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Supply chain quality improvement through a risk analysis in the catering sector, Eating Point case study

Autor : Thomas Servais
Supervisors : Pierre Semal and Paul Chatelain
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Place des Doyens, 1 bte L2.01.01, 1348 Louvain-la-Neuve, Belgique | **www.uclouvain.be/lsm**

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Acronyms

B2B	Business-To-Business
DMADV	Define-Measure-Analyze-Design-Verify
DMAIC	Define-Measure-Analyze-Improve-Control
EP	Eating Point
FIFO	First-in First-out
FTE	Full-Time Equivalent
GE	General Electric
HR	Human Resources
ISO	International Standardization Organization
JIT	Just-In-Time
LM	Lean Management
MVP	Minimum Viable Product
PDCA	Plan-Do-Check-Act
PI	Performance Indicator
TPS	Toyota Production System
TQM	Total Quality Management
VSM	Value Stream Mapping

1 Executive Summary

Eating Point is a catering company, created in 2014 by Jean-Benoit Verstraete. Its core business is B2B oriented. Customer acquisition is mainly done through word of mouth, as the firm benefits from positive image among its numerous clients. Hence client satisfaction is the top priority on this competitive sector. This involves qualitative food, on-time delivery, quality of service and an absence of shortage. The supply chain represents one of the key elements within the value chain.

However, at Eating Point, errors arise frequently and the repercussions may be disastrous. In order to deal with those issues and keep a high client satisfaction, the company deploys additional resources which incur a reduction of the profit margins.

The purpose of this master thesis is twofold. First, a specific methodology will be proposed to (1) analyze the supply chain of the company and identify the different issues they are facing in terms of risks and (2) provide solutions to alleviate these identified risks. Second, we apply this methodology to implement the risk culture and its importance to an efficient supply chain and smooth running of operations. Finally, the methodology and the solutions provided will be evaluated.

The main risks identified within the supply chain are the consumables on stock out, the omission of equipment during the preparation stage and errors during the loading of the materials. These three top risks will be analyzed utilizing the Ishikawa diagram in order to identify the root causes of these problems. In order to solve them, ideal solutions to improve the current situation are not viable because of the small leverage of the company.

However, minimum viable products are proposed in order to monitor the top three risks. Firstly, a Kanban system (Terry (2019)) was established to provide an efficient visualisation of the stocks and decrease the occurrence of stock-outs. Secondly, a new inventory management is proposed to reduce the omission of equipment during the preparation process. Lastly, a new system of zones is suggested to operate more efficiently while using effective buffer between the various operations. Each of the solutions has a full implementation plan using a PDCA methodology. Those three resolutions will be evaluated by the various employees. Hence, in the future, this would guide the company to run their risk analysis in order to improve their supply chain management.

2 Introduction

The catering sector intends to deliver food services at a remote location. Those are called venues and can be a hotel, park, company headquarters or an event venue. The corporate traitors are responsible for fulfilling the companies' demands and needs. There are several types of corporate catering such as corporate lunches, conventions, team buildings, product launches and finally board meetings.

Due to new trends of consumption, the sector is in a growing phase. Moreover, companies have started to realize the importance of maintaining quality relationships with the different parties (employees, clients, suppliers...). In Belgium, the catering total turnover went from 1.559 bn euros in 2008 to 2.407 bn euros in 2018 (growth of 54,39%) (Kamer (2019b)) and the number of catering companies increased from 4.451 to 6.342 over the past ten years (Kamer (2019a)). These figures include all kind of catering companies. However the main Belgian actors in the corporate event sector are Artfood, bFood, Foodlover, Choux de Bruxelles and J&M Catering (Monaylysscat (2019)).

Because of the novelty of the system, companies catering for corporate events are always looking for more efficiency and risks reduction. Companies are investing more and more in social connections. Those links can either be internal or external. An example of internal links would be a team building or a celebration event to congratulate the various stakeholders for their remarkable performance. On the other hand, examples of external events may be a product launch with high value customers.

Eating Point was founded by Jean-Benoit Verstraete in 2014. The growth has been significant since then. In 2019, the yearly revenue was about 1.5 M euros, which represents more than 300 events. The company went from 1 founder to a team of 7 full-time staff members, employing more than 500 different students a year working in average 30 hours a year. This represents 8 FTE (full-time equivalent). In addition, the company proposes a very flexible approach such that they can adapt easily and offer food solution to any field and venue. However, their logistic did not change much throughout this rapid growth. Therefore, the different processes must be analyzed and redesigned. In order to keep growing, the company must question itself to allow a viable expansion.

Eating Point organizes numerous events each week. Each of them are customized to suit the client's needs perfectly and expectations. Therefore, each event is unique. The different steps always remain the same but their composition may totally vary. For example, the materials needed for a corporate party using a single bar and a corporate lunch have only a few of the same items. The different venues' locations also sometimes differ significantly. Some locations have constraints that have to be considered by the event manager. For all these reasons, the supply chain of the company has to be very efficient and reactive to any situation.

The fact that every event is different impacts the different steps. Each event has to be correctly prepared error-free. However, failures remain frequent. The different steps contain risks and errors and those have to be identified first, and monitored afterwards. The error mitigation is crucial to the company as their revenue depends on their image and reputation. Each client has to be treated as a VIP guest. They have influence on the small market and Eating Point cannot afford any mistake. Each of the different corporate catering company has comparable offers and therefore, Eating Point cannot afford to loose its positive notoriety.

Each steps of the supply chain depends on the previous operation. For example, the smooth running of the event depends on the smooth running of the set up which depends on the smooth running of the event preparation and so on. The different steps must be analyzed and the different risks have to be identified. Those must be monitored in order to improve the supply chain reliability.

Furthermore, one of Eating Point's particularity is that the different steps are mainly operated by students. Their experience varies greatly. They mostly work as interim employees and thus do not have any incentive to perform efficiently and effectively. Therefore, the different processes have to be formalized and developed in order to determine the best practices.

The organisation of the thesis will be as follows. The next chapter will focus on the chosen company and describe its specificity. The company and its main offers will be fully presented. Furthermore, the different processes will be displayed. In each of the different steps, risks will be identified and described. Those will be thoroughly analyzed after the literature.

The two next chapters displays the literature used in the report. The thesis is focused on a supply

chain quality improvement. Therefore, the literature and theory about the subject will be used in our analysis. While these techniques and methods have been developed and are used for heavy industry (e.g. automotive), those will be adapted to the catering sector. Methods of management and various tools will be fully developed for an effective comprehension. The different tools like the PDCA cycle (Imai (1986)) and the DMAIC improvement process (Kumar & Sosnoski (2009)) will help to guide the structure of the analysis. In addition, the Ishikawa diagram (Jayaprasad et al. (2018)) and risk matrix (Qazi & Akhtar (2020)) will help to conduct a thorough analysis of the main risks identified earlier.

Thanks to interviews with four company employees, the eighteen risks identified in the third chapter have been quantified using two axes. The X-axis is the impact of the risk. The importance is rated on a continuous scale from zero to ten. The goal is to order the different risk in terms of impact. With the same range, the Y-axis represents the occurrence/frequency of the risks. The main objective of this matrix is to identify the main ones. The different errors with a high impact and high occurrence will be monitored in the next chapter based on the quality improvement management developed in the theoretical chapter.

The next chapter provides a full analysis of the three main risks. The root causes are developed by dint of the Ishikawa diagram (Jayaprasad et al. (2018)). Solutions will be proposed but the constraints of the company will exclude those solutions. However, minimum viable products (MVP) can be proposed to enhance the current situation.

The different improvements (MVPs) within the supply chain will help to either reduce the occurrences or the impacts of the risks. Those MVP's will be implemented in the company thanks to a PDCA method (Imai (1986)). Unfortunately, due to the COVID-19 crisis, only one of the solution has been partially implemented and its efficiency will be proved. Regarding the two other solutions, the implementation plan will be offered to the different stakeholders and their critics about its efficiency will be provided.

The document will end with a complete conclusion describing the method and the limits encountered. This chapter aims to summarize the advises for a better management in the corporate catering sector during and before events.

3 Eating Point

This chapter will primarily analyze the company and its various offers. Secondly, a full description of the different processes will be provided. These procedures encompass several risks that will be identified and thoroughly described.

3.1 Presentation of the company

Eating point is a catering company that was launched in October 2014 by Jean-Benoit Verstraete, its current chief executive officer. The first idea was to create a catering concept that could facilitate human interactions within a company. This would help a team player to communicate and find his place within the organization. The purpose of the company could be summarized in one word: ”MEET”. Their three core values are ”Dynamic, Modern & Human”.

Figure 1: Eating Point Logo

Eating Point suggests different types of menus including a large range of offers. The catering company is not currently producing its food. This segment of the chain is subcontracted through a third-party. They have several offers divided into four main categories: ”Original”, ”Express”, ”Rise” and ”Time-out”. Their main advantage in comparison with their competitors is that they have the ability to serve quality meals regardless of the environment. They do not have as much constraints and requirements as their competitors. For example, they do not need specific kitchen appliances. The only required element to the successful completion of an event is electricity.

In this way, their efficient adaptability offers the possibility to serve at hardly accessible venues such as the Atomium. They have several other prestigious venues such as Quartier Papier, Art Cube, Wild Gallery, Docks Dome and many more. A full description of their working methods will be provided further.

Their main offer is the ”Original” menu. These counters can serve from 50 to 3500 guests within two hours. Each menu is based on a theme. They offer 23 different themes and each of them proposes three main dishes. For example the ”Italian Job” counter will serve ”Penne pancetta and greens”, ”Carne calabrese” and ”Mozzarella di bufala and grilled veggies”. Each menu offers a vegetarian dish as well. The purpose behind the counters is to offer the possibility for each guest to taste the three delicious meals. The ”Melting Pot” counter offers the possibility to create your own menu with the different dishes Eating Point offers. In addition, EP offers extra bites such as dips, starters and desserts. The company also owns drink counters suggesting several offers such as ”Openbar”, ”Softbar” (Openbar without alcoholic drinks), ”Welcoming Champagne”, ”cocktail bar”, ”Thirst point”, ”Juicy juice”, ”Coffee and Tea” and ”Coffee Break” (Coffee and Thea with cookies and brownies). In addition, you can spruce your event with some extra suggestions such as high tables, concept bar, furniture (e.g. sofas, gas heaters, ...), wooden games (e.g. baby football, mikados, ...) and a photo booth to save a keepsake from the event.

Figure 2: ”Original” Menu Counter of Eating Point (”Asia Mania”

Their second main offer is called the ”Express”, serving their famous lunchboxes. The main objective of this concept is to serve and savor the meals quickly. For example, they can serve up to two thousand customers within fifteen minutes in between two conferences. A lunchbox is composed by a salad, several sandwiches and a dessert. The lunchboxes are disposed in a ”totem” (see Figure 3). The main advantage of this concept is that the totem can be installed quickly and fit anywhere. The firm offers two main types of lunchboxes, the ”classic” and the ”signatures”. The firm serves nine different classic menus composed by a large variety of salads ranging from ”Moroccan couscous” to ”Coral lentil salad”, with a large division of sandwiches (e.g. ”Mozzarella and pesto sandwich” or ”Guacamole and dried tomato wrap”). Lastly, customers can enjoy a large range of desserts such as ”Chocolate muffin” and ”Seasonal fruit salad”. Regarding the signature lunchboxes, their different suppliers are Ba Ba Bagel, Van Guils and Pack’n Joy. As mentioned, they offer bagels sandwiches but also bagnat topped with truffles and many more. ”Pack’n Joy” is a lunchbox composed by various salads with a walnut pie as dessert. With this concept, EP suggests to enjoy the drink included in the original. However, clients can also choose from other bottles self-served. Consumers can also customize their event with the same additional features than the original. In order to spice up the experience, the client can insert a golden ticket in one of the lunchboxes gifting reward. It is also possible to personalize it further, from the totem to the lunchboxes, from full customization to little stickers on the lunchboxes.

Figure 3: Totem for an ”Express” service

Third, the ”Rise” menu offers various types of breakfasts and brunches. Their mission is to be ”comfy and healthy”. Their original breakfast is the ”Good to go” menu offering three different types of pastries. Additionally, fresh orange juice is available as well as fruit salad, granola and yoghurt and many more. Eating point also offers breakfast lunchboxes composed either of pastries or topped with yoghurt or a bagel. Lastly, the client can add certain extras such as fruit baskets, bagels, coffee, hot chocolate. The extras and the customization are quite similar to the two packages above.

Figure 4: Breakfast for the ”Rise” menu

Finally, the ”Time-out” concept is composed of delicious snacks and drinks. The catering company offers different types of healthy bites such as raw-bar, granola, yoghurt and so on. Hot-dogs can also be provided by Eating Point. They also suggest seasonal snacks such as the Saint Nicolas snacks composed of crunchy Speculoos, marzipan, pralines during November and December. The Easter bunny is also present with chocolate eggs, praline eggs and crispy waffles.

After thoroughly delving into the offers Eating Point provides, we can now analyze the different procedures to serve these types of event. The different processes will be fully displayed in the next section.

3.1.1 Summary

The Figure 5 visually displays the main offers of Eating Point. This would help the comprehension of the firms' numerous concepts.

