# **POLITECNICO DI TORINO**

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Master of Science in Industrial Engineering

Master of Science Thesis

# Analysis of key performance indicators for last mile logistics

with an application to the fast-fashion industry



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# Abstract

Part of a larger project, the thesis focuses on the determinants of the "last mile logistics" outlining the related Key Performance Indicators (KPIs). The "last mile logistics" concerns the last phase of the Supply Chain, in particular the final section of the delivery of a good, from the sorting center to the place indicated for the withdrawal.

Different scenarios are then analysed, proposing the system of KPIs that better fits with each of them. Subsequently, the same methodology is applied in the context of a fast fashion company, involved in the project, whose main aspects are analysed for outlining the most coherent system of Key Performance Indicators. It will be useful for depicting the level of integration between the last mile logistics and the rest of the Supply Chain to drive possible improvement actions. Moreover, it can be used as a baseline tool of analysis to be customized in accordance with the company's goals, which could change over time.

# SUMMARY

1.	Iı	ntroduction1	
	1.1	The thesis in the context of a larger project1	
	1.2	The thesis' structure2	
2.	N	1iroglio	
	2.1	History3	
	2.2	Supply chain of Miroglio4	
	2.3	Miroglio Textile4	
		2.3.1 Sublitex	
		2.3.2 Filatura Miroglio5	
	2.4	Miroglio Fashion5	
		2.4.1 Motivi	
		2.4.2 Elena Mirò6	
		2.4.3 Oltre	
		2.4.4 Ipekyol	
		2.4.5 Twist7	
		2.4.6 Machka7	
		2.4.7 Tailor7	
		2.4.8 Fiorella Rubino7	
3 A theoretical background			
	3.1	What is a key performance indicator9	
	3.2	Main features of key performance indicators9	
		3.2.1 Subjectivity or objectivity	

3.2.2 Availability	10
3.2.3 Simplicity	.10
3.2.4 Prescriptive effect	10
3.2.5 Consistency with the representation target	11
3.3 What is a system of indicators	11
3.4 The last mile logistics	13
4. Determinants and key performance indicators in last mile logistics	14
4.1 Principal determinants of last mile logistics	14
4.1.1 Customer satisfaction	14
4.1.2 Environmental impact	14
4.1.3 Stock and warehouse management	15
4.1.4 Transportation	16
4.1.5 Flexibility	16
4.1.6 Geographical area and market penetration and density	16
4.1.7 Employees	.17
4.1.8 E-Business	17
4.2 Key performance indicators of last mile logistics	17
4.2.1 Key performance indicators of Customer satisfaction	17
4.2.2 Key performance indicators of Environmental impact	18
4.2.3 Key performance indicators Stock and warehouse management	18
4.2.4 Key performance indicators of Transportation	19
4.2.5 Key performance indicators of Flexibility	20
4.2.6 Key performance indicators of Geographical area and market penetra- and density	tion 21
4.2.7 Key performance indicators of Employees	21

	4.2.8 Key performance indicators of E-Business
4.3	Interactions between determinants and the related key performance
ind	icators
	4.3.1 Interaction between Customer satisfaction and Flexibility23
	4.3.2 Interacton between Customer satisfaction and Environmental impact23
	4.3.3 Interaction between Customer satisfaction and Stock and warehouse management
	4.3.4 Interaction between Customer satisfaction and Transportation23
	4.3.5 Interaction between Customer Satisfaction and E-Business24
	4.3.6 Interaction between Flexibility and stock and warehouse management 24
	4.3.7 Interaction between Flexibility and E-Business
	4.3.8 Interaction between Environmental impact and Transportation24
	4.3.9 Interaction between Flexibility and Transportation25
	4.3.10 Interaction between Transportation and Geographical area and market
	penetration and density25
	4.3.11 Other relationships25
4.4	Features of each indicator25
	4.4.1 Features of each indicator related to Customer satisfaction25
	4.4.2 Features of each indicator related to Environmental impact27
	4.4.3 Features of each indicator related to Stock and warehouse management
	4.4.4 Features of each indicator related to Transportation
	4.4.5 Features of each indicator related to Flexibility
	4.4.6 Features of each indicator related to Geographical area and market penetration and density
	4.4.7 Features of each indicator related to Employees40

	4	.4.8 Features of each indicator related to E-Business	
5 Analysis applied to different scenarios			
	5.1	Small city43	
	5.2	Medium city44	
	5.3	Big city45	
6	Ap	plication of the indicators found46	
	6.1	Company operating in the context of small cities46	
	6.2	Company operating in the context of big cities	
	6.3 orier	Company operating in the context of small cities and a customized goods need strategy	
	6.4 orier	Company operating in the context of big cities and a customized goods need strategy	
7 Application in the Miroglio context		plication in the Miroglio context56	
	7.1	Miroglio's current structure and processes	
	7.2	A system of key performance indicators for the Miroglio context60	
8	Co	nclusion63	
	Re	ferences	

# **1** Introduction

# 1.1 The thesis in the context of a larger project

This thesis constitutes the second analytical step of a larger project involving also a fast fashion company, Miroglio.

The project's aim is to develop optimal management models exploring the impacts of the "last mile logistics" on the planning of the company's entire supply chain.

The "last mile logistics" concerns the last phase of the supply chain, in particular the final section of the delivery of a good, from the sorting center to the place indicated for the withdrawal.

The project develops following a sequence of steps. First, based on the data collected on several levels of the Supply Chain, an analysis of the impact of the "last mile logistics" will be lead, to identify the current trends in terms of processes, projects and strategies. The most important practices will be identified and described, in order to trace the main logistical patterns and then elaborate new models describing possible strategies to cope with supply chain management.

Second, my section will reveal the critical aspects and determinants of the "last mile logistics", and it will outline key performance indicators consistent with each determinant. Different scenarios are then analysed, to propose for each of them the most appropriate system of key performance indicators.

Consistent with the criticalities and requirements resulting from the previous analyses, a system of key performance indicators will be selected and included into a performance/monitoring dashboard dedicated to the Miroglio Company. This dashboard can be used to depict the level of integration between the last mile logistics and the rest of the supply chain to drive possible improvement actions. Moreover, it can be used as a baseline tool of analysis to be customized in accordance with the Company's goals, which could change over time.

In the third and last step of the project, quantitative simulations of the models built during step one are computed and evaluated, which take into account the guidelines set in the second part of the project, i.e. my thesis.

# 1.2 The thesis' structure

The thesis will be organized in 9 chapters. After the introduction, a brief description of Miroglio, the company involved in the project, is presented in chapter 2, followed by some theoretical notions in chapter 3, useful for the achievement of the thesis' goal. Chapter 4 to chapter 7 present the original aspects of the thesis. In chapter 4, the determinants of Last Mile Logistics and the relative Key Performance Indicators are outlined. In chapter 5 three different scenarios are analyzed, necessary for understanding how a system of Key performance indicators can be delineated, as presented in chapter 6. In Chapter 7 there the goal of the thesis should be reached with the finding of a system of Key Performance Indicators and their operationalization for the Miroglio Company. In chapter 8 the key outputs of the thesis are commented, and some considerations for future work developments are offered.

# 2 Miroglio

The Miroglio Group is an Italian industrial company operating since 1947 in the textile and fashion sectors, present in 34 countries with 49 operating companies and 4 production plants.

# 2.1 History

The entrepreneurial activity of the Miroglio family began at dawn at the end of the 1800s, when Carlo Miroglio and his wife Angela, street vendors of fabrics, expanded their activity until the opening of a sales point, in the heart of the Alba used to trade retail and wholesale fabrics. Already in the first years of the 1900' the shop counts a dozen of clerks and the activity is known in all the Piedmont region of Italy.

Thanks to the intuition and the foresight of the first-born of Carlo and Angela, a horse between the two wars, the commercial activity expands further: in 1947 Giuseppe Miroglio decided to enter the production of artificial fabrics and fibers, installing the first looms. In the same years, the sons Carlo and Franco entered the company, to hold the right to the offices of Chairman and Chief Executive Officer.

In 1955 Giuseppe Miroglio had his second, great intuition: to make clothes in series, according to the American model. The Vestebene is born. The vans on which the slogan "Piace! Because Vestebene" dominate the length and breadth of the peninsula. At the same time, the company expands its industrial activity with the use of a modern factory for the dyeing, printing and finishing of fabrics. From the cycle to the packaged dress, his intentions and strategic choices find realization: he specialized the establishments, invested money in modern machinery, created a direct distribution network.

In 1976 the Sublitex division was born: the first Cerutti rotogravure machine was installed and printed on transfer paper; the design is subsequently transferred to heat on the fabrics. In 1980, with the growth in market demand for fabrics and yarns, Miroglio invested in the creation of a modern spinning plant.

With the birth of the Elena Mirò brand, in the mid-80s the Miroglio Group began to offer quality garments for soft sizes. At the same time he started the first collaborations with great stylists such as Moschino and Krizia. In 1990 the Caractère brand was also born, destined, in terms of style and quality, to the medium-high segment of the market. In 1993 the Motivi brand was born, dedicated to the young target and organized according to the dynamics of ready-to-wear fashion. With the Motivi brand, Miroglio opens the first single-brand store; the success is such to encourage the Group to extend, over time, the retail network with the development of single-brand points of sale

for the Elena Mirò, Caractère, Oltre and Fiorella Rubino brands. In the 2000s, the Group continued to develop internationally for both internal lines, with the expansion of the leading brands Motivi and Elena Mirò, and through a strategy of acquisitions and partnerships with a "glocal" approach. Miroglio enters into partnership with Elegant Prosper (2004) and Ayaydin (2008), two clothing companies with a strong presence in China and Turkey respectively. The Miroglio Group consolidates a new philosophy of customization of the service, which is reflected in the final customer with projects focused on the enhancement of the body, through the recovery of the concept of wearability. The same philosophy is addressed to the business customer (fabrics and finished garment) through the strengthening of the supply chain.

