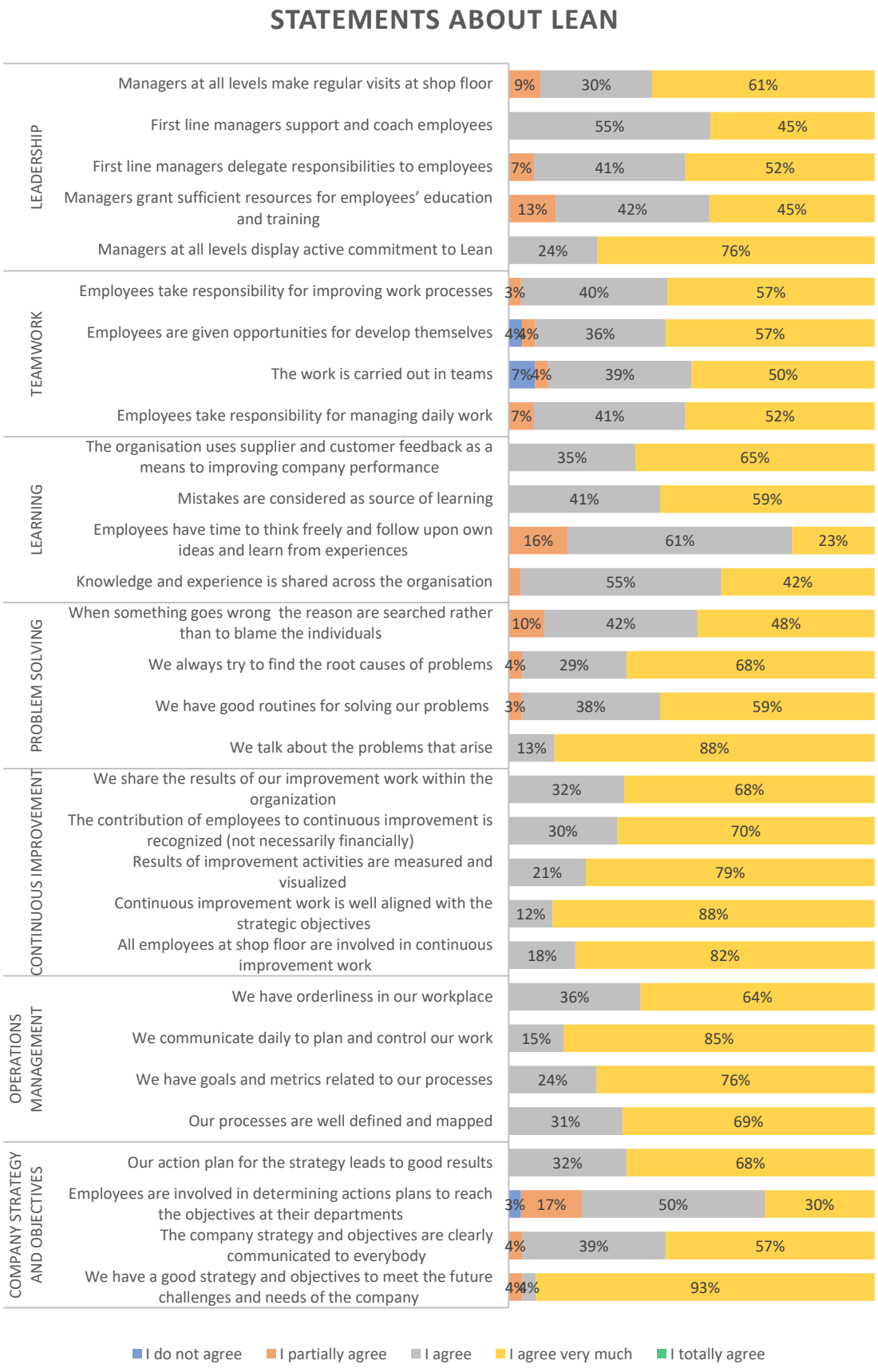

Figure 10: Statements about Lean

Additionally to the *Figure 10*, the matters the respondents consider the most important to success in Lean in the short term and to maintain Lean in the long term and that were directly translated from the Swedish are shown in the *Table 13: Managers' opinions to success and to maintain Lean*.

The opinions given by the respondents are diverse, but for example, reading their views to succeed in Lean in the short term it can be extracted the importance of the existence of committed and involved managers that, being good leaders, work according to Lean culture and that involve employees.

To maintain Lean in the long term, they all agree again in the value of committed managers and employees. Thinking in long term results, delegation of responsibilities to the employees, information flow and continuous improvements are other important considered factors.