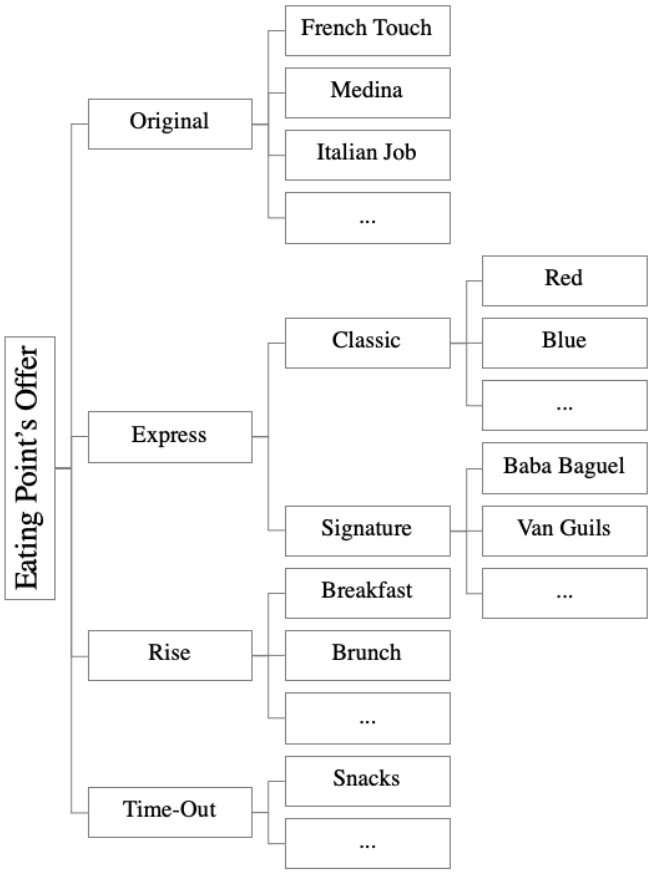

Figure 5: Diagram of Eating Point's offer

3.2 Presentation of the processes

This section's purpose is to describe the different processes of an event in order to identify the different possible risks. Multiple steps are needed for an event. A crucial element is that each of the steps have to be performed successively. In addition, an error in the chain will affect the following process resulting in a ripple effect.

For each operation, a clear description of the processes will be developed. Several interviews with the different operators allowed risks to be identified in the different operations. Those will be fully explained and described further. The multiple processes for the proper running of an event are crucial and complex minor errors could result in major consequences. Those will be fully analyzed in the following sections.

In order to identify and develop the numerous risks, four interviews have been conducted. Thanks to the employees' experiences, the different risks were easily detected. Each interviewees provided the same results for each process.

In order to have a better visualization of the various processes, a diagram is displayed in the Figure 6.

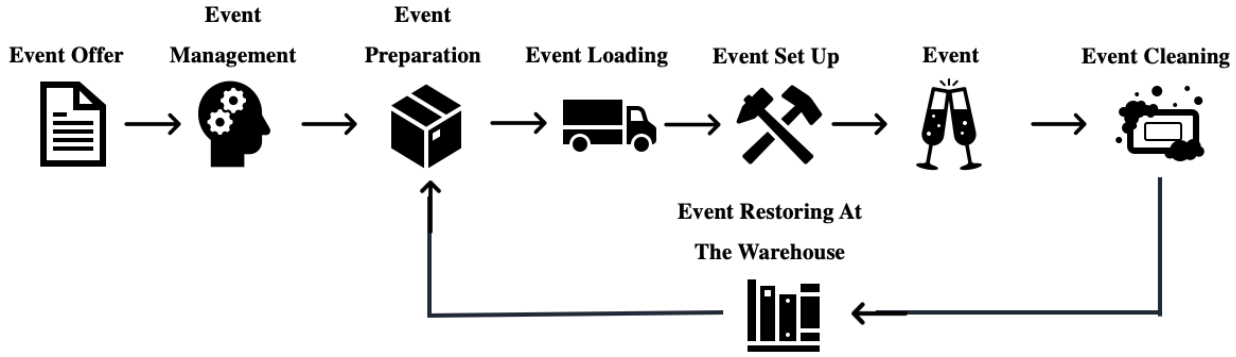

Figure 6: Diagram of Eating Point's Processes

3.2.1 Event offer

Most clients are companies. Eating Point mostly offers its services to corporate events rather than private clients. Indeed, the company prioritizes Business-To-Business (B2B) operations. Their concepts are tailor-made for corporate events. The company includes a sales team composed of several sales vendors whose mission it is to look for new clients and promote events. Each vendor contacts his own customer list and he will be held responsible for performing the whole sales process: from finding the client to contracting an event.

Prospection is operated through several communication channels such as social networks (LinkedIn, Facebook, Instagram), cold calls, the website but also word of mouth. Eating Point has various strong relationships with several companies they conducted several events with (e.g.: Loreal, Euro&Cap, Deloitte and many more) . The company also contracts with venues in order to benefits from a certain exclusivity (e.g.: Quartier Papier, Docks Dome, Atomium, Bozar, ArtCube and many more). For example, the Atomium only partners with a few catering companies and Eating point is one of them. One last strong relationship Eating Point is caring is with event organization companies such as "VO Event".

Once the connection with the client is established, there will be discussions in order to organize the event. The date of the event has to be defined initially. Successively, the following requirement to decide is the location for the event. The client either prefers to do it at his company headquarters or chooses one of the venues offered by Eating Point. As mentioned in the company description, one of the biggest advantage is that Eating Point can work in almost any place that benefits from electricity. Another thing to define with the client is the type of event he wishes to offer: a full event with starters, food and bar or a single bar only. There are countless options. The number of guests is also crucial to determine and will determine the logistic. Lastly, the times at which meals will be served must be decided.

The sales person will sum up the different information into a document that he will provide to the event team. The communication is quite easy due to the proximity as they work in the same open-space. They also share online files to centralize all the information.

Risks identified

- Timings frequently changing before the event: The timings are frequently changing after the initial offer. This typically has to be decided with the event manager at the very last moment. The event manager calls a few times before the event to ensure the timing is approved.
- Errors in the document: The products mentioned in the contract are occasionally wrong. The client often changes the menus or the number of guests. It sometimes happens that the sales manager makes errors. There are various example of mistakes such as wrong number of

guests, wrong address of the venue but these inaccuracies are rapidly identified by the event manager and easily monitored.

3.2.2 Event management

Once the required information for the event is defined, the organization of the event will be initiated by the event manager. To conduct one event, several types of people are necessary, from the suppliers to the students serving during the social gathering. It would be important to opine that Eating Point does not produce any consumables. The firm primarily relies on different suppliers for the food and the beverages. For example, they built a trusted relationship with ”Great Traiteur” which provides most of the food Eating Point serves on its event. The event manager then contacts the different suppliers to collect and gather the different elements desired by the client.

Once the service schedules are defined in agreement with the client, the event manager will establish the shifts required to ease an effective running of the services throughout the event (Figure 20).

The event manager will then communicate with a ”Maitre d’Hotel”. The former is the liaison with the client and is responsible for the event itself. During the social gathering, he will be the main point of contact between the students serving and the guests. The ”Maitre d’Hotel” will have to coordinate the service according to the schedule previously determined.

Then, the event manager will contact the students performing the service during the event. The services processes are readily accessible and do not require any experience. Therefore, Eating Point has an extensive Facebook group centralizing over 500 students available to serve on an event. The event manager will post the different shifts needed and students can apply for them on the Facebook Group.

The event manager is also in charge of setting up the material list encompassing the different tools required for the event (Figure 17). This list will be provided to the warehouse manager to perform the event preparation.

Risks identified

- Unavailable students: Students are occasionally unavailable for various reasons. An obvious example would be the period they are usually completing exams. Students are not always available. Those issues are thankfully easily monitored and resolved by calling other companies such as ”Mise en place”. This partnership allows EP to benefit from additional experienced students.
- Suppliers making errors: Suppliers sometimes are making mistakes. ”Great Traiteur” would be a figurative example. They sometimes fail to produce the quantity agreed upon due to internal errors on their part. Another example would be a supplier delivering the wrong product. This type of error is rare but the impact is considerable as EP is unable to provide the quality service contracted.
- No Maitre d'Hôtels available: There are only six Maitre d'Hotel and all of them may occasionally be unavailable. However, the event manager can fulfill this duty if needed.
- Wrong material list: Material lists are created by the event manager and some materials may sometimes be missing. It happens more frequently when the client asks for specific product. However, this error is rapidly identified by the warehouse manager during the preparation process.

3.2.3 Event preparation

Once the warehouse manager receives the list of material for the event, the event preparation may begin. Thanks to the file provided by the event manager, the warehouse manager lies responsible for the gathering of the different tools needed for the event. The different materials are put into blue boxes (Figure 21) and then on red roulettes (Figure 7).

Figure 7: Example of a pile after the preparation process

Figure 8: Example of a package ready for an event

Eating Point owns a warehouse located ”rue de Theux” in Brussels. This storage stocks two types of materials: consumables and reusables (/washables). ”Chaffen dish” (candles that allow to keep the plates warm) are an easy example for the consumables . Those are essential on most events. Therefore, the replenishment of those articles is crucial. A saucepan is a speaking example of a reusable material, as it can be uses indefinitely. Eating Point uses a variety of utensils, therefore possessing a wide inventory.

Once the event preparation is completed, the event manager places the materials somewhere in the warehouse, ready to be loaded in the van (Figure 8).

Risks identified

- Consumables on stock-out: Consumable materials are often on stock-out. Tissues would be a visual example for a consumable. Those are required on each event and company often runs out of this kind of materials.
- Omission of materials during the preparation: The preparation process is performed by students. Their job is to prepare the package before the loading. Unfortunately, they often forget important materials in the preparation.

3.2.4 Event loading

This process is one of the riskier in terms of physical damage. The material is stored into blue boxes and then stacked on red wheels. Those heavy piles can weigh up to 150 kilos. Any minor issue can cause dramatic injuries. Therefore, the loading is a highly risky process. The warehouse manager straps the piles into the van. This operation has to be effective in order to avoid a blast during the transportation.

Risks identified

- Damage during the loading/transportation: The loading is a risky process. The piles are set up on highly unstable wheels. This step of the chain is performed by experienced students.

- Loading of the wrong material: Loading the wrong preparation package can be highly dangerous for the company as this error affects two events (both the one that has the wrong materials and the one missing its materials). Each event has a completely different package and a mistake in the loading process can be dramatic.

3.2.5 Event set-up

The unloading of the van at the event location is the responsibility of the ”Maitre d'Hotel”. He coordinates the set up of the equipment at the venue. The reception area is built up with the different counters. At the same time, the ”Maitre d'Hotel” will coordinate the back-office installation in order to efficiently run the event. As previously mentioned, Eating Point primarily serves its bites and drinks on counters. Those are the first ones to be arranged.

Eating Point mainly offers dishes packaged into vacuumed plastic bags. This appears highly unattractive although it has proven to be the best conservation method in order ultimately keep the most nutrients and flavor. Those packets are put into boiling water for an hour before the service. The company uses bain-marie but the water needs an hour to reach 100 degrees. Therefore, the bain-marie needs to be connected to the electricity at least two hours before the beginning of the service. The bain-marie are placed into the counters (Figure 2) and thus must be built first.

Although it appears easy to always serve cold drinks, this element may present several challenges. They are refreshed by dint of ice for an hour before the beginning of the beverage service. Glasses must be set up on the counters and their fragility involves additional risks.

The back office can be compared as the heart of the event, as most of the important duties are performed in this space. The ”Maitre d'Hotel” spends the most of his time in this area.

Risks identified

- Set-up taking more time than expected: Sometimes, the set-up time may last longer than planned. This can cause a serious delay in the event. The guests are expected on a fixed time and Eating Point must serve according to the timetable contracted. Although the impact

of this error is quite dramatic, its occurrence is occurs infrequently. is twice higher than its occurrence.

- Issue at the venue: There is a wide range of issues that may occur at a location. An example would be a problem with the electricity.
- Broken materials: During the set-up at the venue, the different materials are tested in order to rapidly notice the potential issues. This type of error is monitored due to an early identification.

3.2.6 Event

The beginning of the event is arguably one of the most stressful moments. The entirety of the services have to be ready on time. The guests arrive and enjoy the different food platters and/or the beverages. The students must be careful while setting up the meals in the plates. The ”Maitre d'Hotel” is responsible for identifying any errors or default.

During the event, the stocks must be regularly checked in terms of quantities. Eating Point offers all-inclusive packages meaning that stock-out cannot happen. In case of emergency, stocks are accessible at the warehouse and the ”Maitre d'Hotel” can easily send a student to pick up the missing components. However, those decisions must be anticipated.

Risks identified

- Inexperienced students and inactive: The students are paid hourly and some of them may not find any motivation to perform well. However, the company implemented a student's rating defined by the manager on the venue which forces the students to be efficient.
- Quality not responding to the client's expectation: The service offered by Eating Point may not always reach the client's expectations. Therefore, the Maitre d'Hôtel is responsible about the client's satisfaction.

- Shortage of food or beverages: The different packages offered by the company are All-inclusive packages. This means that stock-out can not happen on any event. Therefore, the ”Maitre d’Hôtel” regularly checks the stocks and send a student to the warehouse to pick up the missing components if needed.

3.2.7 Event cleaning

At the end of the event, the ”Maitre d’Hotel” starts to organize the cleaning process which may begin before the last guest leaves the venue. Anticipation is key to perform this duty successfully.

Many tasks must be performed before the loading of the materials in the van. Firstly, the dishes have to be washed and so does the materials. After cleaning the different equipment, it is stored back into the blue boxes and stacked on red roulettes.

Once the van is loaded with all the materials, it can be driven to the warehouse. This moment symbolizes the responsibility handover from the ”Maitre d’Hotel” to the warehouse manager.

Risks identified

- Omission of materials at the venue: The cleaning has to be rapidly performed. The venue waits for the catering company to quit the location as soon as possible. Therefore, materials may sometimes be forgotten at the venue. However, it remains inexpensive to ask a student to execute the journey back to pick up the equipment left on site.

3.2.8 Event restoring at the warehouse

The warehouse manager is in charge of cleaning the last materials if needed at the headquarters. Restoring the different reusable equipments into the warehouse will also be performed. This represents the end of the chain for the event. The materials are then placed in the inventory and can be used for a following event.

Risks identified

- Materials not intact restored in the warehouse: While cleaning the event in the warehouse, the different equipment have to be restored at their locations. However, broken materials can be lost in the inventory and may cause issues on the next event. This type of error is frequent but easily monitored by the warehouse manager during the following preparation process.

4 Literature - Quality improvement Managements

Now that the supply chain of the company and its processes have been fully developed, we can look into the supply chain literature. This master thesis is based on the quality improvement of a supply chain. This chapter's purpose is to review the different management methods that can prove to be useful for a catering company in terms of quality improvement. The different theories will be developed through various references in order to have an objective vision of the methods of management.

Indeed, Eating Point is young catering company. Their supply chain is still by hand operated. They do not have a clear focus of an effective supply chain management. Therefore, the literature about quality improvement management is necessary for future improvements and developments. The theory will help the company for a more efficient management with standardized methods. This can initiate the reflection about the redesign of their processes.