### 2.2 Supply Chain Management of Miroglio

The Miroglio Group Supply Chain can meet the needs of the business client in the individual phases as well as in the entire process of the textile-clothing supply chain, from yarn to finished garment:

- a) Spinning;
- b) Nobilization (printed and united fabrics);
- c) Stylistic research;
- d) Model and prototype realization;
- e) Packaging;
- f) Logistics and transport management.

#### 2.3 Miroglio Textile

Founded in Alba in 1947, Miroglio Textile operates with three production plants in the following sectors: fabrics, yarns, transfer paper and technical films. Investments in research and technological innovation have exceeded €30 million in recent years, helping to make Miroglio Textile one of the major European players. The points of excellence are:

- Guarantee of a fully traceable and made in Italy print production
- Italian creativity, design and know-how
- Historical archive of over 50,000 drawings
- Creation of over 3,500 drawings per year
- Production capacity exceeding 50 million meters per year

- Customization of the service, with the possibility of adapting creativity and size prints according to customer needs
- Speed in service, printing and delivery
- Great attention to issues related to social responsibility and eco-sustainability.

Miroglio Textile has then been subdivided in two main business unit: Sublitex and Filatura Miroglio.

#### 2.3.1 Sublitex

In 1976, the Miroglio Group created Sublitex, with the aim of exploring the world of transfer printing. Today Sublitex is one of the most important companies in the world of transfer technology, able to translate paper and film into any type of design or decoration, enhancing materials such as: fabric, leather, PVC, aluminum and steel (COILS).

#### 2.3.2 Filatura Miroglio

Founded in 1981 as an activity aimed exclusively at the needs of the Group, the Filatura Miroglio segment has rapidly developed, establishing itself also on the external markets. The group is specialized in the processing of the discontinuous cotton-cut yarn, whose production, carried out by the Filatura Miroglio division, develops in the Boumerdes plant in Tunisia. Specialized in the processing of the discontinuous cotton-cut yarn, Filatura Miroglio is able to conceive and offer a wide range of fine and high quality yarns, with titrations from Ne 12/1 to Ne 80/1, used in different applications. With a particular focus on the fashion world, the company directs its solutions towards an extensive variety of creations: sportswear, underwear and workwear. Leader in the treatment and careful processing of noble fibers (angora, wool, cashmere, mohair, silk linen).

# 2.4 Miroglio Fashion

Miroglio Fashion is the Miroglio Group's Company that deals with creating, producing and distributing 12 women's clothing brands worldwide. To gain sustainable and enduring success and growth in this environment, fashion companies need to build a strong brand identity, especially with young consumers (Ross and Harradine, 2011). To support the new brand identity, new store concepts have been developed and important communication campaigns have been launched in print, radio, web and billboards.

#### 2.4.1 Motivi

Motivi is the clothing brand that combines Italian style with trendy design. The collections are designed to enhance the femininity of every woman on any occasion. The trends of each season are interpreted according to a unique style: feminine, glamorous and romantic. Each garment is studied in detail and fits into versatile collections with different looks and updated weekly.

#### 2.4.2 Elena Mirò

Elena Mirò is the Italian pret-à-porter brand dedicated to curvy women. An expertise of over 30 years in the industry is the guarantee of a perfect fit of the garments, to enhance every woman with a contemporary style, refined and always new.

#### 2.4.3 Oltre

Oltre is a lifestyle brand clothing for an adult, elegant and feminine woman. A brand that inspires and enhances women with a chic and comfortable style, and thrills them through an engaging shopping experience. The brand's mission translates into collections designed and produced for a range of sizes that covers up to 52 with a fit that follows the proportions of the body of the REAL women. Each garment is designed combining Italian style with international trends, for versatile looks for everyday needs.

#### 2.4.4 Ipekyol

Founded in 1986, the first Ipekyol store was inaugurated in 1989 in Rumeli Caddesi, Nişantaşı, Istanbul. Ipekyol is today one of the most prestigious brands of women's prêt-à-porter. Many successful women prefer mainly Ipekyol. Currently Ipekyol sells its products in seven countries including Cyprus, Northern Iraq, Azerbaijan, Bahrain, Kuwait, Qatar and Saudi Arabia. Ipekyol shops are usually found at the entrance of shopping centers, next to the shops of the main competitors. Ipekyol will continue to develop collections for local and global markets to meet the needs of modern urban women who value quality and want to experience quality in all aspects of their lives. Ipekyol, which created for the first time the brand and the collaboration of designers in the Turkish textile sector, has collaborated with the Turkish designer Zeynep Tosun in 2015. This collaboration has continued until 2016-17

#### 2.4.5 Twist

Twist was created for women of all ages who felt young in 1997, and was soon recognized by a large clientele that likes to buy distinctive and different clothes and buy quality products at reasonable prices. There are shops in Azerbaijan, Kuwait and Cyprus. Fantastic style and original design, Twist is aimed at different tastes with its collection of shoes, bags and accessories, as well as pieces it can be combined with anywhere and at any time. With the pieces that capture the time in their collections, they are facing a line that symbolizes freedom. It adapts to the dynamism of the city and reflects a stereotypical style that frees the soul in its innovative collections that are freely expressed.

#### 2.4.6 Machka

Founded in 2004 by Ayaydin-Miroglio Group, Machka took over Turkey's luxury clothing brand already carrying the first label. Nowadays, Machka has a place among international and local brands, offering high quality designs with unique craftsmanship. The Machka collections are designed by the Turkish designer Ece-Ayşe Ege of the Dice Kayek brand since they were introduced in the fashion world. Designs that bring feminine elements but do not compromise the approach to chic, timeless and never old fashion of the city with its sophisticated and modern line.

#### 2.4.7 Tailor

Tailor is the perfect combination of technology and tradition. Its production system allows to work with the latest generation machinery and with higher precision. The customizations selected by the customers and the packaging details of the products are made by tailors who have more than 25 years of experience in the field of Made in Italy. Thanks to an intuitive web configurator and with a few clicks it is possible to instantly customize and view the item according to each style and need.

#### 2.4.8 Fiorella Rubino

The main focus of this project will be on the main brand, Fiorella Rubino, which is an Italian fast fashion brand with a lively, urban and trendy style, dedicated to women over 46 who live their physicality with ease. Casual and easy-to-wear garments with a perfect fit: from cuts to the choice of materials, all models are designed to offer comfortable clothing with a glamorous style. The collections are characterized by a gritty and sensual personality, and combine quality and passion for details at an advantageous price. Bright colors, sequins, studs, rhinestones, prints and lace

embellish even the most essential garments making the style of Fiorella Rubino unique and recognizable. Present in Italy with over 200 stores, the brand has the largest sales network in Italy dedicated to the curvy segment.

# **3** Theoretical background

# 3.1 What is a key performance indicator

Key Performance Indicators (or KPI) are essential tools for observing the evolution of the production process and its context as a model of a generic system or process (Badawy 2016). Therefore, they are the basis for evaluations, judgments or decisions in industries. According to the norm UNI 11097:2003 an indicator is a "qualitative and/or quantitative information associated with a phenomenon (or a process or a result) under observation, which allows to evaluate the modifications of the latter in time, and of checking the achievement of the objectives for the quality set, in order to allow to take the correct decisions and choices".

Indicators can be Objective indicators which link empirical manifestations to symbolic manifestations so that the mapping does not depend on the subject who performs it, or Subjective, empirical manifestations that are subjectively mapped into symbolic manifestations, depending on subjective perceptions or personal opinions (different people can map the same empirical manifestation into different symbolic manifestations). Indicators can be Basic, obtained from a direct observation of a generic system, or Composite, obtained combining the information of one or more indicators.

# **3.2** Features of each indicator

The main features here analyzed are: the subjectivity or objectivity, the availability, the simplicity, the prescriptive effect and the consistency with the representation target of KPIs.

### 3.2.1 Subjectivity or objectivity

Subjectivity refers to how a person's own uniqueness influences their perceptions. An indicator is said to be subjective if its value reflects the subject's way of being and thinking, which derives from a personal vision. On the other hand, Objectivity refers to a vision of the object, considered as an autonomous or generalized entity, and therefore extraneous to any possibility of intervention or interpretation by the individual. An indicator is said to be objective if his value doesn't depend on customers' personal visions.

#### 3.2.2 Availability

Availability is the possibility to use something widely and freely. Availability depends on circumstances. In the following section, I will indicate the data necessary to measure the availability of each Key Performance Indicator.

#### 3.2.3 Simplicity

Simplicity refers to the ease with which the indicator is understood and used.

#### **3.2.4** Prescriptive effect

Prescriptive Effect is related to the field of Prescriptive Analytics. The relatively new field of prescriptive analytics allows users to "prescribe" several different possible actions to guide them towards a solution. In a nut-shell, these analytics are all about providing advice. Prescriptive analytics attempt to quantify the effect of future decisions in order to advise on possible outcomes before the decisions are actually made. At their best, prescriptive analytics predicts not only what will happen, but also why it will happen, providing recommendations regarding actions that will take advantage of the predictions.

These analytics go beyond descriptive and predictive analytics by recommending one or more possible courses of action. Essentially they predict multiple futures and allow companies to assess a number of possible outcomes based upon their actions. Prescriptive analytics use a combination of techniques and tools such as business rules, algorithms, machine learning and computational modelling procedures. These techniques are applied against input from many different data sets including historical and transactional data, real-time data feeds, and big data.

Prescriptive analytics are relatively complex to administer, and most companies are not yet using them in their daily course of business. When implemented correctly, they can have a large impact on how businesses make decisions, and on the company's bottom line. Larger companies are successfully using prescriptive analytics to optimize production, scheduling and inventory in the supply chain to make sure that they are delivering the right products at the right time and optimizing the customer experience.

In conclusion, an indicator has Prescriptive Effect if its analysis advising on possible outcomes recommends one possible action to be carried out.

#### 3.2.5 Consistency with the representation target

Every indicator should properly operationalize a representation-target. The mapping should be thoroughly verified before using the indicator.