To success in Lean in the short term	To maintain Lean in the long term
Good leadership that works according to philosophy. Clear goals and visions are communicated. Leaders of all levels are active in their daily work and challenge their employees.	Strong leadership, clear goals and visions. Delegate responsibility to those who can do a good role. Allow the employees to participate in decision making and development, which creates commitment.
Leadership, commitment and consensus. Culture: "Having fun together".	Perseverance. Make it a natural part of the business. Based on deviations. Have fun together (with different events etc.).
Commitment of employees and managers.	Commitment of employees and managers.
Commitment Training Time Motivation.	Engagement Follow-up Time Motivation.
Management commitment. Resources (Lean Coordinator). Time. Clear link to strategic objectives. Visualization.	Management's commitment. Clearly see the effect of the work.
Continuous follow-up.	Innovation. Follow-up.
Management involvement. Resource allocation. Training.	Management engagement. Resource Allocation Training.
All employees must keep up with Lean!	All employees must keep up with Lean!
Follow up and develop Lean.	Commitment.
Participation, understanding, education.	Information about results and what the work gives.
Senior management's commitment and knowledge.	Do not see it as a project that can be done. Continue to demand long-term results.
Time and resources.	Daily work with Lean.
To take responsibility and initiative.	Follow-up.
First line managers need to have more time to be on the "floor" and coach, follow up, motivate the staff's work / "lack" of commitment.	First line managers need to have more time to be on the "floor" and coach, follow up, motivate the staff's work / "lack" of commitment.
Long term thinking.	Commitment.
Involve everyone in visual control.	Attendance and commitment.
Perseverance and taking small steps.	Be humble about the task and realize that nobody is perfect.
100% involvement. Committed managers.	Visualization of losses.
Engage staff who are involved in daily improvement work	Not to lose focus on continuous improvement work

Table 13: Managers' opinion to success and to maintain Lean

5.2.5 Improvement activities

Regarding the *Figure 11*: *Improvement activities at the departments*, first of all, it should be said that it draws attention the fact that improvement activities are implemented at all the departments but to a different extent. No surveyed has answered that there is no improvement activity in a department, what is something to take into account.

In particular, at the departments of maintenance, logistics and new product development improvement activities are implemented at least regularly. And particularizing, the maintenance and new product development departments together with the production department have at least 69% of responses between frequent existence of improvement activities and integration as part of daily life. Nevertheless, the production department has a quite high percentage of only occasional existence of improvement activities when comparing with other departments, and at the same time it has the highest percentage of integrated as a part of the daily life. So once again, not all the companies have the same values or priorities, but they all have a successful Lean system.

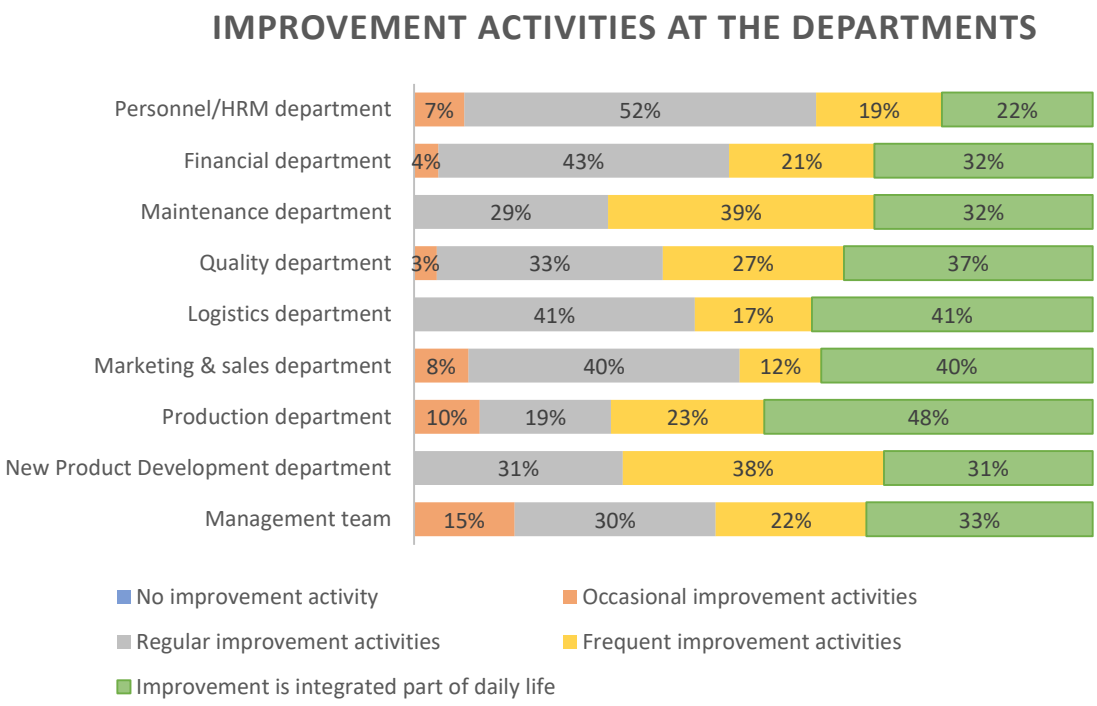

Figure 11: Improvement activities at the departments

5.2.6 Obstacles to the improvement work

Considering the *Figure 12: Obstacles to the improvement work*, the most commonly found obstacle among the companies is the lack of time, and actually, more than half of the questioned employees