Four different methods of management will be analyzed: Total Quality Management (TQM), Lean Management, Six Sigma and Lean Six Sigma. These methods all have singularities. Total Quality management mainly focuses on the final customer and includes every stakeholders in the process improvement. Six Sigma concentrates on high quality levels. Lean Management differentiates from the others with its willingness to reduce the avoidable and unnecessary work. At last, the Lean Six Sigma appears as an effective mix of the last two philosophies. Those four methods of management are the most used in term of quality improvement in the supply chain. In addition, those managements complement each other by their different points of view.

4.1 Total quality management

The Total Quality Management is a continuous improvement management. This approach includes all the different stakeholders within the enhancement process. The mission is to respond perfectly to the customer demand (Othman et al. (2019)).

The Total Quality Management (TQM) was initiated by Walter Shewart in the 1920s (Othman et al. (2019)). TQM was introduced in the US by Deming (1986) but his principles were better supported by the Japanese than the Americans because of their national culture to accept novelty (Galperin & Lituchy (1999)). The Japanese firms were far more collectivist and cohesive than firms in different countries. TQM can be better interpreted by countries with less individualistic mindsets. They focused on the quality at all levels within the organisation. The quality had four evolutionary phases which are inspection, quality control, quality insurances and then TQM (Othman et al. (2019)). According to Topalovic (2015), TQM aims to ensure a total customer satisfaction.

Let's define at first what the quality of a product is. According to Oakland (1992), this aspect represents how a product can best meet the customer expectations. Reliability can be compared with quality. For example, Volkswagen is often pictured as a guarantee of quality because of its reliability (Oakland (1992)). This can also be defined as the ability for a product or service to continue to meet the customer requirements. The level of quality is mostly defined by the customer. However, in several industries such as service, hospitality and many other markets, quality appears more important than price (Othman et al. (2019)).

Traditionally, the quality control is handled by "experts" within the organisation. Quality management can be simplified and seen as the transfer of responsibility of inspection from the customer to the producer (Oakland (1992)).

Total quality management (TQM) aims to improve the effectiveness and flexibility within an organisation (Oakland (1992)). The singularity of this method is that it implies every level, department and person within the business. In order to operate an effective TQM, each sector of the organization must be involved. TQM aims to reduce wasted effort to improve people's lives and improve the whole effectiveness of the work. TQM's techniques can be used into every part of the organisation such as finance, marketing, development, HR and every activity within the company (Oakland (1992)).

The start of the TQM implementation should begin at the top-level with the Chief Executive Officer or an equivalent. The middle management has a key role because they have to grasp the concept but also explain the new methodology to their subordinates. Furthermore, they must ensure that all

employees remain committed. The middle management must also motivate the lower levels with the use of reward and recognition for their efforts (Oakland (1992); Galperin & Lituchy (1999)).

TQM is composed of several key elements being (Fotopoulos & Psomas (2010)): focus on customer, continually increase customer satisfaction, continuous reduction of real costs, systematic approach, horizontal integration of functions and classes, participation of all employees, inclusion of supply chain and customer chain. In addition, Agus & Z. (2011) have selected five key elements for efficient TQM practices: supplier relations, benchmarking, quality, measurement, continuous improvement. The fact that adding the customer in the chain is necessary because its needs should be completely fulfilled. The full business should understand the customer needs by training the staffs, employees and the stakeholders.

According to Sashkin & Kiser (1993) & Galperin & Lituchy (1999), in order to effectively process a Total Quality Management, some core values are needed for an effective implementation:

1. The quality of information will help improving quality and not judging or control people
2. The authority should be equal to responsibility
3. There should be rewards for results
4. There should be cooperation and not competition for working together
5. The employees must have secure jobs and not be afraid of being laid off
6. Install a climate of fairness
7. The compensation should be equal
8. The employees should have an ownership stake

An organisation aiming to improve quality typically tries to reduce defect. A filter is used to inspect the production and divide the failures into two categories: internal and external errors. The external deficiencies are the ones reaching the customer and cause complaints. On the other hand, the internal failures are the ones that can be reworked and rechecked. The top management must

decide where to place the detection filter: high internal and low external failure or low internal and high external failure (Oakland (1992)).

Control mechanisms can be divided into three main categories: before the act (strategic plans, action plans, budgets, job descriptions, individual performance objectives, training), operational (observation, inspection and correction, progress review, staff meetings, internal information, training programs), after the act (annual reports, variance reports, audits, surveys, performance review, evaluation of training) (Oakland (1992)). Most companies only use ”after the fact” mechanisms control. This causes managers to take reactive response rather than a proactive position.

To integrate TQM, the mindset must be turned on quality. The company has to improve the quality by imposing more quality check even if the profit will be impacted. It is important to set barriers to reduce the defect rate. The staff must be trained to identify defect, find the cause and solve it (Oakland (1992)).

An external control system is highly efficient because of its objective vision of the situation. The objective is to make everyone accountable for their performance (Oakland (1992)).

4.2 Lean Management

The goal of Lean management is to produce the appropriate quantity of production, thus avoiding waste as much as possible.

This method of management was first introduced in Japan in the Toyota factory (Holweg (2007)). Consequently, its first name was TPS (Toyota Production System). During to World War II, resources became scarce and Sakichi Toyoda, founder of TPS, decided to produce as little waste as possible while optimally and efficiently using all resources. The term “Lean” was initially used by Womack & Jones (1996) in the book “Lean Thinking” in 1996. Pepper & Spedding (2010) formalised the practices into a book for a better accessibility to the large public. The term Lean is an extension of the TPS by its wide vision of the company with a focus on “the product development process, the supplier management process, the customer management process, and the policy

focusing process for the whole enterprise" (Holweg (2007)).

Toyota production system aims to achieve JIT (just-in-time) production and uses demand as driver for the production. The forecasts originally lead the production without taking the real demand into account. On the other hand, the Lean management follows a bottom-up system and a demand-driven production (Bhasin & Bhasin (2015)).

At first, lean management was applied to large manufacturing factories involving high volumes and low-variety facilities (Pepper & Spedding (2010)). After the success of lean at Toyota, US automotive manufacturers began to consider this new method of management. This was the introduction of the lean culture into the Western companies. The reason of this sudden change was that they were competitor of Toyota. In addition, the market was massively growing with an increasing demand for wider choice in product portfolio's (Pepper & Spedding (2010)). During the years 1968 and 1978, the US productivity grew approximately 23.6 percent in comparison with Japan that faced a 89.1 percent increase (Teresko (2005)). An example would be Chrysler. They trained the lean philosophy in-house to their stakeholders (suppliers, employees, etc.) to improve the full capacity of the chain. It increased the full potential of every part of the group (Pepper & Spedding (2010)).

Applying lean principles to job-shop companies happened after. Companies with high-variety or low-volumes began to pay interest to this management's method (Irani (2001)). Job-shops companies face the hardest obstacles when trying to map or analyze the flow of the 100-2000+ products through the facility (Irani (2001)). The only viable way is to use powerful algorithms or IT softwares. Another issue is that the standardisation appears complex when the "jobs" are different. Each products has its characteristics which makes constraints on the production. Lastly, smaller firms do not benefit from the same resources than bigger companies. Their supply chain are mostly inflexible (Bamber & Dale (2000)).

In order to achieve better performance and efficiency, Lean management reduces waste and identifies three broad sources of waste: Mudas, Muris and Muras (Bhasin & Bhasin (2015)).

Mudas are any type of waste that does not bring value to the final product. There are seven different Mudas: (TIMWOOD) (Bhasin & Bhasin (2015))

- Transport: decrease any avoidable relocation. The products transportation has to be optimized in a way to reduce total amount of shipments. This waste represents the movement of products in between the processes. In this way, the different operations have to be located close together (Tony (2019)).
- Inventory: reduce any inventory "waiting" to be processed. This represents the products sitting and taking space within the factory. Having inventory increases the risk and proves to be costly. An important gain would be to have just as much inventory as is required. The company has to adjust the production in order to have a smooth flow of labor. Another proposition would be to use the first-in-first-out principle (FIFO) (Tony (2019)).
- Motion: avoid unnecessary motion of people/equipment. The work space has to be optimized to reduce unnecessary movement of employees. The different workstations must be redesigned in order to prevent excessive walking, motion and movement (Tony (2019)).
- Waiting: avoid any interruption/waiting time in the production line. Products waiting represent an increase in inventory and this is highly costly. The reason for such waste is a variation in the machines/workers. The system must have a smooth workflow and trusted materials/employees/suppliers (Tony (2019)).
- Overproduction: avoid production ahead of demand. Unsold items are also a part of the costly inventory. The companies like to produce big batches at low costs but this results in high expenditure. Companies prefer this type of production because this decreases the risk in case of a breakdown. Nevertheless, Lean advises to produce smaller batch size and create more reliable processes. An establishment of stable work schedule is also crucial (Tony (2019)).
- Over Processing: avoid unnecessary process (resulting in poor tool). This represents the overtime and effort in a product that the customer did not request. The company has to

standardize the best techniques for workers while setting acceptable quality standards (Tony (2019)).

- Defects: avoid trying to fix defects. When a defect takes place, the cost is not only located in the product itself but also in the replacement in the chain of the defecting process. To decrease the defects rate, the company has to perform several steps. At first, the employees have to be adequately trained and skilled. Secondly, the factory has to improve the processes to furnish to capable supplier (Tony (2019)).

The Muris represent the overwork on workers, equipment and stocks due to poor organization. For example, using a machine more than advised can damage it in the long term. Moreover, by asking a worker to perform overtime work, the company may lose its employee due to the psychological damage, which potentially could lead to a burn-out. In conclusion, Muris are considered poor management and thus demanding extensive performance from a department (Bhasin & Bhasin (2015)).

Muras consider the variability and the unpredictability of the workers, machines and suppliers. Workers do not always perform tasks the same way and at the same speed. Furthermore, machines may stop and break at unexpected times. In addition, suppliers are not always reliable. Thus, the management team must seek to reduce this variability and fluctuation (Bhasin & Bhasin (2015)).

Lean Management is based on several tools needed to physically implement the methodology. The TPS relies on continuous improvement. Firstly, the 5S are the sources of loosing efficiency. The 5S are seiri (sorting), seiton (tidying), seiso (cleaning), seiketsu (standardization) and shitsuke (respect). Those are think tanks in order to enhance the company situation (Pepper & Spedding (2010)).

Secondly, we can use the value stream mapping (VSM) which analyses the flow of production and may point out the trigger points that need fixing (Pepper & Spedding (2010)). This gives a reliable qualitative analysis tool. This will give the current position of the situation and can be used to develop and define the future desired state. This can be seen as the guide to achieve the lean management strategy (Pepper & Spedding (2010)). The VSM is used to provide a common language

for the different manufacturing processes. This tool also gives the different lean techniques. This is the only one providing a good link between information and material flow. Nevertheless, VSM also suffers from certain critics. According to Sheridan (2000), VSM, with its paper and pencil approach, presents limits. Drawing the system on paper will abduct details that have their importance in the system. Using software can offer the possibility to considerably increase the amount of data with frequent updates. Plenty of VSM software exist on the internet (e.g. eVSM). This gives a dynamic vision of the system and a ”real-time” perspective. The software allows to see the future effects of the improvements on the system. This will bring an increase in the flexibility and the information available to the stakeholders (employees, suppliers, customers). This ”live” simulation is the biggest advantage of this kind of tool because complex analysis such as physical simulation modelling would last about several months to complete (Pepper & Spedding (2010)).

Lastly, the KPI (key performance indicators) are used to indicate the performance of the departments as well as the reactivity of the improvement (Bhasin & Bhasin (2015)).

4.3 Six Sigma

Six Sigma was originally found at Motorola thanks to an engineer, Bill Smith (Brady & Allen (2006)). The popularity of Six Sigma drastically increased due to the work of Jack Welch (CEO of General Electric (GE) in 1995). He studied Smith's approach and championed the Six Sigma methodology in GE (Black & Revere (2006)).

Practically, Six Sigma designates the rate of defect within a system. Using statistical techniques, this method gives an approach to improve the process to reach a defect rate of 3.4 defects out of one million, or Six Sigma (Brady & Allen (2006)). Pande et al. (2000) presented concrete examples to demonstrate the difference between Six Sigma and 99 per cent quality. For example in a post company, for every 300 000 letters posted and delivered, 3000 will be misdelivered with the 99 per cent quality. In comparison, the Six Sigma only approximately reaches one defect. Another useful example would be at television stations. With the 99 percent rule, the television would be on dead-air during 1.68 hours each week in comparison with 1.8 seconds if working at the Six Sigma

level (Pande et al. (2000)).

The main objective of Six Sigma is to provide a structure to perform a process improvement. This method is more detailed than the Deming's plan-do-check-act cycle. The Six Sigma rule uses a five stage cycle composed of define-measure-analyse-improve-control (DMAIC) (Pande et al. (2000))(see section DMAIC). Each step of this cycle encompasses tools and techniques to provide the user an extensive range of techniques aiming to bring the system under control (Keller (2005)).

Six Sigma needs to be seen as an evolution. McAdam2004 & Lafferty (2004) proposed to analyse the Six Sigma as a "continuous improvement management philosophy". This method does not yet replace the TQM but the focus is on the mechanised and physical side of it (McAdam2004 & Lafferty (2004)).

The work of Joiner (1994) can be pointed out, and more precisely the Joiner Triangle (Figure 9a). Originally, the Joiner Triangle was equilateral, showing the correlation of the core elements of the "fourth generation management". Nevertheless, on Figure 9b the triangle becomes skewed because of the TQM philosophy mainly focused on the organisation's people behind total quality. The circle represents the link that holds the three angles together. It was under estimating the people side. On the other side, the Six Sigma (Figure 9c) skewed the triangle on the opposite direction in such a way that the scientific approach is emphasized (Pepper & Spedding (2010)). The solution here would be to create a coherent system with an equal growth on each side of the triangle. As the Figure 9d, it represents the target of a healthy growth with continuous improvement returning on the original Joiner Triangle. The growth must be equal in the three dimensions.