# 3.3 What is a system of indicators

By the interactions and definition of different indicators a Measurement and Control system is composed that can guide the company towards achieving its short, medium and long-term objectives, both in a static and dynamic perspective.

The system must be critical, synthetic, exhaustive, correctly detailed, flexible, understandable, comparable, timely and non-redundant.

- 1. Critical: The industry's management takes decisions based on this system of indicators
- 2. *Synthetic:* It is expressed by a simple or composed variable. Indicators are relevant if they support decisions in critical areas of management, where the phenomena that most affect performance are more numerous. They must provide information on the identification of alternative management choices the understanding of the relations between the decisions taken and the achievement of the objectives.
- 3. *Exhaustive*: Indicators of the measurement and control system chosen must treat all parts or aspects of the system of interest, without omission.
- Correctly detailed: The possibility must be excluded that if an indicator maps two empirical manifestations – not distinguished according to a representation-target – into different symbolic manifestations, then the level of detail is excessive.
- 5. *Flexible:* The system is flexible because it can change in relation to changing needs, and to changes of measurement. In the current situation, dominated by conditions of strong dynamism and complexity of the external environment and business strategies, the critical factors of success and the parameters of measurement can change even in the short term, and the speed with which these changes are absorbed by the management strategy can make the difference between a company that survives and one that fails.
- 6. Understandable: The system is understandable if it can be transferred within the Organization with a language and a level of refinement suitable for the needs of the users. In this way the whole organization has the knowledge of the objectives of performance, of the critical variables that determine it and of the results produced by all the activities and the processes carried out in the company. In this way everyone knows in which

direction the company is going and what actions must be taken to achieve the objectives set. The punctuality index must not be understood by the Director of Logistics and the general manager alone, but it must be a common heritage of the logistics Office and the warehouse.

- 7. *Comparable:* The system is represented by quantitative or qualitative variables that are comparable.
- 8. *Timely:* the ability to produce and transmit information in the most opportune moments based on the decision processes: this allows for the right information to reach all the operators in the Supply Chain in the shorter possible time period to avoid misunderstandings.
- 9. *Non redundant:* It is fundamental to avoid the presence of useless indicators, those that if eliminated do not generate any change in the exhaustiveness of the whole system.

Through this set of indicators, the industry's management can not only measure business phenomena in time and space (in various business units, in various markets), but can also plan and program business activities (defining measurable goals in the short and medium Period), measure the deviations (between expected objectives and results obtained), and undertake the necessary actions to correct the gaps.

Business performances are usually numerous and diversified. Some have general characteristics and therefore are found in all processes, such as performance in terms of cost, time, quality and value; others are typical of specific processes, such as the performance of productivity, versatility and flexibility in the field of logistical advantages. The quantitative assessment of the performance of business processes requires the definition of a system of indicators that allows the company to represent, within an organic and prospective framework, the ability of the enterprise to pursue its objectives of short, medium and long term.

It is not a system of measures that considers only the results achieved, according to a vision of static analysis, but a system that is also able to underline the ability of the company to adapt to changes in the external environment (often turbulent and unstable), according to a vision of dynamic analysis.

# 3.4 The last mile logistics

The last mile logistics concern the last phase of the Supply Chain, in particular the final section of the delivery of a good, from the sorting center to the place indicated for the withdrawal, where it is delivered to the customer (Joerss 2016).

From a purely logistical point of view, activities of the last-mile delivery process comprise:

- 1. Consolidating items ordered by different customers
- 2. Managing the warehouse in terms of receiving items, handling and storing them
- 3. Loading the vehicles so to allocate the goods to different delivery locations
- 4. Scheduling the delivery and optimizing the vehicle routing
- 5. Selecting the carriers and rating the shipments.

The main aim is to reach several changeable points of delivery, in continuous growth and variable day by day, in an always shorter time from the moment of the order. The issues related to this phase of the process are relatively recent for companies, because they are linked to the spread of the e-commerce, which, in Italy, has had an exponential growth in recent years. Potential problems in this phase are due to multiple reasons, ranging from the fragmented nature of last-mile deliveries, loss of efficiency from road congestion, the use of polluting vehicles not loaded optimally. Therefore, the methods for dealing with them are not yet consolidated. This is a very delicate phase of the production process as it involves different stakeholders: suppliers, for the supply of products to be delivered, customers, who have ordered the goods, towns and the related communities, which are affected by pollution and traffic jams. It is therefore necessary to reconcile different needs and sometimes contrasts between them. The optimization of the delivery management means, on the one hand, to significantly reduce the distribution costs and, on the other hand, meet consumer expectations that should be one of the focus of the company. The first important step is to switch from viewing the last mile logistics and the supply chain as two different entities to considering them as one integrated entity. This allows to incorporate the transport of goods in a wider context that includes points of storage, transit and interchange, to give life to the real process of physical distribution of goods. That is, not only distributing goods and materials, but creating a network of actors and infrastructures coordinated for the realization of the basic statement of logistics: the right product in the right place, at the right time.

# 4 Determinants and key performance indicators in last mile logistics

# 4.1 Principal determinants of last mile logistics

The determinant of a given process or problem is a factor that is critical to the goal's success (Hyuk-Soo Cho, 2014). In our case there are several determinants to be considered in the analysis that looks for appropriate indicators: customer satisfaction, flexibility, environmental impact, stock, warehouse, transportation, geographical area and market penetration and density, employees and e-business.

### 4.1.1 Customer satisfaction

Consumer satisfaction has become a very important aspect in the analysis of a company's production strategy. It can be measured as the comparison between the expectations with which the customer approaches the type of service (delivery) and the actual perception that occurred after the delivery. We can identify some aspects that influence the customer's satisfaction: the reliability of the service, or the judgment concerning the capacity of the undertaking service to operate in a reliable and precise manner; the response capacity, where the user's judgement on the company's ability to constitute a support function that facilitates the relationship between operators and users is investigated; the reassurance capacity, which investigates the ability of staff to transmit security in carrying out the deliveries, creating an environment oriented to the acceptance of needs and on empathy; the ability of the company to provide a personalized service able to meet the real needs of the individual customer, in its specificity and individuality not considering the customer as one over a million.

# 4.1.2 Environmental impact

It is an alteration from a qualitative and quantitative point of view of the environment, considered as a set of natural resources and human activities linked to them. The factors considered to quantify the environmental impact of chemical and physical pollution, the structure and stability of the territory, the modification of the animal and plant ecosystem, the sanitary and landscape aspects (Jabali, 2012).

It has to be underlined that often consumers are not prepared to either pay more or wait longer for their goods in return for a greener service.

#### 4.1.3 Stock and warehouse management

The management of stock as a macro process is responsible for planning the stop and transfer of the materials between the various logistic nodes. We can identify three main processes:

- Procurement planning: This process deals with planning the transfer of materials from internal and external suppliers according to the demand for materials within the various nodes. In this process, purchase, work account, production, or transfer orders are issued between different warehouses. The process starts downstream of the demand forecast and aims to reduce the rest of the materials inside the knots.
- 2) Forecast of the application: In this phase the demands for material within the various nodes are identified. This process purchases customer orders and forecasts for subsequent periods, and also evaluates the feasibility of the delivery of customer's orders. The goal of the process is the reliability of the demand prediction.
- 3) Planning of Materials level: This process deals with the definition of the parameters of management of the flows of materials as the minimum stock, the point of tidying and the economic lot. It is a periodic activity that defines the parameters necessary for the supply planning and the demand forecast. It is fundamental for being able to respond promptly to new orders but if badly managed it can become a primary cost for the company.

Instead, the warehouse management must take care of managing the rest of the materials within a node that can be the single department store up to the largest regional distribution warehouse. The objective of this area is to make the stock as efficient as possible in terms of both the operational and the financial points of view. There are several phase to be managed:

- The receiving phase: The aim of this process is to ensure that the material from another logistical node is recognized and prepared to enter the logistical node to reduce the waiting time of the materials for being identified and correctly sorted.
- 2) Storage: In this process the material is stored within the different storage systems in the most appropriate allocation for its subsequent withdrawal to avoid its loss within the logistic node.
- 3) Withdrawal: In This process the material is picked up to be transferred from the node. At this stage the withdrawals that need to be made are defined, materials are taken, identified, checked and sorted in the various destinations. The aim of this process is to make the withdrawal phase short and to reduce the identification and sorting errors.
- 4) Shipping. In this process the collected material is prepared to be transferred outside the logistic node. The goal of this process is to minimize errors in the preparation of the shipping units.

#### 4.1.4 Transportation

Although they can seem to be not related, Transportation is strictly linked to changes in the downstream supply chain because it concerns several aspects, such as shipment size, number of delivery stops, delivery frequency and time windows, number of vehicles required, and vehicle size (Rotem-Mindali and Weltevreden, 2013). In the transportation phase, the industry's operators handle the transfer of materials between the various nodes, especially between the nodes owned by the company and stores and the customers' houses.

There are two main processes in this phase:

- Distribution Management: This process deals with handling the shipment of materials to the various nodes. In this process the dispatch plan is defined and the retreats are reserved. The goal of this process is to optimize shipments in order to reduce transportation costs.
- 2) Management of fleets: This process deals with the management of both internal and external means for the transfer of materials. In this process, agreements with external vendors for outsourced shipments are defined, but for managed shipments on their own, all the operations necessary to manage the fleet of vehicles are carried out (maintenance, insurance, drivers). The aim of the process is to optimize the necessary resources, reduce the delivery time and the reliability of deliveries.

#### 4.1.5 Flexibility

The flexibility is the capacity to adapt to different situations and conditions. It can be called upon due to the customer's sudden exigencies if, for example, the customer is not at home at the moment of delivery, or if unpredictable environmental factors delay the delivery. It is the capacity to quickly accommodate every kind of order.