answered that this issue is encountered very often. This means that it is very common that the company has not enough time to execute a training plan among the employees, or to employ in the Lean implementation all the time and attention it needs, because they are already quite in a rush to meet deadlines with their customers and they need to focus on their production plan more than in the implementation of a new system.

The surveyed employees point out the lack of employee involvement as the second most commonly found obstacle. It completely makes sense, because after doing the interviews and its posterior analysis, it is known that this lack of involvement is very much related precisely to the lack of training and knowledge about Lean, which is the third most commonly found issue. Moreover, the lack of support from the leadership should be given mention as the next most often faced problem, and this also develops from the lack of information and training, and therefore, from the lack of time.

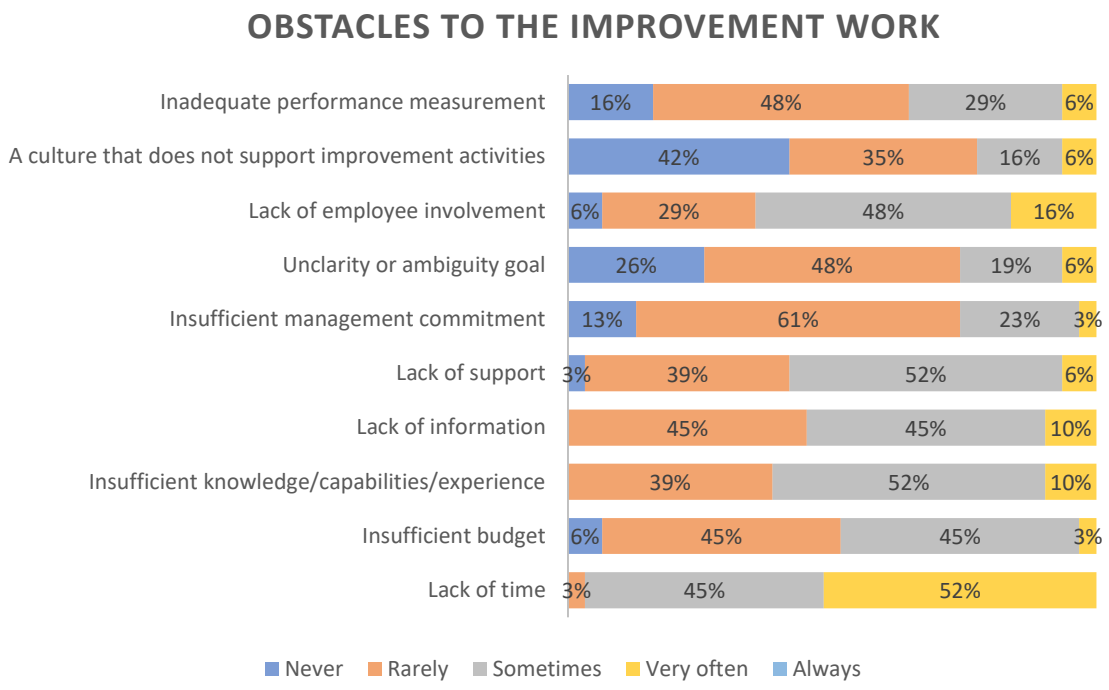

Figure 12: Obstacles to the improvement work

5.2.7 Results after the implementation of Lean

As the *Figure 13: Time to see the first measurable results shows*, in most of the cases the results can be noticed in a very short time after the beginning of the implementation. On the one hand, about half of the respondents consider that it takes less than a year to start seeing good effects from Lean. On the other hand, a bit less than the other half detected the first good results between the first and the third year and only a small percentage took more than 3 years to see them.