Six Sigma can be widely applied. This method was used in a variety of industries such as the manufacturing sector as Motorola and GE (Pande et al. (2000)) but the construction industry was also a fertile ground (Stewart & Spencer (2006)). Accounting practices also used this technique (Brewer & Bagranoff (2004)). The last industry which is using more and more the Six Sigma is the service sector (Sehwail & Deyong (2003); Antony (2006); Chakrabarty & Tan (2007)).

Six Sigma can be successfully implemented thanks several factors which are mainly management commitment and open communication (Pande et al. (2000)).

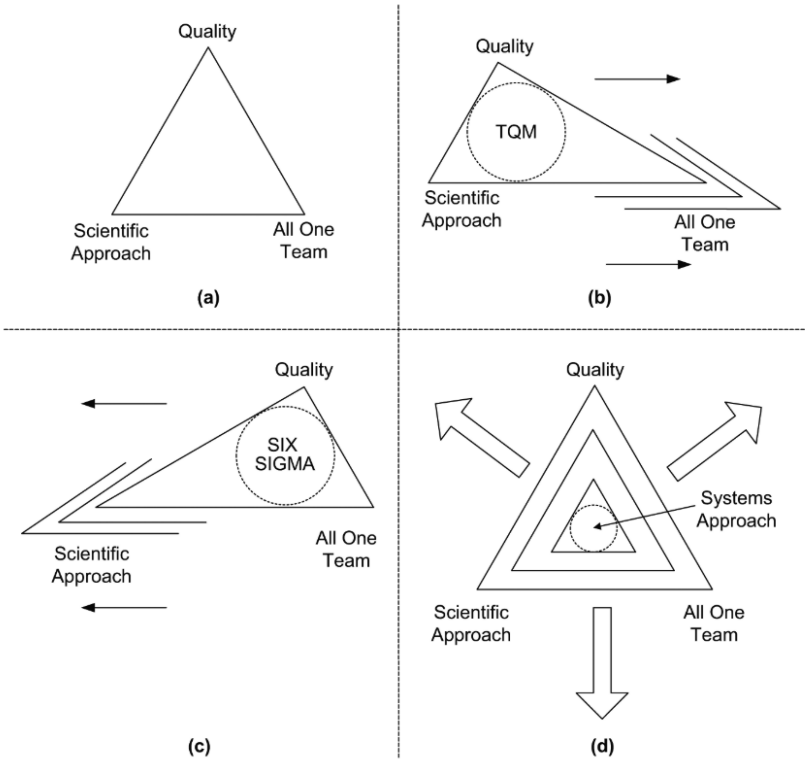

Figure 9: Joiner Triangle (Joiner (1994))

The main risk of Six Sigma is to be incorrectly used and being oversold.

4.4 The Lean Six Sigma

The basis of the lean thinking was found in the Toyota production system and popularized by Womack & Jones (1996) in 1996 (Pepper & Spedding (2010)). As mentioned in the previous section, this method of management was created after World War II because of the scarcity of the resources. The main objective was to reduce the waste at his maximum. We can define the waste as “anything other than the minimum amount of equipment, materials, parts, space and time which are absolutely essential to add value to the product” (Russell & Taylor (2000)). On the other hand, Six Sigma is a philosophy with a high-quality focus within an organisation.

The term ”Lean Six Sigma” represents the combination of these two philosophies (Sheridan (2000)). The Six Sigma method provides tools and know-how to complement the Lean philosophy (Wheat

et al. (2003)). Six Sigma mainly focuses on the standard variation but not on the customer requirements . They both focus on a continuous improvement at all levels of the organisation. They furnish more ownership of their processes to employees. If these two philosophies are implemented separately, this can create two subcultures within the organisation (Harrison (2006); Smith (2003)).

Sharma (2003) advised to use Six Sigma methodologies to help the implementation of Lean within an organisation. This needs to be driven by a strong approach to sustain the strategy direction and focus on the business. Theses two management's method aims to achieve an improvement in quality destined to any kind of industries such as service, manufacturing and more.

As a conclusion, the Lean and the Six Sigma paradigms are two useful stand-alone philosophies. Nevertheless, implemented together they can be used as a very powerful tool. The culture focus of lean aligned with the data focus of Six Sigma can create a sustainable growth for an organisation. Performing a reduction in inventory (Lean philosophy) combined with a decrease in variability (Six Sigma philosophy) would be a great example of a successful Lean Six Sigma implementation. Lastly, if Lean is implemented without the Six Sigma, the lack of tools will be visible. On the other hand, if Six Sigma is implemented without the Lean thinking, there would be a lack of strategy or structure to drive the improvement process.

4.5 Conclusion

The four methods of management differ from their distinct point of view. The main advantage of the Total Quality Management is that it includes all the different stakeholders in the improvement process. Its mission is to perfectly respond to the customer demand. The Lean Management has the same objective with a special focus on reducing the waste as much as possible. The Six Sigma differs by its scientific approach. The main objective is to operate with reliable processes with an impressively low-rate error. The Lean Six Sigma is the combination of the two methods of management. Implemented together is more effective than separated. There are no approach better than another. However, the main specificity for each can be useful in terms of quality improvement for the solutions of the various issues.

5 Literature - Tools

The different methods of management have been previously developed. Tools are required and will guide the project all the way. They will serve as the baseline of the further analysis of the risks. In addition, the tools will aid the implementation of the various solutions.

In this chapter, different tools will be provided to help with the improvement of the operations: PDCA, DMAIC improvement process, ISO9000 and the Ishikawa diagram. These different tools will be useful to implement the improvement of the processes. Lastly, the Risk Matrix will be provided to allow risk categorization for the various dangers identified in the third chapter.

The five tools mentionned previously encompass effectively the need of this thesis. The three first ones are focused on the implementation, and the next two target the problem/risk analysis. In addition, various references will be used in order to have a complete and precise guide.

5.1 The PDCA method

The PDCA finds its origin with Dr. Edwards Deming's lecture in Japan during the year 1950 (Moen & Norman (2009)). The PDCA terms are coming from the "Deming wheel". Lots of ideas and variations emerged from Deming's lecture regarding the PDCA method. The PDCA cycle comes from the Shewart Cycle in 1939. The straight line of Deming were composed of the four following steps: 1) Design, 2) Produce (make it), 3) Sell with a fourth step which was 4) Redesign through marketing research. Deming insisted on the fact that this was a constantly rotating cycle (Moen & Norman (2009)).

Deming Wheel	Japanese PDCA Cycle
Design	Plan
Production	Do
Sales	Check
Research	Act

Table 1: Deming Wheel and PDCA

As we can see on the Table 1, Imai (1986) modified the Deming's Shewart cycle to join the PDCA cycle by changing the name of the four steps. We thus arrive on the PDCA cycle today known as in Figure 10.

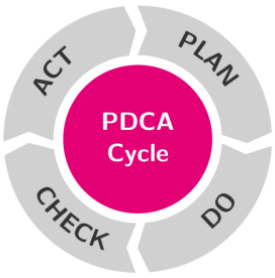

Figure 10: PDCA Cycle (Imai (1986))

The PDCA cycle is composed of the four next steps:

5.1.1 Plan

The first stage is the planning phase. This stage aims to identify and define the changes that will occur. This phase must be fully complete and highly detailed. The expectations have to include details in order for every stakeholder to comprehend it. Everyone has to know and understand the current and future situation (Moen & Norman (2009)).

5.1.2 Do

The Do phase is the application phase. This is the moment we apply the modification. The transition must be approved by every stakeholder. This stage is mostly launched with a test phase sample before a large scale project (Moen & Norman (2009)).

5.1.3 Check

This stage aims to analyze the results of the application of the change. This has to define whether the modification improves the previous position or not. This stage will help to enhance and understand the transformation in a better way the effects. The data gathered will be compared to the forecasts (Moen & Norman (2009)).

5.1.4 Act

The Act stage can also be called the ”Adjust” phase. The process improvement will take place and the modification will ask some arrangements to work optimally. If the change is less than optimal, the modification may be abandoned and the cycle again can be once more performed (Moen & Norman (2009)).

5.2 The DMAIC improvement process

Within the Six Sigma concept, various methods of quality improvement are performed and the two principles are the DMAIC and the DMADV (Kumar & Sosnoski (2009)). DMAIC is an acronym for Define-Measure-Analyze-Improve-Control. On the other hand, the DMADV is an acronym for Define-Measure-Analyse-Design-Verify. However, the focus of this thesis will be on the DMAIC improvement process. This method can be compared with the PDCA because it is based on the Deming cycle (Smetkowska & Mrugalska (2018)).

5.2.1 Define

This stage aims to set the goals and the requirements. It needs the definition of the resources and the responsibilities. The organization structure has to be favorable to achieve the goals. The date of the end of the project must also be set. This phase aims to identify issues and problems to solve

with a clear management supervision. A useful tool to use would be the Pareto diagram to help narrow the problem. This diagram identifies the root causes and their impact in order to identify the biggest ones (Shankar (2009)).

5.2.2 Measure

The focus of the measure stage is on the collection of the information on the processes that need to be improved. This phase is data focused. It would be necessary to check if the amount of data is sufficient. The documentation on the current effectiveness is crucial to perform comparative tests. Gathering the information will help give a better understanding of the processes in organisation, customers' expectations, suppliers' specifications and all locations where a problem may occur. The creation of a process map would help to identify the possible risks. The main issue about this stage is to collect meaningful and proper information to help with the process improvement (Shankar (2009)).

5.2.3 Analyze

The analyze phase aims to determine the root causes of the process imperfections while proposing solutions for improvement. Identifying the problem is important in order to define the road ahead. The objective is to define the process capability in order to determine achievable goals. In this stage, an estimation of the resources required to achieve the target will be defined. The obstacles toward the target also have to be defined. To sum up, this phase aims to identify the gap between the current performance and the target accomplishment (Smetkowska & Mrugalska (2018)).

5.2.4 Improve

This is the implementation of the process improvements. It aims to eliminate the imperfections. This phase will develop and test possible solutions and select the best one. This stage is also meant to define the implementation of the plan. This phase can be seen as the action plan in order to

improve the current situation of the organisation. It typically requires a pilot solution to confirm the effectiveness and the validity of the solution to perform adjustments before the application on a large scale Smetkowska & Mrugalska (2018).

5.2.5 Control

This phase aims to monitor the results continuously. Standardizing the process improvements will help the enhancements' control. This stage will demonstrate the efficiency of the improvements. Control systems should be implemented to prevent any deviation from the original target (Smetkowska & Mrugalska (2018)).

5.3 ISO 9000

In the 1990s, the International Standardisation Organisation provided standards for an efficient quality assurance system. These measures are called the ISO 9000 standards and were initially created for manufacturing processes. The situation has changed and they are now used for different types of industries such as health care organisations, nuclear medicine and many more. As developed in the ISO 9000, a quality assurance system is based on three main characteristics: (Geraedts et al. (2001))

1. The focus is on the process itself and not on the final outcome.
2. The utilization of a systematic approach is required. The means that the process measurement are based on a regular basis with the usage of performance indicator.
3. The system in its entirety has to be fully documented in records describing the different processes and standard instructions. These reports must be frequently updated in agreement with the standards for document control. Any change or improvement of a process requires an update in the document.

Using the ISO 9000 standards has several benefits. Firstly, the processes within the organisation are more transparent because of the full documentation. Another benefit is that in order to maintain a valid ISO 9000 certificate, the organisation has to perform audits from internal and external auditors periodically. Secondly, the document control procedure is strict to have an efficient ISO-quality system. This accounts for a fully detailed heavy process as well as efficient in quality levels for all types of industries. Even the ”heaviest” ones such as nuclear medicine use this standard (Geraedts et al. (2001)). The ISO 9000 asks for frequent update and continuous improvement based on performance indicators (PI's). The company has to determine those and set minimum standards that must be acceptable and reasonable. The PI's need to be regularly monitored and checked (Deeb & Iung (2006)).

5.4 Ishikawa

The Ishikawa diagram, also called the Fishbone diagram due to its shape, helps to identify the root causes of a problem. The model aims to understand the likely causes and their effect on an event. An example of a diagram is provided in the Figure 11. This graph helps to achieve an efficient visualisation of the situation. The diagram is based on the identification of the first causes of the problem in order to find the root causes for each (Jayaprasad et al. (2018)).

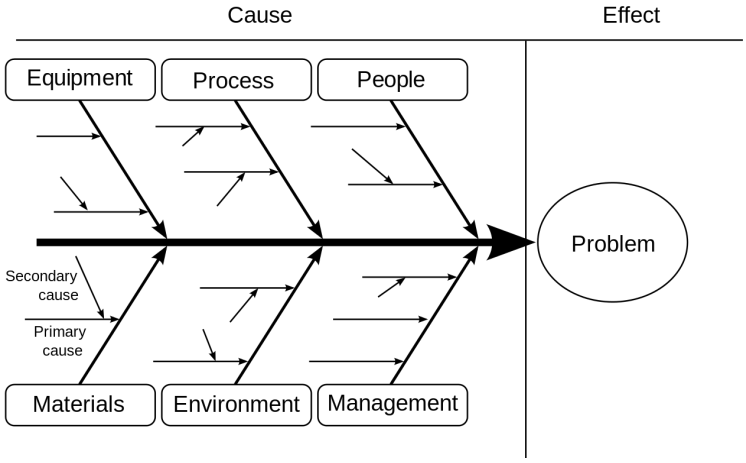

Figure 11: Ishikawa Diagram (Moperto (2009))

The six main pillars on which the diagram is based are 'equipment', 'process', 'people', 'materials', environment' and 'management'. Those are the main root causes to a problem (Besterfiel (2011)).

5.5 Risk Matrix

A risk matrix is a matrix allowing a certain categorization of the different dangers identified. The risks are divided into different levels by considering the probability of occurrence and the severity of the impact. This type of matrix offers visibility regarding the different hazards within an organization (Qazi & Akhtar (2020)).

The probability of occurrence/likelihood can be separated either on a continuous axle or on various levels such as "very likely", "likely", "possible", "unlikely" and "very unlikely". This classification can be repeated on the second axis for the impact with either continuous estimation or various levels such as "severe", "significant", "moderate" , "minor" and "negligible". The red boxes are considered as the most important risks and thus with a high priority (Ramazanov (2019)).