#### 4.1.6 Geographical Area and Market Penetration and Density

In certain regions, market penetration may be crucially important to attain a sufficient critical mass. Here, the main sub characteristics or proxy variables are the density of the region or market and the average distance between the various delivery points, as well as the extent to which goods may be pooled during routing.

#### 4.1.7 Employees

The management of people.

#### 4.1.8 E-Business

Internet is becoming every day more important in the last mile logistics, both to make an order and to control the status of the shipped order. The easiness of use of a web-site or application is fundamental and for a company is a key factor, especially in the fast fashion industry, since for reasons of competition it is fundamental to make the web-site work as smoothly as possible, especially in important seasons of the year such as Christmas.

# 4.2 Key performance indicators for last mile logistics

In this chapter some indicators will be outlined that relate to each of the above determinants. This will be fundamental in the subsequent analysis.

#### 4.2.1 Key Performance Indicators for Customer satisfaction

To the determinant "Customer Satisfaction" are related six Key Performance Indicators:

- 1. *Degree of customer satisfaction*: relative to the delivery time (subjective indicator, expressed directly by the customer).
- 2. *Degree of customer satisfaction, relative to the delivery service*: It is a subjective indicator expressed directly by the customer.
- 3. *Percentage of deliveries not successful in a given period of time due to damaged goods or packaging during transport:* Calculated as the ratio between the number of deliveries not successful (because damage to the product or packaging) and the number of total deliveries in the period considered.
- 4. *Percentage of deliveries not successful in a certain period of time, due to the absence of the user at the place of withdrawal of the parcel*: Obtained as a ratio between the number of deliveries not successful (cause end user absence in the place of withdrawal) and the total number of deliveries, during the period considered.
- 5. *Percentage on time deliveries:* Calculated as the ratio of the number of on-time deliveries over the total number of the deliveries within a given time interval.
- 6. *Order accuracy:* Calculated by comparing the known inaccuracies of orders (known for complaints or disputes) over all shipped orders.

# 4.2.2 Key performance indicators for Environmental impact

To the determinant "Environmental Impact" are related five Key Performance Indicators:

- Total number of CO<sub>2</sub> and NO<sub>x</sub> emissions every day: It is the total number of emissions of CO<sub>2</sub> and NO<sub>x</sub> in a single day due to the deliveries.
- Quantity of fuel consumed by means of transport, in relation to the number of deliveries made: It is the ratio between the liters of fuel consumed by the total of the means of transport and the total of deliveries made.
- 3. *Emissions of CO<sub>2</sub> and NO<sub>x</sub> every delivery:* It is calculated as the ratio between the total emission of the delivery means and the total number of deliveries.
- 4. *Percentage of deliveries by ecological vehicles*: It is computed as the ratio between the deliveries made using ecological vehicles (as bike or electrical car) over the total number of deliveries.
- 5. *Percentage of available ecological vehicles:* It is computed as the ratio between the available ecological vehicles ( as bike or electrical car) over the total number of available means of delivery.

# 4.2.3 Key performance indicators for Stock and warehouse management

To the determinant "Stock and warehouse management" are related ten key performance indicators:

- 1. *Average number of items in Stock:* It is the average number of stock in a given period and it is an indicator to minimize, since each item in stock is a cost. And space in not unlimited unfortunately.
- 2. *Average inventory management each day:* It can be computed as the average cost of the inventory management for each item, times the average number of items present in the inventory each day.
- 3. Inventory turnover: Shipped/Average Inventory
- 4. *Punctuality of the suppliers:* It is calculated as the ratio between the orders delivered in time by the suppliers and the total number of orders emitted.
- 5. *Overstock*: Surplus stock value/stock value
- 6. *Obsolescence* : Obsolete inventory value/stock value
- 7. *Percentage of acceptable orders:* It is calculated as the ratio between the Number of acceptable orders in a given period and the number of total orders received in the period.

- 8. *Warehouse occupancy rate:* It is the ratio between occupied cells of the warehouse over the total number of cells.
- 9. *Surface saturation:* It is the ratio between the occupied area and the total available area for storing materials.
- 10. *Volumetric saturation:* It is the ratio between the occupied volume and the total volume of the warehouse space.
- 11. *Inventory accuracy:* Number of items in the right location over the total number of items moved in a given period of time.
- 12. *Cost of Inventory management over Revenues:* It can be computed as the ratio between the average cost of inventory management each day and the sum of prices of the goods delivered each day.

# 4.2.4 Key performance indicators for Transportation

To the determinant "Transportation" are related fourteen Key Performance Indicators:

- 1. *Average Delivery time*: It is computed as the sum of the time for each delivery over the total number of deliveries
- 2. *Average Vehicle Capacity Used Versus Available:* The ratio between the number of vehicle used for the delivery and the total number of vehicle available in a given period of time.
- 3. *Average vehicle saturation*: The ratio between the sum of the actual used capacity by all the vehicles in a given period of time and the sum of the available capacity of the vehicles.
- 4. *Average Number of vehicles necessary each day:* It is the number of vehicles used to deliver products in a given period of time.
- 5. *Number of Kilometers treaded every day:* It is the number of kilometers treaded by all the vehicles in a given period of time.
- 6. *Number of deliveries every day*: It is the number of deliveries in a given period of time (one day).
- 7. *Average number of items each vehicle:* It is computed as the total number of items delivered in a given period of time and the total number of vehicles used in that period.
- 8. *Number of deliveries to store:* It is the ratio between the number of deliveries to a store and the total number of deliveries in a certain period of time.
- 9. *Number of deliveries to customers:* It is the ratio between the number of deliveries to customers and the total number of deliveries in a certain period of time.

- 10. *Average Number of items each delivery:* It is the ratio between the total number of item delivered in a given period of time and the total number of deliveries in the same period.
- 11. *Percentage of deliveries by car or trucks:* It is computed as the number of deliveries by car or trucks over the total number of deliveries in a given period of time.
- 12. Average cost of transportation for km in a day: It can be computed as the ratio between the total cost of transportation ( i.e. fuel, tolls,...) in a day and the total number of Kilometers treaded every day
- 13. *Average cost of transportation in a day:* It is the sum of the cost of transportation of each means of transport in a day.
- 14. *Cost of Transportation over Revenues:* It can be computed as the ratio between the average cost of transportation each day and the sum of prices of the goods delivered each day.

#### 4.2.5 Key performance indicators for Flexibility

To the determinant "Flexibility" are related eight Key Performance Indicators:

- 1. *Percentage of customized items:* It is the ratio between the number of customized items and the total number of items delivered
- 2. *Average Time for managing non-ordinary orders:* It is the average of the time for producing and delivering non-ordinary items in terms of particular customers' requests.
- 3. *Average Time for managing personalized items:* It is the average of the time for producing and delivering personalized items
- 4. *Ability to satisfy non-ordinary orders:* It is the ratio between the order I can satisfy (According to the customer's requests in terms of order's specifications) and the total number of orders.
- 5. *Percentage of non-ordinary orders*: It is the ratio between the number of non-ordinary orders ( particular requests of the customers) and the total number of orders.
- 6. *Percentage of non-ordinary due dates of delivery due to customers' requests:* It is the ratio between the number of deliveries with non-ordinary due dates and the total number of deliveries.
- 7. *Efficiency in managing non-ordinary orders*: It is the ratio between the average time for managing non-ordinary orders and the average time for managing ordinary orders
- 8. *Efficiency in managing personalized items:* It is the ratio between the average time for managing personalized items and the average time for managing ordinary items

# 4.2.6 Key performance indicators for Geographical area and market penetration and density

To the determinant "Geographical area and market penetration and density" are related eight Key Performance Indicators:

- 1. Number of stores: It is the total number of stores of the company spread in the world.
- 2. *Number of warehouses:* It is the total number of warehouse of the company spread in the world.
- 3. *Percentage of stores in Italy*: It is computed as the ratio between the number of stores in Italy and the total number of stores of the company in the world.
- 4. *Number of Stores in Europe:* It is computed as the ratio between the number of stores in Europe and the total number of stores of the company in the world.
- 5. *Percentage of warehouses in Italy:* It is computed as the ratio between the number of warehouses in Italy and the total number of warehouses of the company in the world.
- 6. *Percentage of warehouses in Europe:* It is computed as the ratio between the number of warehouses in Europe and the total number of warehouses of the company in the world.
- 7. *Percentage of orders in Italy:* It is the ratio between the number of orders received in Italy and the total number of orders received by the company in the world.
- 8. *Percentage of orders in Europe*: It is the ratio between the number of orders received in Europe and the total number of orders received by the company in the world.

# 4.2.7 Key performance indicators for Employees

To the determinant "Employees" are related four Key Performance Indicators:

- 1. *Number of employees:* It is the number of employees in the whole supply chain from the "receiving goods" in the warehouse to the sales-men.
- 2. *Available hours in a day:* It can be computed multiplying the number of workers and the number of working hours in a standard day (usually 8 hours)
- 3. *Average number of hours actually worked in a day:* It can be estimated empirically or computing the difference between the time that would be sufficient to finish the work, and the total time available.
- 4. *worker utilization:* Divide the average number of hours actually worked by the available hours in a day

# 4.2.8 Key performance indicators for E-Business

To the determinant "E-Business" are related five Key Performance Indicators:

- 1. Website accessibility: It is a subjective indicator expressed directly by the customer.
- 2. *Easiness in seeing the state of the order*: It is the ratio between the online orders of which is possible to check the progress and the total number of orders.
- 3. *Percentage of items available on line over items available in store:* It is computed as the ratio between the number of items available online and the number of items available in store.
- 4. *Percentage of online-orders:* It is the ratio between the online orders and that in the stores.
- 5. *Percentage of online customized order over total number of online orders:* It is the ratio between the number of online customized orders and the total number of online orders.

# 4.3 Interactions between determinants and the related key performance indicators

In the previous section some indicators related to different aspects of the last mile logistics and of the Supply Chain have been analyzed. It is fundamental to immediately underline how some determinants, and therefore indicators, could be at odds with each other.