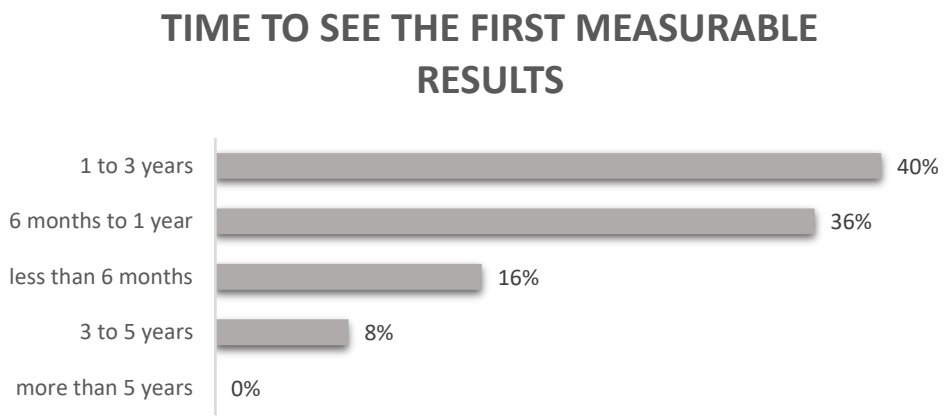

Figure 13: Time to see the first measurable results

The *Figure 14: Business performance* represents the considered percentage contribution of Lean to the different areas of business in the studied companies.

On the one hand, in first sight, the attention is drawn to the employee satisfaction, which is the considered area to have suffered the biggest deterioration by most of the respondents. At the same time, it is also the area considered to have the highest improvement of more than a 20%. This contradiction might have an explication, in the cases where the respondents answer negatively, they were probably thinking about the beginning of the Lean implementation, where as it was explained before, the employees do not see Lean very positively. But in the cases where the respondents answered positively, they were possibly thinking in a further time when Lean is already implemented in the company and the employee satisfaction is risen.

There are also some negative results gotten in quality of products and work safety. There is not a big percentage of respondents who answered like that, and it was an unexpected result. From what is known from the interviews, one of the main goals of the companies when implementing Lean is to achieve products with a better quality, to keep the customer satisfied, and they actually achieve that very soon. About work safety, since the processes are standardized normally fewer unforeseen events occur at the workstations, so according to this the negative result gotten in the survey does not make much sense.

On the other hand, the areas which have been influenced most positively after Lean according to the respondents are mainly the led time and the production volume, followed by delivery reliability, and customer satisfaction.