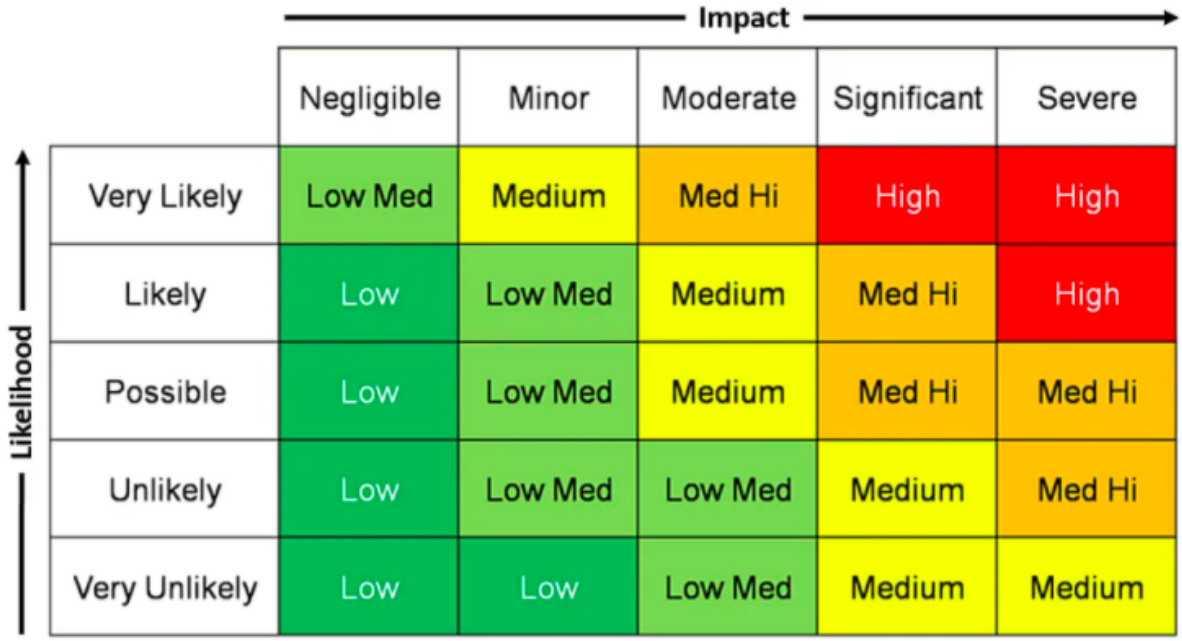

Figure 12: Risk Matrix (Ramazanov (2019))

5.6 Conclusion

In conclusion, the PDCA cycle guide the implementation of a concrete solution. On the other hand, the DMAIC improvement process focus on a quality enhancement from the beginning to the end. This will serve as guide for the whole thesis. The ”Define” stage has been fully developed in the third chapter. The following unit will be the ”Measure” step. The ISO 9000 standards would help the company to monitor its progress. This advises to focus en performance indicator supported by standardized instructions. The Ishikawa diagram will be useful four our problem analysis in order to identify the root causes. Lastly, the risk matrix will help to order and quantify the numerous risks in terms of ”impact” and ”occurrence” (Ramazanov (2019)).

6 Risk Listing and Categorization

The different risks identified in the third chapter can be categorized thanks to the literature. Those risks decrease the whole supply chain quality. They need to be clearly measured and quantified in order to perform an effective monitoring. According to the DMAIC improvement process, the ”Define” stage is fully developed in the third chapter with the risks identification and description. The next phase would be to ”Measure” the risks thanks to two variables further developed.

Firstly, the list of risks is displaying, followed by a risk map. This map categorizes the different risks on two main axis. The main goal is to identify the most important risks in order to focus the section ”Process improvements” on the principal errors.

6.1 Risks Listing

Risk	Risk Title	Impact	Occurrence
1	Timings frequently changing before the event	0,75	1,9
2	Errors in the document (error of menu/PAX/...)	1	3,33
3	Unavailable students	1,5	0,8
4	Suppliers making errors	7	0,4
5	No Maître d'Hotel available	3,5	2
6	Wrong Material Lists	2,8	4
7	Consumables on stock-out	6,2	5,1
8	Omission of materials during the preparation	4,1	4,5
9	Damage during the loading/transportation	5	0,4
10	Loading of the wrong materials	6,8	4,1
11	Set-up taking more time than expected	3,9	2,1
12	Issue at the venue (physical issue, electricity, water, ...)	5,1	1,7
13	Broken materials	3,7	1,2
14	Inexperienced students inactive	3,1	2,4
15	Quality not responding to the client's expectation	4,1	1,2
16	Shortage of food or beverage	4,5	2,8
17	Omission of materials at the venue	1,2	0,6
18	Materials not intact restored in the warehouse	2,1	4,7

Table 2: Risk Evaluation Eating Point

Here are the different risks identified in the 3.2 section describing the processes. The listing will help to categorize the matrix for the next subsection.

On the side of the list, two continuous variables are highlighted: the ”Impact” and the ”Occurrence” for each risk. Those are based on a scale from 0 to 10 and are determined based on the four interviews of Eating Point managers. They currently do not have any clear data to record the different information. However, those are estimations from various stakeholders. Each interviewee had to assess the impact and the occurrence for each risk. The mean for each variables is provided in the Table 2.

6.2 Risk map

The risk matrix is based on two main axes. Those are the variables described in the previous section. The X-axis represents the magnitude of the impact on the company in case the risk happens. On the other hand, the Y-axis represents the occurrence/frequency of the risk (Ramazanov (2019)).

On this map, we can easily identify the three most important risks. When Eating Point equally weights the impact and the occurrence, the highest risks can be easily identified. The first one would be the risk 7 with a mean of 5,65 out of 10. The rating of the 8th risk is about 4,3 out of 10. The 10th is the last major risk, evaluated at 5,45 out of 10 (See Table 3).

In order to perform an efficient analysis, averages with different weights were tested and are provided in the Table 3. In addition, the multiplication between the ”impact” and the ”occurrence” have been calculated in the Table 3. However, after conducting a thorough analysis, the top three risks remain unchanged.

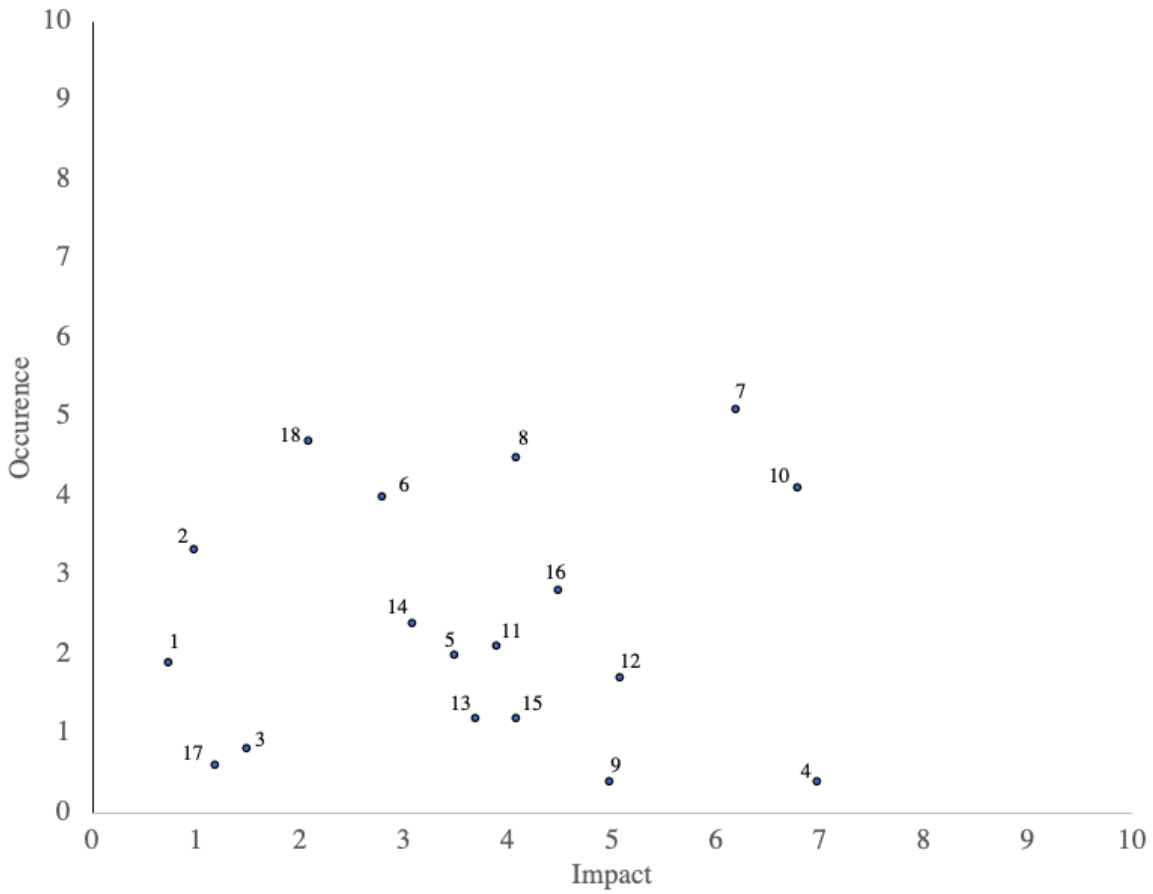

Figure 13: Risk Map Supply Chain Eating Point

In conclusion, we know that the three main risks Eating Point currently faces are the risks 7, 8 and 10:

- **Risk 7:** Consumables on stock-out
- **Risk 8:** Omission of materials during the preparation
- **Risk 10:** Loading of the wrong materials

The next chapter analyses the root causes of those risks and attempts to provide solutions in order to improve the current situation.

7 Analysis of the main risks

The different risks have been previously quantified and measured in terms of ”occurrence” and ”impact”. According to the DMAIC improvement process, we are in the ”Analyze” phase. Therefore, this chapter investigates the three main risks identified in the previous chapter. The purpose of this unit is to breakdown the top three risks and narrow the root causes using an Ishikawa diagram. The literature previously provided demonstrates that this tool divides a problem into six main pillars which are 'equipment', 'process', 'people', 'materials', environment' and 'management' (Moperto (2009)). Identifying these will help locate the main recurrent issues and offer possible solutions. Nevertheless, the company has constraints and the viability of the main solutions will be analyzed further.

7.1 Analysis

We can analyze the three following main risks using the Ishikawa diagram. The main purpose will be to identify the root causes of the three different risks. The different pillars will be revised in order to improve the current situation.

7.1.1 Risk 7: Consumables on stock-out

The **equipment** is diverse, as Eating Point owns efficient storage shelter in order to stock the different materials. They do not have any specific investment in terms of equipment. However, this does have any responsibility the numerous stock-outs issues.

The reordering **process** is performed by the operational manager. The different stakeholders and persons in charge are well-defined and standardized.

The **people** included in this process run this imperfectly. They have to work together side by side but the communication is inefficient. Errors are made on both sides. The warehouse manager does

not seem to report the different errors and the operational manager may not be aware of them.

Eating Point uses several **materials**, a few of which are consumables. Those need to be reordered occasionally. However, the materials used are not the root cause of the problem.

The **environment** has its importance in the situation. The different stakeholders are under a certain level of stress. This pressure is caused by the numerous events that must be organized. The focus always lies on the next event, disregarding the continuous evolution of the warehouse.

The **management** is sometimes unaware of this kind of problem. This type of errors are not sufficiently reported to the management and thus not monitored.

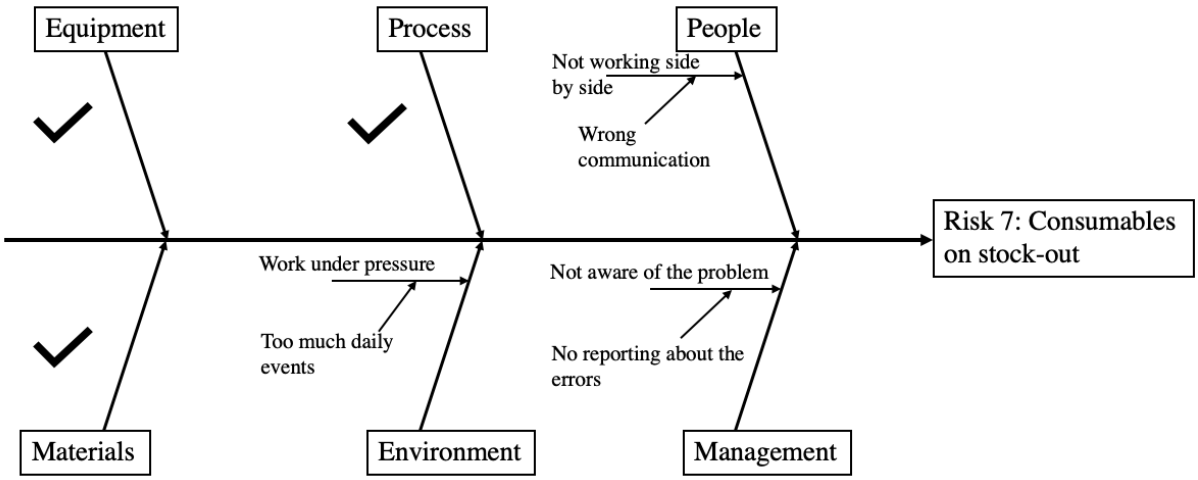

Figure 14: Ishikawa Diagram Risk 7

7.1.2 Risk 8: Omission of materials during the preparation

The **equipment** does not cause the problem. The omission of materials is unrelated to the equipment used by Eating Point.

On one hand, the preparation **process** is standardized and well understood by the different stakeholders. On the other hand, its efficiency can be improved as it is not effective enough.

The **people** running the preparation process are responsible for the mistakes. They are supposed

to take materials from the inventory but they sometimes forget items due to a lack of motivation. The people are not enough involved into the process because the operators performing are interim students and easily replaceable.

The **materials** are surely not the source of the omitting item issue. The materials used perform well and work well for a smooth running.

The **environment** is the same than the previous subsection. The different preparations have to be performed in time before the event and cannot encounter any delay. The different people are put under pressure and this increases the error rate.