This section will focus on the relationships between the determinants and the most relevant indicators for each of them.

### 4.3.1 Interaction between Customer satisfaction and Flexibility

The Customer satisfaction and the Flexibility are two determinants strictly positively correlated. In fact, the more the company is flexible to the needs of the customers, the higher will be her satisfaction.

Indicators as the Degree of Customer satisfaction related to the delivery time and the Degree of customer satisfaction related to the delivery service or the Order accuracy are influenced positively by the Average Time for managing non-ordinary orders, Average Time for managing personalized items and Ability to satisfy non-ordinary orders.

# 4.3.2 Interaction between Customer satisfaction and Environmental impact

Customers are every day more eager to have a delivery as ecological as possible, but even though not willing to pay more, their satisfaction is affected by the mode of delivery, for example by the indicators of the Emissions of  $CO_2$  and  $NO_x$  during every delivery.

# 4.3.3 Interaction between Customer Satisfaction and Stock and warehouse management

Obviously the degree of customer satisfaction relative to the delivery time, and more in general her satisfaction, is influenced by the percentage of orders that can effectively be accepted and processed.

# 4.3.4 Interaction between Customer satisfaction and Transportation

These determinants are very strictly correlated since 90% of customer satisfaction depends on the time of delivery which is in turn strictly influenced by the Transportation, the last phase of the

whole process. Lower the Average Delivery time, higher the Customer Satisfaction. It is important to note how the main effect of minimizing the delivery time is the increasing costs.

## 4.3.5 Interaction between Customer satisfaction and E-Business

Customer satisfaction and E-business are strongly correlated since for customers E-stores are a great opportunity for several reasons: first of all comfort and the possibility to see different items without too much effort. Higher the level of indicators as Website accessibility, Ease in seeing the state of the order, higher the level of the Degree of customer satisfaction related to the delivery service, in this case an E-delivery service.

# 4.3.6 Interaction between Flexibility and Stock and warehouse management

Flexibility and Stock and warehouse management are two determinants negatively correlated since to decrease the Average Time needed to manage non-ordinary orders and the Average Time needed to manage personalized items, and to increase the Ability to satisfy non-ordinary orders, it is necessary to have a higher level of Items in Stock, which implies higher costs.

# 4.3.7 Interaction between Flexibility and E-Business

Flexibility is strictly correlated to the E-Business since on web sites there is more variety of items that must be managed by the company flexibly. In case of a high Percentage of items available on line over items available in store means that lots of items are not very common, sometimes online it is also possible to personalize items, involving important effort in terms of flexibility for the company.

# 4.3.8 Interaction between Environmental Impact and Transportation

The Environmental impact depends almost exclusively on the Transportation. Indicators as the Total number of  $CO_2$  and  $NO_x$  emissions every day and the Emissions of  $CO_2$  and  $NO_x$  every delivery are strictly influenced by the vehicle used for the delivery, the Average vehicle saturation, the Average Number of vehicles necessary each day, the Number of Kilometers treaded every day, the Percentage of deliveries by car or trucks, the Percentage of deliveries by ecological vehicles and the Percentage of available ecological vehicles.

# 4.3.9 Interaction between Flexibility and Transportation

Flexibility and Transportation are strictly negatively correlated since often to increase the company's level of the Percentage of non-ordinary due dates of delivery due to customers' requests without lowering the customers' satisfaction, it is necessary to increase the Average cost of transportation for km in a day.

# **4.3.10** Interaction between Transportation and Geographical area and market penetration and density

Transportation and Geographical area and market penetration and density are two determinants strictly correlated since to a higher number of stores and warehouses, correspond a lower Average time of delivery and Average cost of transportation in a day.

# 4.3.11 Other relationships

Some relationships have not been analyzed because they are either not important or they depend on other analyzed relationships.

# 4.4 Features of each indicator depending on the related determinant

The properties which will be analyzed are those explicated in paragraph 2.2: subjectivity or objectivity, availability, simplicity and prescriptive effect. Their Consistency with the representation target property will not be considered in this analysis because it depends on the company's goals. All indicators are in line with the aim of improving the Last Mile Logistics management, but each company has its own idea of the result to obtain, the time to dedicate to this activity and the time horizon for achieving the goal. The indicators will be a toll to evaluate whether the aim have been achieved (Macharis, 2009)

# 4.4.1 Features of indicators related to Customer satisfaction

To main features of the indicators related to the determinant "Customer satisfaction" are analyzed:

#### 1. Degree of customer satisfaction, relative to the delivery time

- a) Subjective or objective: It is a subjective indicator.
- b) Availability: It is necessary to ask customers to make a questionnaire after the delivery.
- c) Simplicity: It is an easy indicator to manage and understand since the evaluation can be expressed in a rank from 1 to 10, for example.

 d) Prescriptive effect: It can have prescriptive effect since from the evaluation given by the customer it is possible to understand if business model changes are necessary.

#### 2. Degree of customer satisfaction, relative to the delivery service

- a) Subjective or objective: It is a subjective indicator.
- b) Availability: It is necessary to ask customers to make a questionnaire after the delivery.
- c) Simplicity: It is an easy indicator to manage and understand since the evaluation can be expressed in a rank from 1 to 10, for example.
- d) Prescriptive effect: It can have prescriptive effect since from the evaluation given by the customer it is possible to understand if business model changes are necessary.

# 3. Percentage of deliveries not successful in a given period of time due to damaged goods or packaging during transport

- a) Subjective or objective: It is an objective indicator.
- b) Availability: It is necessary to keep track of the number of deliveries not successful (because damage to the product or packaging) and the number of total deliveries in the period considered.
- c) Simplicity: It is an indicator which value is very clear to understand and evaluate.
- d) Prescriptive effect: It have not prescriptive effect since there are several reasons for a high number of damaged goods or packaging not related directly to the business model.

# 4. Percentage of deliveries not successful in a certain period of time, due to the absence of the user at the place of withdrawal of the parcel

- a) Subjective or objective: It is an objective indicator.
- b) Availability: It is necessary to keep track of the number of deliveries not successful (cause end user absence in the place of withdrawal) and the total number of deliveries, during the period considered.
- c) Simplicity: It is an easy indicator to manage and understand.
- d) Prescriptive effect: It have not prescriptive effect since it is dependent also on external factors as Customers' last minute engagements.

#### 5. Percentage on time deliveries

- a) Subjective or objective: It is an objective indicator.
- b) Availability: It is necessary to keep truck of number of on-time deliveries over the total number of the deliveries within a given time interval.
- c) Simplicity: It is simple to understand since it is a percentage.
- d) Prescriptive effect: It can have prescriptive effect since a low value of the indicator depends only on company's factors.
- 6. Order accuracy
  - a) Subjective or objective: It is an objective indicator.
  - b) Availability: It is necessary to keep track of the known inaccuracies of orders (known for complaints or disputes) over all shipped orders.
  - c) Simplicity: It is an easy indicator to understand since it is a percentage
  - d) Prescriptive effect: It can have prescriptive effect since the accuracy depends exclusively on the company effectiveness.

# 4.4.2 Features of indicators related to Environmental impact

The main features of each indicators related to the determinant "Environmental impact" are analyzed:

#### 1. Total number of $CO_2$ and $NO_x$ emissions every day

- a) Subjective or objective: It is an objective indicator.
- b) Availability: It is necessary to have an idea of the emissions of each type of vehicle
- c) Simplicity: It is not an easy indicator to manage since it not comparable with other values and depends on the distance and time of the delivery.
- d) Prescriptive effect: It does not have prescriptive effect since prescriptive effects are related to other indicators that can be related also to the Environmental Impact (such as the Transportation). It can be only a useful factor to evaluate emissions every day.

# 2. Quantity of fuel consumed by means of transport, in relation to the number of deliveries made

- a) Subjective or objective: It is an objective indicator.
- b) Availability: It is necessary to keep track of the liters of fuel consumed by the total of the means of transport and the total of deliveries made.
- c) Simplicity: It is not an easy indicator to manage since it not comparable with other values and depends on the distance and time of the delivery.
- d) Prescriptive effect: It does not have a prescriptive effect since prescriptive effects are related to other indicators linked to the other determinants that can be related also to the Environmental Impact (such as the Transportation). It can be only a useful factor to evaluate emissions every day.

### 3. Emissions of $CO_2$ and $NO_x$ every delivery

- a) Subjective or objective: It is an objective indicator.
- b) Availability: It is necessary to keep track of the total emission of the delivery means (relative to a table detailing the emissions of each vehicle) and the total number of deliveries.
- c) Simplicity: It is not an easy indicator to manage since it not comparable with other values and depends on the distance and time of the delivery.
- d) Prescriptive effect: It does not have any prescriptive effect since prescriptive effects are related to other indicators linked to the other determinants that can be related also to the Environmental Impact (such as the Transportation). It can be only a useful factor to evaluate the emissions at every delivery.

### 4. Percentage of deliveries by ecological vehicles

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of deliveries made using ecological vehicles (such as bikes or electrical cars) over the total number of deliveries.
- c) Simplicity: It is an indicator very easy to understand since it is a percentage
- d) Prescriptive effect: It can have a prescriptive effect if used in coordination with indicators related to the Environmental Impact determinant.

### 5. Percentage of available ecological vehicles

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of available ecological vehicles (such as bikes or electrical cars) over the total number of available means of delivery.
- c) Simplicity: It is an indicator very easy to understand since it is a percentage
- d) Prescriptive effect: It can have prescriptive effect if used in coordination with indicators related to the Environmental Impact determinant.

### 4.4.3 Features of indicators related to Stock and warehouse management

The main features of the indicators related to the determinant "Stock and warehouse management" are analyzed:

### 1. Average number of items in stock

- a) Subjective or objective: It is an objective indicator.
- b) Availability: It is necessary to keep track of number of stock in a given period
- c) Simplicity: It is an easy indicator to understand since it is a number
- d) Prescriptive effect: It does not have any prescriptive effect since there is no clear link to the business model of the company. Prescriptive effects are linked to other indicators of the same determinants.