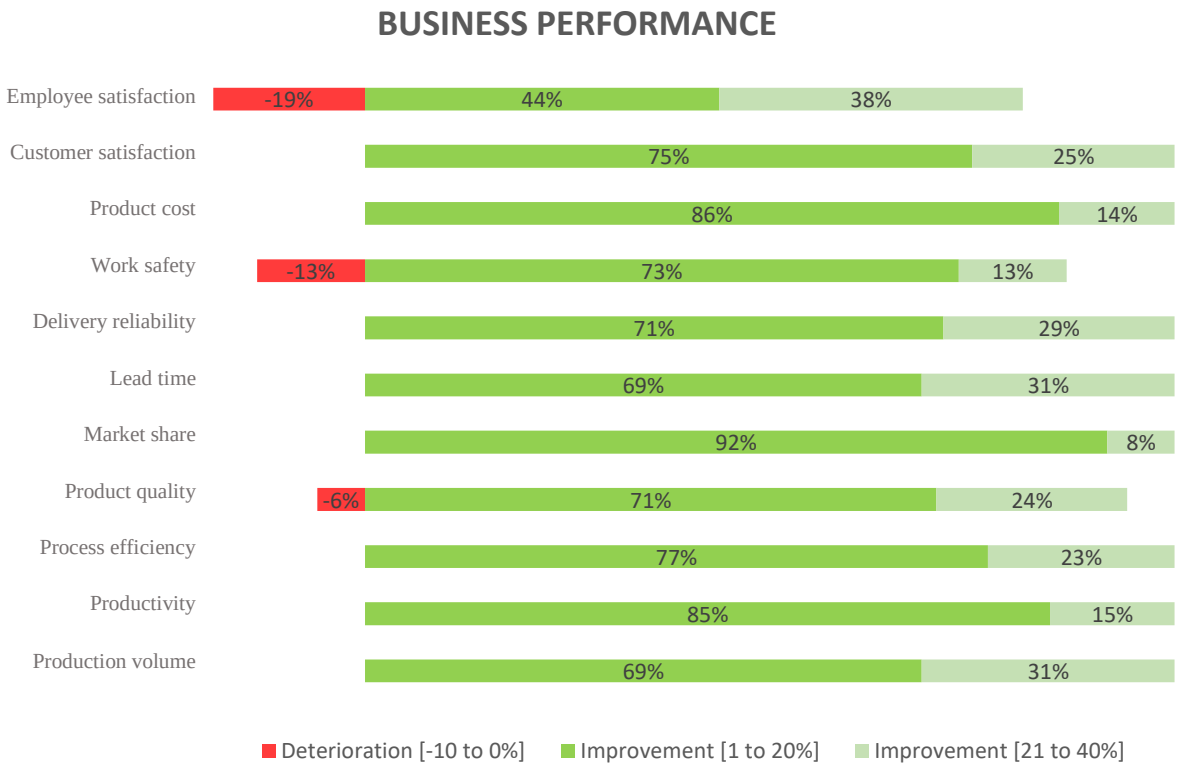

Figure 14: Business performance

6. CONCLUSIONS

As a conclusion of the analysed factors, the most influential ones to the success and sustainability of Lean are the training and learning of managers and employees, the managers' leadership and commitment, and the employees' behaviour and commitment.

Training the managers and the employees means to educate them in Lean so that they can understand the importance of implementing it in their organization. This training should take place in the beginning of the implementation as well as periodically after Lean is implemented. The learning should never stop. It is extremely important to have committed managers and employees, otherwise Lean will not succeed. So, these three factors are related among them and they are considered the most important ones to the success and sustainability of Lean.

A company that wants to implement Lean should have a good and a clear objective, strategy and vision that conduct them to implement it, otherwise the implementation will probably not succeed.

The first step to do when a company decides to implement Lean should be to train and to educate the managers in Lean, since the existence of committed managers that effectively understand Lean is absolutely necessary. It is a common failure to hire an external consultant thinking that he will do all the job: to reduce costs and solve all the problems. This consultant could be more useful if he were hired to train the managers instead. This importance of training the managers is something that most of the companies learnt with the years. The managers need to be good leaders. Leadership in Lean encompasses activities as goal setting, action planning or review meetings.

Moreover, only once the managers are committed to Lean, they can convince employees about it. In addition, to convince the employees when Lean is implemented for the first time in a company, it is a good idea to show them an external benchmark of a company that has succeeded with Lean. And of course, it is also needed to train and educate the employees in Lean, since, as one of the interviewed managers asserted, uncertainty because of the lack of training, and hence of knowledge, can be a barrier, which could mean the non-motivation and non-commitment. Something that some managers agreed with is that in the beginning of the implementation of Lean the employees were discontent with it because they did not understand neither Lean nor the reasons to implement it, hence they did not see it as the wait of doing business. In addition, the employees are the factor that makes things happen in the company, so they need to be aware of what is going on to work towards the same goal, they have to be communicated the strategy and the goals of the company. Once the employees have understood Lean, their empowerment, which is another characteristic of Lean, needs to take place. Empowerment of the employees is based on the idea that giving them skills, resources, authority, opportunity, motivation, as well holding them responsible and accountable for outcomes of their actions, will contribute to their competence and satisfaction.

Furthermore, the training and the learning should never finish. The managers and employees need to be

trained an educated not only in the beginning, but continuously, because the way of working might change with the circumstances (updating, new demands, adjustments, new technologies).

It may be said that Lean highly improves the communication between managers and employees by for example having a daily meeting.

By educating managers and employees, the Lean culture is spread through all the organization, which is a key factor that companies should focus on to success and maintain Lean in the long-term. As one of the interviewed manager said “Lean is not about tools, but a cultural phenomenon based on common sense, change in mentality, commitment and respect”.

A company that works with Lean works with continuous improvement, there is always something to improve. There is one improvement team per area or department. It is important to try new ideas out to see if they work, not being afraid of possible failures. It is possible to learn both from success and from mistakes. And in case of failure, it can lead to take next steps which can be advantageous for the organization.

Regarding one of the main partners a company has, the suppliers, it might be profitable to do business with suppliers that also work with Lean (with continuous improvement systems). It is also desired to have claimant customers that give feedback to discover what is valuable for them so that the company can understand what the wastes which are wanted to be eliminated are. A waste is everything that is not valuable for the customers. Also, to include suppliers and customers in the production chain is a goal the companies that work with Lean ought to achieve.

Ultimately, it must be said that Lean is not a short road to walk. So, companies that are in the first steps of Lean implementation should not be discouraged, they will achieve their goals over time.