The **management** is well aware of this kind of issue. The main problem is that they do not have the resources necessary to improve it and it is not their top priority.

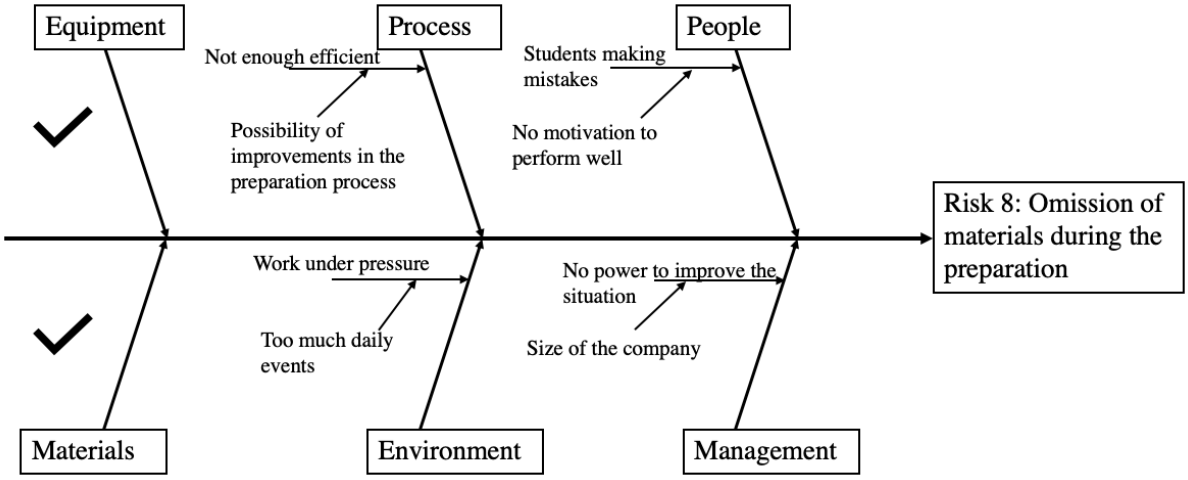

Figure 15: Ishikawa Diagram Risk 8

7.1.3 Risk 10: Loading of the wrong materials

The **equipment** is not as effective as it should be. The different packaging are located in the warehouse and this can be optimized. There is no effective equipment to differentiate the materials package destined for one event or another.

The **process** should be more standardized. The packaging is performed but the next procedure to be made is quite uncertain for the different employees.

The **people** are the same as the ones performing the preparation process. They are typically students who do not have any incentive to perform well. There is a disconnect between the team that prepares the packages and the one that load the van en route to the venue. Thus, there is a loss of information.

The **materials** are not the source of the issue for this error.

The **environment** is the same as the one for the two previous issues. The employees are put into a lot of pressure. This kind of environment is not healthy to perform efficiently and effectively.

The **management** is also aware of this type of problem but they have no time to monitor this kind of risk. They only have a short term vision of the situation because of the pressure they are put under.

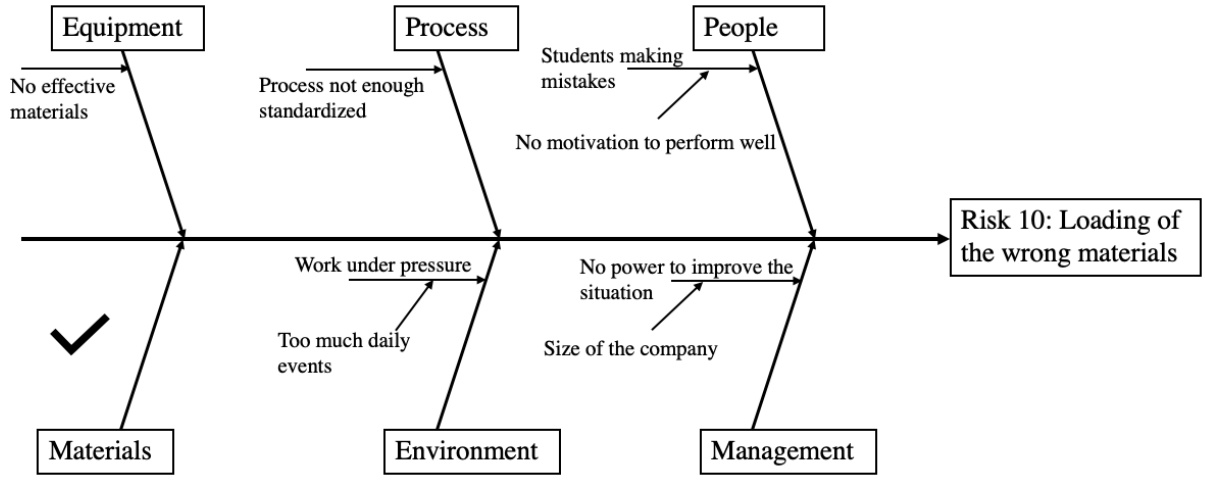

Figure 16: Ishikawa Diagram Risk 10

As a conclusion, the different risks are each located on multiple pillars. The main issue is the human error as they employ interim students who may not perform as well as professional workers would.

The second main mistake is based on the responsibility of the processes. They are not well standardized and efficient. In addition, the pressurized environment would be hard to improve because

it lies at the core of the business. The company must efficiently perform while having daily events. The next section will provide ideal solutions to improve the current situation while checking the viability of the improvements proposed.

7.2 Ideal solution

Different solutions may be proposed to improve the current situation. The first issue previously mentioned was that the main root cause was the **people** within the organization. An idea to enhance the current status would be to offer training to the different employees. The main objective would be to teach them on how to reduce the different risks. The investment into the people would help the current situation and ultimately improve the supply chain efficiency.

Nevertheless, the actual working method of the company does not allow this kind of solution. Training is costly and the employees are mainly students. Those students are not full-time worker. The mean of the hours performed by a student working for Eating Point over the course of a year does not exceed 30 hours. This shows that a training would be a sunk investment. However, coaching could be offered to the two event managers although they would be costly and probably not efficient enough.

The other main risk is located in the **processes**. They need a better standardization. In a perfect world, the best method to mitigate and decrease the occurrence of those problems would be to implement full automation, or at least a full digitization. This would lead to a full transformation of the processes. Everything would be computerized and the different processes would be analyzed on different software. The various risks would be drastically decreased because errors could be instantly identified and opined by the system. This would lead to a Six Sigma management because the errors rate would reach the 0,0003 %. An idea would be to use a VSM software in order to allow a data visualization of the organization.

Nevertheless, this kind of transformation in the company does not represent a top priority. The actual demand and size of the company do not require this type of system. Furthermore, this kind

of improvement is extremely costly in comparison with the possible benefit.

The **environment** will remain unchanged. The pressure exerted on the employees can be decreased by hiring more permanent employees. Nevertheless, the company cannot currently afford this solution.

In conclusion, it remains difficult to change the entire supply chain organization. However, improvements can be proposed to enhance the current situation. Those will be developed in the next chapter to reduce the occurrence/impact of the top three risks.

8 Process improvement: implementation and results

The previous chapter described a complete redesign of Eating Point's supply chain. However, the company cannot currently afford this kind of improvement. However, this chapter will provide smaller improvements in order to improve the current situations. This has been fully developed through brainstorming with the warehouse and the event manager.

This chapter offers improvements to Eating Point's supply chain. Those enhancements are minimum viable products (MVPs) to improve the current situation. Section 7.2 offers perfect answers and solutions. Despite presenting smaller benefits, the possible options suggested in the present segment can be implemented more easily. The different risks identified in Section 6.2 may be monitored. In order to improve the situation, there are two contrasted measures that may be taken. On one hand the occurrence of the risk may be reduced as to encounter the issue less frequently. On the other hand, the risk impact can also be decreased for a tinier repercussion on the company's revenues.

Firstly, a description of the enhancement will be provided followed by an implementation methodology using the Deming Wheel (PDCA).

Secondly, an evidence to show the effectiveness will be fully presented. Improvements are only meaningful when quantitatively or qualitatively demonstrated.

Those solutions are not perfect but they will drastically decrease the different risks' error rate. The results are not the most important. However, the methodology used will help to guide the company for further improvements.

8.1 Description of the solutions

This section will describe the solutions proposed to mitigate the top three risks identified in section 6.2. Those improvements have been found through the literature and the numerous experiences encountered by the interviewees. These developments will help to reduce the occurrence of the

main risks. As a matter of fact, the impacts of the risks would be hard to improve.

8.1.1 Risk 7: Consumable on stock-out

During the preparation process, materials sometimes face stock-out. The operational manager is responsible for always having enough consumables on hand. However, stock-out unfortunately happen too frequently. The operational managers occasionally visually checks if the stock is sufficient. However, this process is not standardized and defined well enough. Therefore, the solution in order to have a more reliable consumable stock would be to use a Kanban system.

Kanban System

The Kanban system is a way to make the stock more visual. This allows the firm to hold a physical control of the stocks instead of a computerized system. The Kanban system comes from the Lean manufacturing and adapts well to a Just-In-Time production (Terry (2019)).

Eating Point remains opposed to adapting to a computerized stock system for the consumables. Therefore, the visual management method could be an efficient answer to the stock-out issue. The controls will be performed regularly but the quantities will be more easily and visually managed.

Specifically, the company must define what the turnover rate is for each of the consumables. Each of them may have a different ratio. Therefore, an estimated ideal stock will have to be established for each consumable. The ideal quantity should be noted above the consumables and the operational manager will have to go through the stocks every week/month (depending on the turnover rate previously decided). He can then rapidly identify the consumables that need to be reordered.

For example, the ”chaffen-dishes” are the candles keeping the plates hot and are considered consumables. The stock will be put into blue boxes. The ideal turnover rate would be around 400. In a blue box, there are 200 chaffen-dishes. Therefore, the warehouse needs two blue boxes of ”chaffen-dishes”. During the preparations, the quantity will decrease until one of the two boxes is empty and will then be removed. The operational manager controlling the stock will easily identify the missing blue box filled with the ”chaffen-dishes” and will place an order to resupply the stock.

If we suppose that resupplying happens instantly (which is the case for most of the consumables at Eating Point), the consumable stock mean should be at 75% of the turnover rate. This element must be taken into account in the turnover calculation. So does the time required to order the products. The process has to follow a FIFO rule (firs in-first out) in order to avoid outdated consumables.

The next section explains the implementation of this method in order to carry out this methodology efficiently.

8.1.2 Risk 8: Omission of materials during the preparation

The preparation phase is crucial for the smooth running of the event. Therefore, the materials preparation has to be efficiently and correctly performed. The omission of an essential equipment can be fatal to an event. Eating Point offers premium events and has to fulfill his engagement to the contract.

The preparation needs a certain improvement and standardization. Therefore, the inventory of the materials has to change.

New locations for the materials

The location of the materials will have the same order than on the materials' list. Therefore, the students preparing the materials package will have to go through the inventory and select the materials required. The upgrade lies in the new organization of the inventory. It will now follow the materials lists created by the event manager.

The main idea is to follow an Ikea store. The student will have to go through all the materials and successively determine if he has to add the material to the package or not. Similarly to the Ikea store, he will have to follow a precise path defined to prepare his materials package. The omission of materials will be reduced because the students will have to check each of the materials in the warehouse. This method is viable because the inventory is not too massive. The total volume of the inventory for the preparation process does not exceed 50 cube meters.

The implementation will have to be effective and will be fully explained in the next section.

8.1.3 Risk 10: Loading of the materials for the event

The omission of materials during the preparation process can be disastrous to an event and so does taking the wrong package. Once an event preparation is finished, the materials package is placed somewhere in the warehouse. Students often take the wrong package for the event. As you can imagine, this can be fatal not only for one event but for two (the one with the wrong package and the one that did not receive any package at all). Packages are different for each event and thus cannot be transferred from one event to another. Therefore, the occurrence of this kind of mistake has to be drastically reduced. A solution would be to efficiently use zones.

Zones

Those zones are destined to help organize a buffer between the different processes. They will be well-defined and therefore, each event will have its own zone. Each zone will be assigned with a purpose and this will be coordinated by the warehouse manager.

There will be four types of zones:

- **Inbound Zone:** This zone collects the different materials coming from the multiple suppliers. The warehouse manager will be held responsible to clear this zone as soon as an item comes in from a supplier.
- **Outbound Zone**: In opposition with the inbound zone, the outbound zone gathers the different items that have to be taken by the suppliers. For example, ”CDS” retrieves its glasses after an event. The warehouse manager will also be held responsible to identify the items that need to be deposed on this zone.
- **Loading Zone**: These zones centralize the different packages when their preparation is done. These zones serve as buffer until the materials package is taken to the venue. They will also

serve to collect the materials after the event before restoring them into the inventory. Each zone should have a note with the name of the event, its date and the required information.

- **Preparation Zone**: The preparation zones serve to gather the different items during the materials preparation process. These zones will be closer to the inventory in order to be the most efficient. Preparations for different events are often being performed in parallel. Therefore, these separated zones will avoid any mistakes.

8.2 Implementation

This section describes how the different improvements defined in the previous section will be implemented. The PDCA cycle will be used to implement the different solutions effectively. As described, the Deming wheel is composed of four pillars: ”plan”, ”do”, ”check” and ”act”.

8.2.1 Kanban System

As mentionned in the previous section, the Kanban system will allow a better visualization of the stocks in order to run the stocks more effectively and avoid stock-out.

Plan

The first stage consists of the planning of the implementation. Firstly, the different stakeholders must be identified. The warehouse manager would be the first to experience the impact because he is the one coordinating the warehouse. The operational manager is supposed to check the numerous stocks. The warehouse manager has to explain this new method to the various students working in the warehouse and who must follow the new procedure. Those are the main stakeholders.

The different turnovers have to be calculated based on a long period of time in order to possess relevant figures and data. This data is crucial, as the inventory relies on it. The main idea would be to calculate which quantity is used during a period.

The main objective must be clearly identified. This would be to transform the inventory management into a visual inventory management. The planning itself is also crucial. It has to be well defined and agreed by the different stakeholders. The warehouse manager will coordinate the transformation and employs students to help him in his task. This change will have to take place when the warehouse is at a low-level utilization. This could be during a weekend for example. The different tasks have to be clearly defined in order to have an efficient shift.