### 2. Average inventory management each day

- a) Subjective or objective: It is an objective indicator.
- b) Availability: It is necessary to keep track of the average cost of inventory management and the average number of items in inventory each day
- c) Simplicity: It is an easy indicator to understand since it is a number
- d) Prescriptive effect: It does not have any prescriptive effect since it has to be compared to some other values.

### 3. Inventory turnover

- a) Subjective or objective: It is an objective indicator.
- b) Availability: It is necessary to keep track of the shipped and of the average Inventory ( to compute easily)
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It can have prescriptive effect since it depends strongly on the company's choices.

### 4. Punctuality of the suppliers

- a) Subjective or objective: It is an objective indicator.
- b) Availability: It is necessary to keep track of the orders delivered in time by the suppliers and the total number of orders emitted.
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It does not have a prescriptive effect since there is no clear link to the business model of the company. Prescriptive effects are linked to other indicators of the same determinants. If low in value, this indicator can highlight the

need to investigate the reasons why e.g. suppliers always late, maybe in view to renegotiate the terms of the contract.

### 5. Overstock

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the Surplus Stock value and the Stock Value.
- c) Simplicity: It is an indicator very easy to understand since it is a percentage
- d) Prescriptive effect: It can have prescriptive effect since the value depends in part on the management choices of the company.

### 6. Obsolescence

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the Obsolete inventory value and the average stock value
- c) Simplicity: It is an indicator very easy to understand since it is a percentage
- d) Prescriptive effect: It can have prescriptive effect since the value depends in part on the management choices of the company.

### 7. Percentage of acceptable orders

- a) Subjective or objective: It is an objective indicator
- a) Availability: It is necessary to keep track of the Number of acceptable orders in a given period and the number of total orders received in the period.
- b) Simplicity: It is an easy indicator to understand since it is a percentage
- c) Prescriptive effect: It does not have a strong prescriptive effect since there is no clear link with the management choices of the company.

### 7. Warehouse occupancy rate

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the Number of Occupied cells of the warehouse and the total number of cells.
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It does not have a strong prescriptive effect since there is no clear link with the management choices of the company, but it can be a useful indicator to evaluate if further investigation is necessary.

### 8. Surface saturation

- a) Subjective or objective: It is an objective indicator.
- b) Availability: It is necessary to keep track of the occupied area and the total available area for storing materials.
- c) Simplicity: It is an easy indicator to understand since it is a percentage.
- d) Prescriptive effect: It does not have a strong prescriptive effect since there is no clear link with the management choices of the company, but it can be a useful indicator to evaluate if further investigation is necessary. In the long term it can be useful for understand if the investment in the warehouse is too large compared to the volume of goods.

### 9. Volumetric saturation

- a) Subjective or objective: It is an objective indicator.
- b) Availability: It is necessary to keep track of the occupied volume and the total volume of the warehouse space.
- c) Simplicity: It is an easy indicator to understand since it is a percentage.
- d) Prescriptive effect: It does not have a strong prescriptive effect since there is no clear link with the management choices of the company, but it can be a useful indicator to evaluate if further investigation is necessary. In the long term it can be useful for understand if the investment in the warehouse is too large compared to the volume of goods.

### 10. Inventory accuracy

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the Number of items in the right location and the total number of items moved in a given period time.
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It has some prescriptive effect since depends on the accuracy and effectiveness of the warehouse management model of the company. In case of low values on this indicator the system doesn't work effectively.

### 11. Cost of Inventory management over Revenues

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the average cost of inventory management each day and the sum of prices of the goods delivered each day.
- c) Simplicity: It is an easy indicator to understand since it is a percentage

d) Prescriptive effect: It can have prescriptive effect since can be used for evaluating in which measure the management of inventory decreases margin.

### 4.4.4 Features of indicators related to Transportation

The main feature of each indicator related to the determinant "Transportation" are analyzed:

### 1. Average Delivery time

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the Number of items in the right location and the total number of items moved in a given period time.
- c) Simplicity: It is an easy indicator to understand since it is a number
- d) Prescriptive effect: It does not have prescriptive effect since although easy to understand it doesn't provide clear information about the company's management model.

### 2. Average Vehicle Capacity Used Versus Available

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of vehicle used for the delivery and the total number of vehicle available in a given period of time.
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It can have prescriptive effect since a low level on this indicator can be a sign of a bad management. In the long term it can bring to a reduction in the number of vehicles.

### 3. Average vehicle saturation

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the sum of the actual used capacity by all the vehicles in a given period of time and the sum of the available capacity of the vehicles.
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It can have prescriptive effect since a low level of saturation can be a sign of a bad management. In the long term it can bring to a reduction in the number of vehicles.

### 4. Average Number of vehicles necessary each day

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of vehicles used for delivery products in a given period of time.
- c) Simplicity: It is an easy indicator to understand since it is a number
- d) Prescriptive effect: It does not have a prescriptive effect since from the number of vehicles it is not possible to understand how the management model works (it might depend on contingent factors).

### 5. Number of Kilometers treaded every day

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of kilometers treaded by all the vehicles in a given period of time.
- c) Simplicity: It is an easy indicator to understand since it is a number
- d) Prescriptive effect: It does not have a prescriptive effect since from the number of kilometers is not possible to understand how the management model works (it might depend on contingent factors).

### 6. Number of deliveries every day

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of number of deliveries in a given period of time
- c) Simplicity: It is an easy indicator to understand since it is a number
- d) Prescriptive effect: It does not have a prescriptive effect since from the number of deliveries every day is not possible to understand how the management model works (it might depend on contingent factors).

### 7. Average number of items each vehicle

Subjective or objective: It is an objective indicator

Availability: It is necessary to keep track of the total number of items delivered in a given period of time and the total number of vehicles used in that period

Simplicity: It is an easy indicator to understand since it is a percentage

a) Prescriptive effect: It cannot have prescriptive effect since its value depends on the capacity of the vehicles. It could be useful as an important tool for further analysis.

### 8. Percentage of deliveries to store

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of deliveries to a store and the total number of deliveries in a certain period of time.
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It cannot have prescriptive effect since the number of deliveries to store has no clear link with the effectiveness of the management system, but it has to be inserted into a deeper analysis complemented with other indicators.

### 9. Percentage of deliveries to customers

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of deliveries to customers and the total number of deliveries in a certain period of time
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It cannot have prescriptive effect since the number of deliveries to customers does not have a clear link with the effectiveness of the management system, but it has to be inserted into a deeper analysis complemented with other indicators.

### 10. Average Number of items each delivery

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the total number of item delivered in a given period of time and the total number of deliveries in the same period
- c) Simplicity: It is an easy indicator to understand since it is a ratio
- d) Prescriptive effect: It cannot have prescriptive effect since the number of items each delivery to customers does not have a clear link with the effectiveness of the management system but it has to be insert into a deeper analysis complemented with other indicators.

### 11. Percentage of deliveries by car or trucks

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of deliveries by car or trucks and the total number of deliveries in a given period of time
- c) Simplicity: It is an easy indicator to understand since it is a ratio
- d) Prescriptive effect: It cannot have prescriptive effect since the number of items each delivery to customers does not have a clear link with the effectiveness of the

management system, but it has to be inserted into a deeper analysis complemented with other indicators.

### 12. Average cost of transportation for km in a day

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the total cost of transportation ( i.e. fuel, tolls,...) in a day and the total number of Kilometers treaded every day
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It can have prescriptive effect since it depends strongly on the contract stipulated by the company in the transportation sector and not on other factors (such as the number of deliveries and distance of each delivery) that are excluded from this indicator

### 13. Average cost of transportation in a day

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of sum of the cost of transportation of each means of transport in a day.
- c) Simplicity: It is an easy indicator to understand since it is a number
- d) Prescriptive effect: It cannot have prescriptive effect since it depends strongly on other factors (such as number of deliveries and distance of each delivery) that are not related with decisions on the supply chain's management.

### 14. Cost of Transportation over Revenues:

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the average total cost of Transportation each day and prices of goods delivered
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It can have prescriptive effect since a percentage higher than 1 means that, not considering production costs or other factors, the margin of each good is lower than zero.

### 4.4.5 Features of indicators related to Flexibility

The main features of each indicator related to the determinant "Flexibility" are analyzed:

### 1. Percentage of customized items

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of number of customized items and the total number of items delivered

- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It cannot have prescriptive effect since it depends on customers' needs, not only on the company's decisions. It has prescriptive effect if the main focus of the company are customized products

### 2. Average Time for managing non-ordinary orders

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the average time needed to produce and deliver non-ordinary items based on the customers' particular requests
- c) Simplicity: It is an easy indicator to understand since it is a number
- d) Prescriptive effect: It cannot have prescriptive effect since it doesn't depend only on the decisions of the company, but also on the type of item.

### 3. Average Time for managing personalized items

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the average time needed to produce and deliver personalized items.
- c) Simplicity: It is an easy indicator to understand since it is a number
- d) Prescriptive effect: It cannot have prescriptive effect since it doesn't depend only on the decisions of the company, but also on the type of item.

### 4. Ability to satisfy non-ordinary orders

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of orders I can satisfy (according to the customer's requests in terms of the order's specifications) and the total number of orders.
- c) Simplicity: It is an easy indicator to understand since it is percentage
- d) Prescriptive effect: It cannot have a prescriptive effect since it doesn't depend only on the decisions of the company, but also on the customers' requests.

### 5. Percentage of non-ordinary orders

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of non-ordinary orders (particular requests of the customers) and the total number of orders
- c) Simplicity: It is an easy indicator to understand since it is percentage
- d) Prescriptive effect: It cannot have a prescriptive effect since it doesn't depend only on the decisions of the company, but also on the customers' requests.