7. REFERENCES

- Abernathy, W. (1999), "Evaluating organisation scorecards and incentive-pay systems", Employment Relations Today, Vol. 25, pp. 83-92.
- Alhuraish, I., C. Robledo, and A Kobi. (2016) "Assessment Of Lean Manufacturing And Six Sigma Operation With Decision Making Based On The Analytic Hierarchy Process." IFAC-Papersonline 49 (12): 59-64. doi:10.1016/j.ifacol.2016.07.550.
- Arora, R. (2002), "Implementing KM – a balanced scorecard approach", Journal of Knowledge Management, Vol. 6, pp. 240-50.
- Arslankaya, Seher, and Hatice Atay (2015) "Maintenance Management And Lean Manufacturing Practices In A Firm Which Produces Dairy Products." Procedia - Social And Behavioral Sciences 207: 214-224. doi:10.1016/j.sbspro.2015.10.090.
- Asif, M., E. Joost de Bruijn, A. Douglas, and O. A. Fisscher (2009) "Why Quality Management Programs Fail: A Strategic and Operations Management Perspective." International Journal of Quality & Reliability Management 26 (8): 778–794.
- AstraZeneca: "Framgångsrik Satsning På Ledarskap – Möt Astra Zeneca, Vinnare Av Lean Forums Ledarskapspris 2016". 2017. Lean Forum. http://leanforum.se/artiklar/nyheter/framgangsrik-satsning-pa-ledarskap-mot-astra-zeneca-vinnare-av-lean-forums-ledarskapspris-2016/.
- Autoliv: "Autoliv Sverige Vinnare Av Svenska Leanpriset". 2017. Industrinyheter.Se. http://www.industrinyheter.se/20161227/6130/autoliv-sverige-vinnare-av-svenska-leanpriset
- Bateman, N. (2005) "Sustainability: the elusive element of process improvement. International Journal of Operations & Production Management." 25(3), pp.261-276.
- Beer, M. (2003) "Why Total Quality Management Programs Do Not Persist: The Role of Management Quality and Implications for Leading a TQM Transformation." Decision Sciences Journal 34 (4): 623–642.
- Blaikie P, Cannon T, Davis I, Wisner, B (2014) "At risk: natural hazards, people's vulnerability and disasters." Routledge
- Booth, R. (1996), "Accountants do it by proxy", Management Accounting, Vol. 74, pp. 48-9.
- Brown, J. and McDonnell, B. (1995), "The balanced scorecard", The International Journal of Contemporary Hospitality Management, Vol. 7, pp. 7-12.
- Brulin, G. and Svensson, L. (2011) "Learning Through Ongoing Evaluation", pp. 149–166 (Lund: Studentlitteratur).
- Buchanan, David, Louise Fitzgerald, Diane Ketley, Rose Gollop, Jane Louise Jones, Sharon Saint Lamont, Annette Neath, and Elaine Whitby (2005) "No Going Back: A Review Of The Literature On Sustaining Organizational Change." International Journal Of Management Reviews 7 (3): 189-205. doi:10.1111/j.1468-2370.2005.00111.x.
- Bryman, A. (2004) Social Research Methods, Oxford, Oxford University Press.

- Chakravorty, Satya S., and Douglas N. Hales (2016) "Sustaining Process Improvement: The Red Queen Effect." Production Planning & Control, 1-16. doi:10.1080/09537287.2016.1165308.
- Cherrafi, Anass, Said Elfezazi, Andrea Chiarini, Ahmed Mokhlis, and Khalid Benhida (2016) "The Integration Of Lean Manufacturing, Six Sigma And Sustainability: A Literature Review And Future Research Directions For Developing A Specific Model." Journal Of Cleaner Production 139: 828-846. doi:10.1016/j.jclepro.2016.08.101.
- Choomlucksana, J., Ongsaranakorn, M. and Suksabai, P. (2015) "Improving the Productivity of Sheet Metal Stamping Subassembly Area Using the Application of Lean Manufacturing Principles." Procedia Manufacturing, 2, pp.102-107.
- Coffey, M. (2000) "Developing and Maintaining Employee Commitment and Involvement in Lean Construction." In:, 8th Annual Conference of the International Group for Lean Construction. Brigthon, UK, 17-19 Jul 2000.
- Dawson, P. (1994) "Organizational Change: A Processual Approach." London: Paul Chapman.
- De Treville, S., Antonakis, J., Edelson, N.M. (2005) "Can standard operating procedures be motivating? Reconciling process variability issues and behavioural outcomes." Total Qual. Manag. Bus. Excell 16, 231e241. http://dx.doi.org/10.1080/14783360500054236.
- DiCicco-Bloom B. and Crabtree B. (2006). The Qualitative research interview. Medical Education. 40, 4, pp. 4-13.
- Dimancescu, D., Hines, P. and Rich, N. (1997), The Lean Enterprise, Amazon, New York, NY.
- Dombrowski, U., Mielke, T. (2013) "Lean Leadership - Fundamental principles and their application." Procedia CIRP 7, 569–574. doi:10.1016/j.procir.2013.06.034
- Eklund, J. (1998) "Work conditions and company strategies." in: P. Vink, E. Koningsveld and S. Dhondt (eds) Human Factors in Organizational Design and Management – IV, pp. 263–268 (Amsterdam: North Holland).
- Emballator Lagan Plast: "Nyheter - Emballator Lagan Plast". 2017. Emballator Lagan Plast. http://www.emballatorlagan.se/nyheter/.
- Frigo, M. (2003), "Performance measures that drive the goal Tenets of strategy", Strategic Finance, Vol. 85, pp. 9-13.
- Fullerton, R. R., McWatters, C. S., & Fawson, C. (2003). An examination of the relationships between JIT and financial performance. Journal of Operations Management, 21(4), 383-404
- Graetz, Fiona, and Aaron C.T. Smith (2010) "Managing Organizational Change: A Philosophies Of Change Approach." Journal Of Change Management 10 (2): 135-154. doi:10.1080/14697011003795602.
- Halvarsson, A. and O¨ hman-Sandberg, A. (2009) "How theory can contribute to learning – interactive research in national programmes."
- Hines, P., Holweg, M. & Rich, N. (2004). "Learning to evolve: A review of contemporary lean thinking.", International Journal of Operations & Production Management, Vol. 24 Iss: 10, pp.994-1011.