Do

The transformation of the inventory will have to be performed after noting all the ideal quantities for the consumables. The visual inventory management will then be implemented and used. This test phase must last for at least a few weeks in order to test its efficiency.

The warehouse manager coordinates the students and tests the ability of the method with the students. It must be efficient enough to avoid stock-out or at least drastically reduce its occurrence.

The operation manager will test the system and order consumables when identified from the Kanban system.

Check

This is the most crucial phase. This stage must check the method in its entirety. The operation manager audits the system's efficiency. He is held responsible for interviewing the different stakeholders and collect their opinion about the new procedure.

The various turnovers will be checked. The main objective is to have enough stocks although the size of the warehouse is quite rigid. Thus, handling a large quantity of consumables is not viable. Those must be checked and one of the managers then assesses the rightness of the turnovers calculated in the planning stage.

Act

The last stage is about adjusting the small errors. A reduced turnover calculation, dangerously approaching stock-out is a speaking example of an error. This phase typically runs for a long time

until an error is identified. Once a stock-out occurs, the operational manager is held responsible to browse the Deming wheel again process in order to fix the issue.

8.2.2 New materials locations

This new organization in the warehouse strives for a better efficiency and reliability in the preparation process.

Plan

As for the previous subsection, the planning stage first serves to identify the main objectives. The first one would be to have an efficient order for a better preparation process. The second objective would be to reduce the omission of materials.

The different stakeholders involved in the process should first be identified. The warehouse manager is responsible for this process and thus for the improvement process. He must implement the enhancement in the warehouse from the beginning to the end. He will have to work side by side with the event manager. The order of the locations and the materials list have to be correlated in order to facilitate the preparation process. In addition, the locations have to be organized efficiently. Therefore, this requires a coordination between the two departments.

The warehouse manager has to establish an effective order for the items in order to be efficient during the preparation process. He should bear in mind that the preparation will be performed by students. He must communicate with the event manager and the operational manager to modify the materials list.

The relocation will last for a couple of days. This must take place during while the warehouse is only partially used. The months of July and August would be the ideal period. Indeed, Eating Point offers its services to corporate events and there are very few during the summer holiday.

The warehouse manager should coordinate the relocation and could employ students to help him with this task. He will be held responsible for the smooth running of the shift.

Do

Once the new map of the organization is ready. The relocation can take place. The warehouse manager will remove the different items from their previous location and place them into their new ones. He will coordinate the students during the relocation process in order to fit what was planned with the event and operational manager.

The new materials location should be implemented and be tested for a few weeks. The innovative inventory management must be assessed and evaluated over a long and pertinent period. This period should be objective and comparable to the regular utilization of the warehouse.

The warehouse and operational manager will be held responsible for identifying the potential issues in the new organization of the inventory. The new locations and their efficiency could the focal points. Nevertheless, the rate of errors will be the KPI to highlight progress. There should be a significant decrease in the omission of materials during the preparation process.

Check

Once the test phase is completed, the managers must draw conclusions from the previous weeks. Decisions about the completion of the test have to be taken. A complete analysis of the test should be provided by the warehouse manager. He must provide the different rates of errors as well as a before and after analysis. The efficiency of the new locations has now been tested and it the warehouse manager's responsibility to determine whether the situation can still be improved or not.

He must coordinate with the operational and event manager in order to assess if the test proved to be conclusive or not. Their feedback is crucial to determine if the changes will be implemented or not.

The last adjustments can be identified and performed within a few days.

Act

The last phase is the definite decision about the improvement. Once the analysis is provided, we can

identify whether the implementations resulted in a significant improvement or not. The last details can be adapted in order to have an effective inventory with a low error rate regarding omission of materials during the preparation process.

If the test phase proves to be inconclusive, we can run the PDCA process again in order to improve the actual situation.

8.2.3 Zones

The new various zones will be used as buffer between the preparation and loading process as well as between the unloading and restoring process after the event.

Plan

The first stage is the planning phase. It requires to define the objectives. We must have different zones (defined in the previous section) to avoid any mistakes in regards to materials during the loading of the truck. They will be efficient in order to drastically reduce the error rate.

The different stakeholders are the operational manager, the event manager, the warehouse manager and the various students. This improvement will take place in the warehouse and thus placed under the responsibility of the warehouse manager. He will coordinate with the other stakeholders. He has to organize the warehouse in an efficient way, while being easily understandable by the students.

Before the implementation, the warehouse manager will build a map of the numerous zones with the agreement of the management. An example of a map is provided in the previous section.

The various zones will be installed within one or two days. This means that this implementation can be organized during a weekend recording a low utilization rate. Those zones need a clear marking to differentiate them as well as a note describing their purpose. The minimum information would be the name of the event, the date, the event manager and more information if needed. For example, the various types of zones can be differentiated thanks to colors.

Do

Once the map with the different zones is created by the warehouse manager, the installation can take place. As mentioned, the set up of this implementation will last about a day or two. The warehouse manager will coordinate the students in order to establish effective zones in the warehouse.

As for the two other implementations, the test stage will last for a few weeks in order to test the zones' efficiency. The warehouse manager will use the areas with the students for numerous events.

Check

The main goal of this stage is to analyse the test stage. The warehouse manager will check if the different objectives are achieved or not. He will collect the feedback regarding the improvement in order to perform a full analysis of the enhancement.

Furthermore, the warehouse manager is held responsible for identifying various slight improvements that can be added to the zones. An example of an improvement would be a crucial element of information missing on the notes.

Act

This phase is the decision stage. Thanks to the analysis of the warehouse manager, the management can decide if the improvement is conclusive or not.

The adjustments will then be implemented by the warehouse manager. However, the PDCA circle can be performed again in any situation for any improvement.

8.3 Result analysis

This section provides evidence of the improvements. The purpose of this section is to prove the added value of the three enhancements developed on the previous section. However, the COVID-19 crisis made it difficult.

8.3.1 Risk 7 & 8

Both solutions to reduce the occurrence of the risks 7 and 8 have not been implemented due to the COVID-19 crisis. However, the implementation plan described in the previous section has been provided to the different employees. The objective is to determine if this goal appears achievable and operational based on their experience. Their feedback is the following:

The warehouse manager first analyzed the process improvement for the risk number 7. He fully agreed with this theoretical enhancement. The Kanban system appeared as a pertinent solution to him. The description was thorough enough to obtain an effective system. The implementation methodology also seemed applicable to him. He admitted that he would not have thought about so many standardized steps (PDCA) to implement the solution. However, he was highly motivated by this operation's enhancement. In addition, he agreed to perform the various tests and redo the process if the results were not satisfactory enough.

The warehouse manager read the improvement's description for risk number 8. This clearly describes the enhancement mutually developed. On the other hand, he truly valued the implementation plan. As for the previous risk, he promised to monitor and regularly check the various results of the experience and adjust if they are not satisfying enough.

In addition, the document has been provided to an experienced student frequently working in the warehouse (Loïc Robert). He was deeply impressed about the different solutions proposed to monitor the various risks. Those improvements seemed effectively achievable to him. His feedback about the implementation plan was sincerly constructive. He truly believes in the effective application of the three solutions. He admitted that those improvements will decrease the several risks' occurrence. However, he agreed that a complete redesign of the way of working (digitise the system for example) would be more effective. Nevertheless, this kind of transformation is currently not affordable for Eating Point as developed in the 7th chapter.

8.3.2 Risk 10

In order to reduce the risk of taking the wrong materials for an event, the solution provided was to implement loading zones. This solution has been partially carried out. In fact, the loading zones have been installed. However, after gathering some feedback from the different stakeholders, they realized that the occurrence of the issue had already been significantly reduced. The occurrence of the error rate is expected to have gone from 4,1 to 2,8 out of 10. This means that there is still room for improvement. Therefore, the three other types of zones could help further minimize this issue.

According to the warehouse manager, the students have been performing less errors and this system appears highly efficient. It allows a better coordination between the various events. The warehouse manager can now organize different event preparation at the same time with numerous students. His role as a manager has therefore been facilitated. He can centralize the information about the different events more easily while coordinating the students. He mentioned that his job was more efficient, resulting in lower pressure due to the standardization of the process.

9 Conclusion

The conclusion summarizes the research and the methodology used in the thesis. In addition, a complete description of the numerous limits and issues faced will be developed.

This whole methodology has been performed while working side by side with Eating Point's employees. The most advantage of this lean approach was that every step of this procedure was performed according to the firm's needs and constraints. The numerous steps were achieved with the approval of the various stakeholders.

The main purpose of the thesis was twofold: (1) analyze the supply chain of the company and identify potential issues and monitor them (2) implement the risk culture to the company's supply chain. The results of the first objective were hardly provable because of the non -implementation due to the COVID-19 crisis. However, the risk culture has been well received by the different Eating Point's employees. They easily agreed this new mindset and vision. Furthermore, they understood its benefits and its necessity for a qualitative supply chain management.

Eating Point is a young catering company created in 2014. Since its creation, its supply chain has not evolved. However, the company has impressively grown. Numerous risks occur during the event organization process. Those risks have distinctive rates of occurrence and levels of impact on the company. Thanks to several interviews, this thesis identified the various risks located in each processes. They have been gradually estimated in terms of occurrence and impact. Unfortunately, the company does not record each risk's occurrence. Hence, these have been evaluated by the various employees.

The 18 risks have been placed on a risk matrix with the impact and occurrence as abscissa and ordinate. The founder and chief executive officer of Eating Point considered these two axis with the same importance. Therefore, the weighting highlighted three main risks: the 7th risk (”Consumables on stock-out”) with a mean of 5,65, the 8th risk (”Omission of materials during the preparation”) with a mean if 4.3 and the 10th risk (”Loading of the wrong materials”) with a mean of 5,45 out of 10. Those errors are thus considered as the three major dangers faced by Eating Point's supply chain.

Afterwards, a complete analysis of the root causes of the top three risk was performed. The Ishikawa diagram allowed to further investigate the data. The main risks have been placed on the model and its six pillars (”Equipment”, ”Process”, ”People”, ”Materials”, ”Environment” and ”Management”). The root causes of the risks were analyzed in order to identify the main sources of the issues in the supply chain.

The main sources of error were located in the people and the processes. Several solutions have been proposed in order to monitor and improve the current situation. However, the different suggestions to enhance the status were not viable solutions. Eating Point is not ready to modify its work process. Nevertheless, these ideas can initiate the reflection for future developments.

Nonetheless, minimum viable products have been developed with the precious help and contribution of different employees in order to monitor the three main risks. The first solution was to implement a Kanban inventory management. This would drastically reduce the stock-out issues. Secondly, a new organization of the locations for the various materials has been proposed. The main objective is to coordinate the materials list and the inventory as well as creating a standardized path that the employee would follow during the preparation process. This would reduce the omission of equipment during this operation. The last improvement was the implementation of four types of zones. Those will serve as buffer between the preparation and the loading process. These will significantly reduce the errors associated with taking the wrong preparation package during the loading.

A complete implementation plan has been created for each of the three solutions. This follows the Deming wheel or PDCA model. The last section’s purpose serves as a proof of the improvements’ efficiency. However, because of the COVID-19 crisis, only one improvement has partially been implemented. Nevertheless, the PDCA model has been provided to the different employees in order to test its efficiency and thoroughness. Their feedback was impressively positive and they agreed to follow each of the steps during the implementation. They agreed that obstacles will be encountered. However, they will use the methodology to guide them in the solving and implementation.

Limitations

The main issue faced through the development of the thesis was the lack of data regarding the company. This young company does not have the resources to record the various errors. For future developments, the company should improve its data collection. The different risks have to be recorded and their occurrences must be objectively evaluated. The company should assign this responsibility to someone with a long-term vision. For example, this task should not be given to an event manager who mainly cares about the numerous following events. The risk analysis should be performed at least once a year. The main purpose would be to identify the progression and the failures by reevaluating each risk. New errors can also be identified if the supply chain happens to be modified or changed. The implementation process could help to guide the company for future implementations. The operational manager is held responsible and will ”Control” (last stage of the DMAIC improvement process) the effective conduct of these advises.

The methodology developed during the thesis has some constraints. The risk analysis can help to provide an accurate visualization of the risks the company faces. This would help the prioritization of the various issues. It would effectively assist the elaboration a Pareto diagram. However, the problem-solving side of the methodology has been difficult. Indeed, the company cannot afford any massive investment in a supply chain modification. The various MVPs were small improvements in comparison with the ideal solutions provided in the 7th chapter.

The implementation methodology following the PDCA cycle has been effectively used for the different solutions. This procedure is easily accessible for various types of industries and projects. However, bigger improvements would need additional informations and more precise informations for an effective implementation.

The last complication during the elaboration of this thesis was the COVID-19 crisis as it significantly slowed down the whole project management process. The different solutions were hardly implementable. In addition, the company has totally stopped its activities, making the analysis more difficult to perform. However, all Eating Point employees were readily available to offer advises throughout the development.

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10 Annexes

10.1 Interviews

For the interviewed people, the french language was easier for a fluent discussion. This section will at first develop the themes that have to be tackled. For each of the themes, there will be several questions in order to help the progress of the thesis.

10.1.1 Questionnaire d'interview

1. Informations sur la personne interviewée
    - Qui êtes-vous et pouvez-vous m'expliquer votre fonction au sein de l'entreprise?
    - Quel est votre background dans le milieu de l'entreprise ? Avez-vous une quelconque expérience dans le milieu du catering ou bien l'événementiel ?
    - Quels sont les domaines qui vous intéressent particulièrement ?
2. La supply chain de l'entreprise et les risques
    - Sauriez-vous me développer les différentes étapes de la supply chain de l'entreprise ?
    - Quelles sont les étapes critiques au sein de la supply chain pour l'entreprise ?
    - Sauriez-vous identifier les risques majeurs que l'entreprise confronte lors de ces étapes ?
    - Pour chaque risque, est-il possible de le quantifier (occurence et impact)?
    - Quels seraient selon vous les risques qui peuvent arriver dans le futur ?
3. L'amélioration
    - Quels sont les moyens mis en oeuvre afin de diminuer l'occurence des risques?
    - Quels sont les moyens mis en oeuvre afin de diminuer l'impact des différents risques ?