### 6. Percentage of non-ordinary due dates of delivery due to customers' requests:

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of deliveries with nonordinary due dates and the total number of deliveries.
- c) Simplicity: It is an easy indicator to understand since it is percentage
- d) Prescriptive effect: It can have a prescriptive effect since the decisions and the management system of the company influence this type of indicator. Complemented with other indicators it can lead the company to the right decisions in terms of management changes.

### 7. Efficiency in managing non-ordinary orders

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the average time for managing nonordinary orders and the average time for managing ordinary orders
- c) Simplicity: It is an easy indicator to understand since it is ratio
- d) Prescriptive effect: It can have prescriptive effect since the decisions and the management system of the company influence this type of indicator. It depends also on the type of order, but a high value of this indicator can induce the company to perform further analysis of the problem.

### 8. Efficiency in managing personalized items

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the average time for managing personalized items and the average time for managing ordinary items
- c) Simplicity: It is an easy indicator to understand since it is ratio
- d) Prescriptive effect: It can have prescriptive effect since the decisions and the management system of the company influence this type of indicator. It depends also on the type of items, but a high value of this indicator can induce the company to perform further analysis of the problem.

# 4.4.6 Features of indicators related Geographical area and market penetration and density

To main features of the indicators related to the determinant "Geographical area and Market penetration and density" are analyzed:

### 1. Number of stores

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the total number of stores of the company spread in the world.
- c) Simplicity: It is an easy indicator to understand since it is number
- d) Prescriptive effect: It cannot have prescriptive effect since, although it depends on the decisions of the company, a little number of stores is not a sign of poor management

### 2. Number of warehouses

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the total number of warehouses of the company spread in the world.
- c) Simplicity: It is an easy indicator to understand since it is number
- d) Prescriptive effect: It cannot have a prescriptive effect since, although it depends on the decisions of the company, a little number of warehouses is not a sign of poor management, but it can be a sign of efficiency.

### 3. Percentage of stores in Italy

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the total number of stores in Italy and the total number of stores of the company in the world.
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It cannot have a prescriptive effect since management choices in this regard are influenced by other factors, such as the willingness to pay in Italy, the dispersion of customers in Italy and the analysis benefits/costs between the cost of transportation and the cost of building a store.

### 4. Number of Stores in Europe

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the total number of stores in Europe and the total number of stores of the company in the world.

- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It cannot have a prescriptive since management choices in this regard are influenced by other factors, such as the willingness to pay in Europe, the dispersion of customers in Europe and the analysis of benefits/costs between the cost of transportation and the cost of building a new store.

### 5. Percentage of warehouses in Italy

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the total number of warehouses in Italy and the total number of warehouses of the company in the world.
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It cannot have prescriptive since management choices in this regard are influenced by the dispersion of customers in Italy and the analysis of benefits/costs between the cost of transportation and the cost of building a new store.

### 6. Number of warehouses in Italy

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the total number of warehouses in Europe and the total number of warehouses of the company in the world.
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It cannot have prescriptive since management choices in this regard are influenced by the dispersion of customers in Europe and the analysis of benefits/costs between the cost of transportation and the cost of building a new store.

### 7. Percentage of orders in Italy

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the total number of orders received in Italy and the total number of orders received by the company in the world.
- c) Simplicity: It is an indicator very easy to understand since it is a percentage
- d) Prescriptive effect: It cannot have a prescriptive effect since it depends directly on the customers' choice to buy.

### 8. Percentage of orders in Europe

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of orders received in Europe and the total number of orders received by the company in the world.

- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It cannot have a prescriptive effect since it depends directly on the customers' choice to buy.

As shown above, none of these indicators has prescriptive effect on its own, but it is possible to collect useful information from couples of indicators considered together, such as the Percentage of stores in Italy, the Percentage of warehouses in Italy and the Percentage of orders in Italy which together give a good idea of the situation in terms bot of demand and supply side. They should be complemented by a the analysis of the cost of transportation from warehouses outside of Italy.

### 4.4.7 Features for indicators related to Employees

The main features of each indicator related to the determinant "Employees" are analyzed:

### 1. Number of employees

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of employer in the whole supply chain from the "receiving goods" in the warehouse to the sales-men.
- c) Simplicity: It is an easy indicator to understand since it is a number
- d) Prescriptive effect: It cannot have a prescriptive effect since it is only a factor that depends on the dimension of the company.

### 2. Available hours in a day

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track the number of workers, the number of working hours in a standard day (usually 8 hours) and the number of work shift
- c) Simplicity: It is an easy indicator to understand since it is a number
- d) Prescriptive effect: It cannot have a prescriptive effect, since it is only a number that depends on the dimension of the company and the number of employees.

### 3. average number of hours actually worked in a day

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track the number of workers, of the time that would be sufficient to finish the work, and the total time available.
- c) Simplicity: It is an easy indicator to understand since it is a number

d) Prescriptive effect: It cannot have a prescriptive effect since it is only a number that depends on the dimension of the company and the number of employees.

### 4. worker utilization

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep of average number of hours actually worked by the available hours in a day
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It cannot have a prescriptive effect since it is only a number that depends on the dimension of the company and the number of employees.

### 4.4.8 Features for indicators related to E-Business

To each indicator related to the determinant "E-Business" are analyzed the main features:

- 1. Website accessibility
  - a) Subjective or objective: It is an subjective indicator
  - b) Availability: It is necessary make an online questionnaire
  - c) Simplicity: It is an indicator very easy to understand since it is a number (Maybe between 1 and 10)
  - d) Prescriptive effect: It can have a prescriptive effect since in case of low values on this indicator it could be a good idea to change the structure of the web site, making it easier to use.

### 2. Easiness in seeing the state of the order

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the online orders of which is possible to check the progress and the total number of orders
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It can have a prescriptive effect if and when knowing the state of the order becomes a customer requirement.

### 3. Percentage of items available on line over items available in store

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of items available online and the number of items available in store
- c) Simplicity: It is an easy indicator to understand since it is a percentage

 d) Prescriptive effect: It can have a prescriptive effect in case one of the company's main focus are online sales and yet this indicator has a low value.

### 4. Percentage of online-orders:

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the online orders and that in the stores.
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It can have a prescriptive effect in case one of the company's main focus are online sales and yet this indicator has a low value. Complemented with other indicators as the Web Site Accessibility it can lead to radical changes in the management strategy.

### 5. Percentage of online customized order over total number of online orders

- a) Subjective or objective: It is an objective indicator
- b) Availability: It is necessary to keep track of the number of online customized orders and the total number of online orders
- c) Simplicity: It is an easy indicator to understand since it is a percentage
- d) Prescriptive effect: It can have a prescriptive effect only in case the company' business is focused on customized products. It can be complemented with an indicator, such as the percentage of customized products.

# 5 Analysis applied to different scenarios

When creating a system of key performance indicators, it is necessary to consider the context or scenario in which the management of the Supply Chain must be improved. It is therefore fundamental to assign a relative importance to each determinant of the "last mile logistics" in each scenario. The Indicators proposed in chapter 6 will be based on these weights. To simplify things, in this case three different scenarios are evaluated: Small City, Medium-large City, Big City. The relative importance of each determinant in the different scenarios do not reflect an objective value and should not be considered as absolute truth: they have a purely practical meaning and they clarify the differences in the various scenarios in terms of importance of the various determinants.

### 5.1 Small city

In this scenario, as with all the others, Customer satisfaction is the most important determinant, since it is one of the key factors to care after across the management specter to remain (not only logistics) in the business. Great importance is assigned also to the Geographical Area and market penetration density, since small cities can hardly be inserted into an optimized vehicle route (given the small size of the city, it is possible to receive very few orders). For this reason, transportation is a very important determinant in this scenario, because there is no optimization logic behind the delivery. Moreover, Environmental Impact has a low importance here (the pollution is lower than in the Metropolis). Different relative importance is assigned to each determinant as shown in scheme 5.1.



# 5.2 Medium-large city

In a Medium large city transportation becomes a bit more important, although the optimization logic is not yet well viable, for the number of customers is surely greater than in a small city. Pollution starts to be a problem and for this reason more importance is assigned to Environmental Impact. The customer satisfaction continues to be the key of all the system of indicators. Different relative importance is assigned to each determinant as shown in scheme 5.2.



5.2 Medium- large city scenario scheme

# 5.3 Big city

The big city is a completely different scenario from the previous two. Rapid urbanization and urban population growth have generated an increasing freight transportation demand in cities. These phenomena cause environmental and mobility problems mainly associated with air pollution and

Traffic congestion (Benjelloun and Crainic, 2008). The Environmental Impact is an enormous problem and rigorous laws are applied (for example the prohibition to use Diesel vehicles in some area of major cities in some parts of the world, or the creation of Limited Traffic Area that make the delivery much more expensive and demanding). The transportation in this scenario is not very important because of the possibility to adopt an optimization logic to allow a high level of customer satisfaction, which remains the most important determinant. Different relative importance is assigned to each determinant as shown in scheme 5.3.



5.3 Big city scenario scheme

# 6 Elaboration of different systems of key performance indicators in different contexts

In the analysis, depending on the scenarios and strategy analyzed, some necessary Data will be introduced for a complete evaluation of the scenario through the appropriate Systems of KPIs.

### 6.1 Company operating in a context of small cities

As introduced in paragraph 5.1 the context of a small city has as peculiar features the fact that there is not the need of ecological vehicles for delivery because of the near absence of the problem of Pollution. Small cities can be difficult to integrate into an optimized vehicle routing process and for this reason in this context the strategy of the company is fundamental. If the company wants to guarantee a high level of customer satisfaction it is necessary to have a high number of stores spread all around the territory. Now we can introduce an example of simple system of indicators to be used in this context as shown in Tab 6.1. There, possible values of KPIs are introduced to offer a better understanding of the functioning of the system. These values have the only meaning to clarify what could be the computed result of each indicator and how it could be used for a Company's management analysis; therefore, the values indicated in Tab 6.1 are absolutely factious.