- Iris, C., Cebeci, U., (2014) "Analyzing relationship between ERP utilization and lean manufacturing maturity of Turkish SMEs." J. Enterp. Inf. Manag. 27, 261–277. doi:10.1108/JEIM-12-2013-0093
- Jørgensen F., Matthiesen R., Nielsen J., Johansen J. (2007) "Lean Maturity, Lean Sustainability." In: Olhager J., Persson F. (eds) Advances in production Management Systems. IFIP — The International Federation for Information Processing, vol 246. Springer, Boston, MA
- Kaye, M. and Anderson, R. (1999). Continuous improvement: the ten essential criteria. International Journal of Quality & Reliability Management, 16(5), pp.485-509.
- Ketokivi M, Schroeder R (2004) "Manufacturing practices, strategic fit and performance: a routine-based view." International Journal of Operations & Production Management 24(2):171–191.doi:10.1108/01443570410514876
- Khodeir, Laila M., and Reem Othman (2016) "Examining The Interaction Between Lean And Sustainability Principles In The Management Process Of AEC Industry." Ain Shams Engineering Journal. doi:10.1016/j.asej.2016.12.005.
- Kotter, J.P. (1995) "Leading change: why transformation efforts fail." Harvard Business Review, 73, 59–67.
- Langenwalter, G. (2006) "Life is our ultimate customer: from lean to sustainability." Target 22 (1), 5e15.
- Kumar, M., Antony, J., Douglas, A. (2009) "Does size matter for Six Sigma implementation?" Findings from the survey in UK SMEs. TQM J. 21, 623–635.
- Lean Production. Retrieved from http://www.leanproduction.com/top-25-lean-tools.html
- Leana, C.R. and Barry, B. (2000) "Stability and change as simultaneous experiences in organizational life." Academy of Management Review, 25(4), pp. 753–759.
- Liker, J. (2004). The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer. New York: McGraw-Hill.
- LIKER, J. and MEIER, D. (2006) The Toyota way fieldbook. 1st ed. New York, NY [u.a.]: McGraw-Hill, pp.6-14.
- Longoni A, PagellM, Johnston D, Veltri A (2013) "When does lean hurt?—an exploration of lean practices and worker health and safety outcomes." Int J Prod Res 51(11):3300–3320. doi:10.1080/00207543.2013.765072
- Maasouman, Mohammad Ali, and Kudret Demirli (2015) "Assessment Of Lean Maturity Level In Manufacturing Cells". IFAC-Papersonline 48 (3): 1876-1881. doi:10.1016/j.ifacol.2015.06.360.
- Merriam, S. B. (1998) Qualitative Research and Case Study Applications in Education, San Francisco, Jossey-Bass.
- Moeuf, A., Tamayo, S., Lamouri, S., Pellerin, R. and Lelievre, A. (2016) "Strengths and weaknesses of small and medium sized enterprises regarding the implementation of lean manufacturing." IFAC-PapersOnLine, 49(12), pp.71-76.
- Neely, A. (1999), "The performance measurement revolution", International Journal of Operations & Production Management, Vol. 19, pp. 205-28.