- Auriez-vous une idée afin de diminuer soit l'occurence soit l'impact des différents risques ?
- La transformation digitale pourrait-elle être une part de la solution ?
- Quels sont les points forts de l'entreprise et que recommanderiez-vous ?

10.1.2 Interview Anais Demets April 11th 2020

The different answers of Anais Demets are the following ones:

1. Informations sur la personne interviewée

   - Qui êtes-vous et pouvez-vous m'expliquer votre fonction au sein de l'entreprise ?

     Anais Demets, operationnal manager, un peu de tout dans le management. Le but principal est de gérer au bon travail de l'event manager. Pour que l'event manager ai tous les outils pour ses events. Responsable des matériels et consommables. Faire en sorte que chacun ai la logistique pour pouvoir travailleur au mieux. Tout doit tourner niveau événement.

   - Quel est votre background dans le milieu de l'entreprise ? Avez-vous une quelconque expérience dans le milieu du catering ou bien l'événementiel ?

     Elle a suivi des études de relations publiques. Elle a adoré la communication mais ce n'était pas pour elle. Elle a commencé chez "secretary plus" qui est un bureau de sourcing en administratif. Elle a fait entre autre du marketing. Elle a ensuite rejoint Eating Point car elle était intéressée par l'évenementiel.

   - Quels sont les domaines qui vous intéressent particulièrement ?

     Elle adore l'événementiel. Elle est curieuse de savoir comment les choses sont organisées en festival. Comment tout se coordonne et comment tout marche. L'ambiance en fête est quelque chose qu'elle affectionne.

2. La supply chain de l'entreprise et les risques

- Sauriez-vous me développer les différentes étapes de la supply chain de l'entreprise ?

  Elle sont retrouvables dans le document.

- Quelles sont les étapes critiques au sein de la supply chain pour l'entreprise ?

  Le point critique de l'événementiel est le nombre d'évenements sur la semaine. L'event management est l'étape où il y a le plus grand danger à rencontrer et si il se passe mal c'est boule de neige.

- Sauriez-vous identifier les risques majeurs que l'entreprise confronte lors de ces étapes ?

  Ils sont dans le documents

- Pour chaque risque, est-il possible de le quantifier (occurence et impact)?

  Voir Risk map

- Quels seraient selon vous les risques qui peuvent arriver dans le futur ?

  Le risque principal est lors d'une grosse croissance et perdre cet esprit dynamique et familial. Le fait de grandir peut aussi diminuer le contact avec le client qui sont maintenant en contact régulier.

  Le plus gros risque au niveau opérationnel est de passer à des plusieurs collaborateurs pour la même tache. La division des tâches devra être efficiente, le risque général va augmenter. Il faudrait un sytême standardiser.

3. L'amélioration

- Quels sont les moyens mis en oeuvre afin de diminuer l'occurence des risques ?

  Un check mensuel devrait être fait pendant des périodes calmes, une fois toutes les deux semaines lors des périodes chargées.

  Le double check n'est pas assez bons. Les listes matos doivent être standardisées.

- Quels sont les moyens mis en oeuvre afin de diminuer l'impact des différents risques ?

- Auriez-vous une idée afin de diminuer soit l'occurence soit l'impact des différents risques ?

  Voir améliorations

- La transformation digitale pourrait-elle être une part de la solution ?

  Oui, ce serait la situation idéale mais ce n'est pas dans les objectifs acutels d'EP. Cela couterait trop cher à installer mais à garder comme idée pour plus tard.

- Quels sont les points forts de l'entreprise et que recommanderiez-vous ?

  Les comptoirs permettent une facilité d'organisation lors des événements. Leur manière de travailler leur permet d'être extrêmement flexible.

10.1.3 Summary Interview Eroan Krisada April 11th 2020

Eroan is working as event manager at EP since september. Was a student and worked as student and then followed. Worked in restaurants (Castel and Pegase) to learn the good behaviour of services. An event manager is organizing the event itself, the suppliers and so on.

According to Eroan, an automation of the tools has to be done. For example for the event file, is has to be more automatized.

A better stock organization. The toolkit list has to be adapted to the stock organization. A good stock list has to be computerized.

The different informations Eroan provided for this interview can be founded in the section 3.2.

10.1.4 Summary Interview Jean-Benoit Verstraete April 23rd 2020

Jean-Benoit is the CEO and the founder of Eating Point, he helped me to describe the vision of the company and its offers (section 3.1). On the other hand, he provided his top management vision of the company. He has to agree to the different improvements and helped to the research of solutions. The different solutions provided can be founded in the section 8.1.

In addition, Jean-Benoit advised me to be careful with the human vision. Every employees has its own willingness for the company. He suggested me to keep an objective vision for the different

ideas of the different stakeholders. He agreed to be present at the thesis presentation and he will read the thesis before its publication.

10.1.5 Summary Interview Nathan Gallois April 23rd 2020

Nathan Gallois is the warehouse manager of Eating Point. He is employed in the company a few months. He has a complete and whole vision of EP's supply chain. Fistly, he worked as a student for the company during several years. Therefore, his knowledge about the firm were very useful.

He is the one where most of the risks happen in the warehouse. However, he develops the different processes and provided estimation in order to evaluate the different errors. He helped to build the risk matrix located in the section 6.2. The different informations provided are in the document.

10.1.6 Summary Brainstorming with Eroan Krisada and Nathan Gallois May 17th 2020

The main objective of this brainstorming was to collect their feedbacks about the three improvements and their implementation. Because of the crisis, the different enhancement could not have been implemented. However, the idea was to collect their vision of the implementation plan and test its efficiency. The summary of their answers are located in the section 8.3.1.

10.2 Tables

10.2.1 Risk Map Means calculation

This tables displays the different weightings for the two variables. The first column represents the reference of the risk. The two next rows are the variables evaluated through the different interviews with Eating Point's managers. The next columns are the weightings for each variables. For example, the (40-60) row represents a weighting of 40% for the occurrence and 60 % for the impact. The last column is the multiplication of the occurrence and the impact.

Risk	Occurrence	Impact	50-50	40-60	60-40	70-30	30-70	Occ*Imp
1	0,75	1,9	1,325	1,44	1,21	1,095	1,555	1,425
2	1	3,33	2,165	2,398	1,932	1,699	2,631	3,33
3	1,5	0,8	1,15	1,08	1,22	1,29	1,01	1,2
4	7	0,4	3,7	3,04	4,36	5,02	2,38	2,8
5	3,5	2	2,75	2,6	2,9	3,05	2,45	7
6	2,8	4	3,4	3,52	3,28	3,16	3,64	11,2
7	6,2	5,1	5,65	5,54	5,76	5,87	5,43	31,62
8	4,1	4,5	4,3	4,34	4,26	4,22	4,38	18,45
9	5	0,4	2,7	2,24	3,16	3,62	1,78	2
10	6,8	4,1	5,45	5,18	5,72	5,99	4,91	27,88
11	3,9	2,1	3	2,82	3,18	3,36	2,64	8,19
12	5,1	1,7	3,4	3,06	3,74	4,08	2,72	8,67
13	3,7	1,2	2,45	2,2	2,7	2,95	1,95	4,44
14	3,1	2,4	2,75	2,68	2,82	2,89	2,61	7,44
15	4,1	1,2	2,65	2,36	2,94	3,23	2,07	4,92
16	4,5	2,8	3,65	3,48	3,82	3,99	3,31	12,6
17	1,2	0,6	0,9	0,84	0,96	1,02	0,78	0,72
18	2,1	4,7	3,4	3,66	3,14	2,88	3,92	9,87

Table 3: Risk Weighthings Calculations Eating Point

10.3 Eating Point Documents and Photos

This section regroups the different documents and photos useful for a better comprehension of the company.

EATING POINT

WALK EAT • TALK EAT

MATERIAL PREPARATION	
EVENT	XXXXXXX
EVENT MANAGER	XXXXXXX
PREPARATION (CHECK)	
CONTROL PREP (Q CHECK)	

DATE	XXXXXX
DELIVERY ZONE	

LARGE MATERIAL		
0	REGULAR COUNTER	1 ELECTRICITY BOX
2	SPECIAL COUNTER	3 BAIN-MARIE + LID
0	TOTEM - 50	15 HIGH TABLES + TABLETS
0	MULTICOLOR CART	4 TRASH CAN + LID

GENERAL					GENERAL				
BOX N°	LOCATION	ITEM	Q	CHECK	Q CHECK	BOX N°	LOCATION	ITEM	Q	CHECK	Q CHECK
		SHIRT SIZE S	3					FIRST AID KIT	1		
		SHIRT SIZE M	5					BROOM	1		
		SHIRT SIZE L	2					RACLETTE	1		
		SHIRT SIZE XL	0					BLUE WATER CAN	2		
		APRON	10					WOODEN SERVICE PLATTER	4		
		DISH TOWELS	10					CLEANING BASKET	3		
		DISHCLOTHS	10					BACK BAR TABLE	2		
		SPONGE	4								
		METAL SPONGE	1								
		DISHSOAP	1								
		CLEANING SPRAY (AJAX)	2								
		BOX OF GLOVES	2								
		BUCKET	4								
		BRUSH + DUSTPAN	1								
		BLACK TAPE	3								
		GARBAGE BAG ROLL	2								
		TORK PAPER ROLL	1								
		20M EXTENSION CORD	1								
		IKEA ZIP BAGS	1								
		TEALIGHT CLEAN	15								
		CANDLES	15								
		EP FOLDER	10								
		ORANGE TOWEL	4								

PACKAGING					
BOX N°	LOCATION	ITEM	Q	CHECK	Q CHECK
		REGULAR PALM BOWL	250		
		FORKS	100		
		NAPKINS	400		
		EP PAPER CUP	20		
		STRAWS	0		
		GREY BOX	3		
		LITTLE BEER PUMP	1		

Figure 17: Example of Materials List 1/3

Ciao Bella					
BOX N°	LOCATION	ITEM	Q	CHECK	Q CHECK
		METAL CUTLERY POT	2		
		PAELLA PAN	8		
		SERVICE SPOON	6		
		GASTRO 1/6 + LID	2		
		BREAD BASKET	4		
		SALT & PEPPER	1 & 1		
		KITCHEN TONGS	3		
		SCISSORS	2		
		FUEL PASTA POTFULL	6		
		LIGHTER	1		
		ALLERGEN BOARD + BASE	1		
		WOODEN STICK	0		
		MENU ROUND	0		
		MENU RECTANGLE	1		
		MILK BOTTLE (GLASSES)	3		

DIPS / HUMUS TRIO					
BOX N°	LOCATION	ITEM	Q	CHECK	Q CHECK
		CHIPS BOWL	20		
		MEDIUM CERAMIC BOWL	60		
		TORTILLA CHIPS	7		
		TRASH CERAMIC BOWL	16		
		SCISSORS	1		

DESSERT / COOKIES & BROWNIES					
BOX N°	LOCATION	ITEM	Q	CHECK	Q CHECK
		LARGE KNIFE	1		

OPEN-BAR / SOFT-BAR					
BOX N°	LOCATION	ITEM	Q	CHECK	Q CHECK
		BOTTLE OPENER	2		
		CORKSCREW	2		
		SCISSORS	0		
		BACKBAR TABLE	0		
		JAR + LID	2		
		1 LITER BOTTLE	2		
		SMALL WOODEN PLANK	1		
		SMALL KNIFE	1		
		LEMON JUICE	1		
		WOODEN STICK	1		
		EATING POINT RECTANGLE	1		
		"DRINKS" ROUND	1		
		LAMP	2		
		MULTI-SOCKET	2		
		10M EXTENSION CORD	1		

RENTED MATERIALS festi					
BOX N°	LOCATION	ITEM	Q	CHECK	Q CHECK
		LONGDRINKS	6		
		Vin	5		
		Flute	3		
		Nappe	1		
		Forks	250		

Figure 18: Example of Materials List 2/3

LAST MINUTE ITEMS					
BOX N°	LOCATION	ITEM	Q	CHECK	Q CHECK
		CRUSHED ICE 10KGS	20Kg		
		ICE CUBES 2KGS	4Kg		
		COOKIES BROWNIES - order	ALL		
		PASTEIS DE NATA	40		
		FOOD JASPAR - SEE ORDER	ALL		
		STARTERS JASPAR - SEE ORDER	ALL		

Figure 19: Example of Materials List 3/3

EATING POINT

WALK EAT • TALK EAT

XXXXXX @ XXXXXX
XX/XX/XXXX
Square de l'Atomium
1020 Brussels
Beginning event **XX/XX 18:30**

HR and TIMINGS

Timing

Afterwork - 72 pax

18:30 Openbar - bubble platters
Dips
Starters

Dinner - 72 pax

19:45 Openbar
Food counter
21:30 Desserts
23:00 End

Dips
Hummus pesto, beet and curry

Starters
Bar Tataki, Holstein beef toast, vegetarian maki

Ciao Bella
Pasta alla tartufata
Marengo veal *(with rice)*
Cannelloni, ricotta and black sesame *(with vinaigrette)*
Green topping

Desserts
Cookies white chocolate and macadamia nuts
Cookies black chocolate and pecan nuts
Chocolate brownie
Pasteis de nata

HR

Name	Phone	Begin		End time		ROLES
XXXX	**XXXX**	**06:00**		**12:30**		**Montage**
XXXX	XXXX	06:00		12:30		Montage
XXXX	XXXX	06:00		12:30		Montage
Name	**Phone**	**Begin**		**End time**		**ROLES**
XXXX	**XXXX**	**15:00**		**01:15**		**MH**
XXXX	XXXX	15:00		00:30		REFILL
XXXX	XXXX	17:00		00:30		CLEANING
XXXX	XXXX	17:00		23:00		CLEANING
XXXX	XXXX	17:00		23:00		FOOD
XXXX	XXXX	17:00		00:30		BAR
XXXX	XXXX	17:00		00:30		FOOD
XXXX	XXXX	17:00		00:30		BAR

Figure 20: Example of HR Planning

Figure 21: Example of blue boxe 1/3

Figure 22: Example of blue boxe 2/3

Figure 23: Example of blue boxe 3/3