- Nolato Meditech: "Nolato Meditech Vann Svenska Leanpriset". 2017. Lean Forum. http://leanforum.se/artiklar/nyheter/nolato-meditech-bast-pa-lean/.
- Norrgren, F., Hart, H. and Schaller, J. (1996) “Fo ̈ra ̈ndringsstrategiers Effektivitet, CORE WP 3” (Gothenburg: Chalmers University of Technology).
- Pampanelli, A.B., Found, P., Bernardes, A.M. (2014) “A lean & green model for a production cell.” J. Clean. Prod. 85, 19e35.
- Patel, A. (2014). Why Lean Fails- A look at defining culture and its role. Retrieved from http://theleanwayconsulting.com/why-lean-fails-a-look-at-defining-culture-and-its-role/
- Patton, Michael Quinn (1995). Qualitative Evaluation And Research Methods. 1st ed. Newbury Park: Sage
- Powell, D., Alfnes, E., Strandhagen, J.O., Dreyer, H. (2013) “The concurrent application of lean production and ERP: Towards an ERP-based lean implementation process.” Comput. Ind. 64,324–335. doi:10.1016/j.compind.2012.12.002
- Rimmer, M., Macneil, J., Chenhall, R., Langfield-Smith, K. and Watts, L. (1996) “Reinventing Competitiveness: Achieving Best Practice in Australia. South Melbourne, Australia: Pitman.”
- Stump, Brandon, and Fazleena Badurdeen (2009) "Integrating Lean And Other Strategies For Mass Customization Manufacturing: A Case Study". Journal Of Intelligent Manufacturing 23 (1): 109-124. doi:10.1007/s10845-009-0289-3.
- Sugimori, Y., Kusunoki, K., Cho, F. and Ucgikawa, S. (1977). Toyota production system and Kanban system Materialization of just-in-time and respect-for-human system. International Journal of Production Research, 15(6), pp.553-564.
- Simons, D., Taylor, D. (2007) “Lean thinking in the UK red meat industry: A systems and contingency approach.” Int. J. Prod. Econ. 106, 70–81. doi:10.1016/j.ijpe.2006.04.003
- Smith, M. (1998), “Measuring organisational effectiveness”, Management Accounting, Vol. 76, pp. 34-6.
- Standard, C. and Davis, D. (2000), “Lean thinking for competitive advantage”, Automotive Manufacturing & Production, Vol. 112, pp. 68-9.
- Svensson, L., Aronsson, G., Randle, H. and Eklund, J. (2007) “Ha ̈llbart arbetsliv – projekt som ga ̈stspel eller somha ̈llbar utveckling” (Malmo ̈: Gleerups).
- Tetra Pak: "Tetra Pak Om Svenska Leanpriset 2014 - Det Är Ett Erkännande". 2017. Lean Forum. http://leanforum.se/artiklar/nyheter/tetra-pak-om-svenska-leanpriset-2014-det-ar-ett-erkannande/.
- Thomas, A., Barton, R., Chuke-Okafor, C. (2009) “Applying lean six sigma in a small engineering company – a model for change.” J. Manuf. Technol. Manag. 20, 113–129. doi:10.1108/17410380910925433
- Tortorella, Guilherme Luz, Lizandra Garcia Lupi Vergara, and Evelise Pereira Ferreira (2016) "Lean Manufacturing Implementation: An Assessment Method With Regards To Socio-Technical And Ergonomics Practices Adoption". The International Journal Of Advanced Manufacturing Technology 89 (9-12): 3407-3418. doi:10.1007/s00170-016-9227-7.

- Upton, David (1996) "Mechanisms For Building And Sustaining Operations Improvement". European Management Journal 14 (3): 215-228. doi:10.1016/0263-2373(96)00002-3.
- Verrier, Brunilde, Bertrand Rose, Emmanuel Caillaud, and Hakim Remita (2014) "Combining Organizational Performance With Sustainable Development Issues: The Lean And Green Project Benchmarking Repository". Journal Of Cleaner Production 85: 83-93. doi:10.1016/j.jclepro.2013.12.023.
- Vinodh, S., K. R. Arvind, and M. Somanaathan (2010) "Tools And Techniques For Enabling Sustainability Through Lean Initiatives". Clean Technologies And Environmental Policy 13 (3): 469-479. doi:10.1007/s10098-010-0329-x.
- Wade, D. (1997), “Measuring performance with a balanced scorecard”, Managers Handbook, Vol. 2, pp. 6-17.
- Womack, J., Jones, D., & Roos, D. (1990). The Machine That Changed the World: The Story of Lean Production. New York: Rawson Associates.
- Womack, J.P. and Jones, D.T. (1996) “Lean thinking.” 1st ed. New York, NY: Simon & Schuster, pp.15-90.
- Womack, J.P. and Jones, D.T. (1996) “Beyond Toyota: How to Root Out Waste and Pursue Perfection.” Harvard Business Review, Vol. 74, No. 5, pp. 140-158.
- Womack, J., & Jones, D. (2003). Lean Thinking: Banish Waste and Create Wealth in Your Corporation: Free Press.
- Yin, Robert K. (1994). Case Study Research. 1st ed. Thousand Oaks, Calif: Sage.