System of indicators for the context of small cities			
DETERMINANT	KPI	Possible values	
Customer satisfaction	Degree of Customer Satisfaction(1 to 10)	5	
	Percentage of deliveries not successful in a		
Customer satisfaction	given period of time due to damaged	10%	
	goods or packaging during transport		
Customer satisfaction	Percentage on time deliveries	50%	
Environmental impact			
Stock and warehouse	Inventory turnover	3.5	
management		,	
Stock and warehouse management	Surface Saturation of Warehouses	90%	
Stock and warehouse			
management	Surface Saturation of Stores	80%	
Stock and warehouse	Volumetric Saturation of Warehouses	75%	
management	volumetric Saturation of Watchouses	7570	
Stock and warehouse	Volumetric Saturation of Stores	70%	
management			
Transportation	Average Number of vehicles necessary each day	45	
Transportation	Average vehicle saturation	20%	
Transportation	Cost of Transportation over revenues	50%	
Flexibility			
Geographical area and market	Average Number of Stores in a radius of		
penetration and density	100 km	1	
Geographical area and market	Average number of Warehouses in a		
penetration and density	radius of 100 km	3	
Employees	Average number of hours actually worked	8	
F Business	$\frac{111 \text{ a uay}}{\text{Website accessibility}(1 \text{ to } 10)}$	7	
E Dusiness	Percentage of on line orders	/ 	
E-DuSIIIess	rencentage of on-time orders	0570	

Tab 6.1 system of indicators for the context of small cities

This can be a good system of Key Performance Indicators. The key points of this analysis are:

- a) There is no KPI for the Environmental Impact since the context is that of small cities
- b) Flexibility is not considered as determinant since in this phase there is no reference to a management strategy (as that presented in the following paragraphs)
- c) There are strict relationships between Customer Satisfaction, Transportation and Geographical Area and Market Penetration and Density. In fact, a low value on Customer Satisfaction derives from a low value of the Percentage of on time deliveries due to the too low number of Stores and warehouse in a radius of 100 km that, in turn, increases the Cost of Transportation over Revenues.
- d) Because of the low number of Stores and Warehouses, the Volumetric Saturation and Surface Saturation have optimal values.
- e) The high level of Percentage of on-line orders underline the little relevance of stores (to which are associated higher inventory costs) compared to the presence of warehouses.

Through this system of Indicators, it is possible to determine some possible corrective actions, such as increasing the number of Stores limiting on-line sales, or accepting a low level of Customer Satisfaction.

### 6.2 Company operating in a context of big cities

As introduced in paragraph 5.3, the context of a Big city has as peculiar features the fact that because of the problem of Pollution, the presence of ecological vehicles in the company's fleet becomes a real exigence. In a Big city with a great number of Stores, it is necessary to optimize the vehicles' routes and saturation for ensuring a high level of customer satisfaction. Now it is possible to introduce an example of simple system of indicators to be used in this context as shown in tab 6.2

In Tab 6.2, possible values of KPIs are introduced that have the only purpose of clarifying what could be the computed result of each indicator and how it could be used for the Company's analyses; therefore, these values are factious.

System of indicators for the context of big cities		
DETERMINANT	KPI	Possible values
Customer satisfaction	Degree of Customer Satisfaction(1 to 10)	8
	Percentage of deliveries not successful in a	
Customer satisfaction	given period of time due to damaged	10%
	goods or packaging during transport	
Customer satisfaction	Percentage on time deliveries	80%
European en tal import	Percentage of deliveries by ecological	
Environmental impact	vehicles	95%
Euroine and a line and	Percentage of available ecological	950/
Environmental impact	vehicles	83%
Stock and warehouse	Inventory turnover	1.5
management		-,-
Stock and warehouse	Surface Saturation	70%
management		
Stock and warehouse	Volumetric Saturation	65%
management		
Stock and warehouse	Cost of Inventory management over	35%
management	revenues	
Transportation	Average vehicle saturation	90%
Flexibility		
Geographical area and market penetration and density	Average Number of Stores each city	16
Geographical area and market penetration and density	Average number of warehouses each city	1
Employees	Average number of hours actually worked in a day	8
E-Business	Website accessibility (1 to 10)	7
E-Business	Percentage of on-line orders	10%

Tab 6.2 system of indicators for the context of big cities

This can be a good system of key performance indicators. The key points of this analysis are:

- a) In the context of Big city two Key Performance Indicators for Environmental Impact have been introduced that in line with the context should have high values.
- b) Flexibility is not considered as Determinant since in this phase there are no particular reference to a particular strategy as will be in the following paragraph
- c) There are strict relationships between Customer Satisfaction, Transportation and Geographical Area and Market Penetration and Density. In fact, differently from the previous system, the level of Customer Satisfaction is higher due to the presence of more stores in a shorter range.
- d) In this context, as described in Paragraph 5.3, the Transportation is less important a determinant and this results in the presence in the system described above of only one indicator related to that Determinant. The KPI used is the Average Vehicle Saturation whose value is higher compared to the context of Small cities because of the possibility to apply an optimization of routes and of the vehicles capacities.
- e) Because of the high number of Stores and Warehouses the Volumetric Saturation and Surface Saturation have lower values.
- f) It is introduced as Indicators the Cost of Inventory management over Revenues since in Big cities rent costs for stores are much higher.
- g) The high presence of Stores reduces the need for customers to order online so that the percentage of on-line orders is significantly lower.

Through this system of Indicators it is possible to determine some corrective actions in case of lower values of ecological vehicles, or a higher value of Cost of Transportation over Revenues, or a percentage of on-line orders so high to make the presence of stores almost not useful.

# 6.3 Company operating in a context of small cities and a customized goods oriented strategy

In this paragraph, to the context described in paragraph 6.1 we add some considerations about the strategy of the company whose performances are evaluated here. In this context, the company's strategy is a customized products oriented supply chain. A strategy of this type sorts its effects along all the supply chain not only on the production side but also on the inventory management side. A possible example of how managing this type of strategy in the context of a company operating in Small cities is illustrated below in Tab 6.3. There, possible values of KPIs are introduced to allow a better understanding of the functioning of the system. These values clarify what could be the computed result of each indicator and how it could be used for the Company's analyses: therefore the values indicated in Tab 6.3 are absolutely factious.

System of indicators for the context of small cities and customized goods oriented strategy		
DETERMINANT	KPI	Possible values
Customer satisfaction	Degree of Customer Satisfaction(1 to 10)	8
	Percentage of deliveries not successful in a	
Customer satisfaction	given period of time due to damaged	10%
	goods or packaging during transport	
Customer satisfaction	Percentage on time deliveries	50%
Environmental impact		
Stock and warehouse	Inventory turnover	3.5
management		5,5
Stock and warehouse	Surface Saturation of Warehouses	90%
management		2070
Stock and warehouse	Surface Saturation of Stores	60%
management		
Stock and warehouse	Volumetric Saturation of Warehouses	75%
management		
Stock and warehouse	Volumetric Saturation of Stores	55%
management		
Transportation	Average Number of vehicles necessary	45
	each day	200/
Transportation	Average vehicle saturation	20%
Transportation	Cost of Transportation over revenues	60%
Flexibility	Percentage of customized items	70%
Flexibility	Ability to satisfy non-ordinary orders	95%
Geographical area and market	Average Number of Stores in a radius of	
penetration and density	100 km	1
Geographical area and market	Average number of Warehouses in a	
penetration and density	radius of 100 km	3
Employees	Average number of hours actually worked in a day	8
E-Business	Website accessibility (1 to 10)	7
E-Business	Percentage of on-line orders	65%

In Tab 6.3 the main differences compared to the context of paragraph 6.1 where a not clear strategy is highlighted are:

- a) Flexibility becomes a key determinant. Two indicators (i.e. Percentage of customized items and Ability to satisfy non-ordinary orders) are introduced. In line with the strategy they should have high values otherwise the investments made according to the strategy are useless.
- b) The change in the Volumetric and Superficial saturation are not so relevant as would be in the context of a Big city with lots of shops in short radius. In fact with great distances between Warehouses and Stores it is necessary for the company to keep enough high the level of inventory also in case of a customized oriented strategy otherwise it would impossible to keep high the level of Customer Satisfaction and it is not thinkable the idea to deliver each customized product in so distant cities without increasing the KPI Cost of Transportation over Revenues to value unacceptable and surely unprofitable. So this strategy is not easily applicable in this context.
- c) In this case also E-Business becomes a relevant determinant because of the possibility through the website to customize the item.

# 6.4 Company operating in a context of big cities and a customized goods oriented strategy

In this paragraph, to the context described in paragraph 6.2, are added some considerations about the strategy of the company whose performances have to be evaluated. In this context, the company's strategy is a customized products oriented supply chain. A strategy of this type reflects its consequences along all the supply chain, not only on the production side but also on the inventory management one. A possible example of how to manage this type of strategy in the context of a company operating in Big cities is illustrated below in Tab 6.3. In Tab 6.4, possible values of KPIs are introduced to allow a better understanding of the functioning of the system. These values have the only purpose of clarifying what could be the computed result of each indicator and how it could be used for the Company's analyses: therefore, the values indicated in Tab 6.4 are factious.

System of indicators for the context of Big cities customized goods oriented strategy		
DETERMINANT	КРІ	Possible values
Customer satisfaction	Degree of Customer Satisfaction(1 to 10)	8
	Percentage of deliveries not successful in a	
Customer satisfaction	given period of time due to damaged	10%
	goods or packaging during transport	
Customer satisfaction	Percentage on time deliveries	80%
	Percentage of deliveries by ecological	
Environmental impact	vehicles	95%
	Percentage of available ecological	050/
Environmental impact	vehicles	85%
Stock and warehouse		1
management	inventory turnover	1
Stock and warehouse	Surface Saturation	50%
management	Surface Sutaration	5070
Stock and warehouse	Volumetric Saturation	45%
management		
Stock and warehouse	Cost of Inventory management over	35%
management	revenues	
Transportation	Average vehicle saturation	90%
Flexibility	Percentage of customized items	70%
Flexibility	Ability to satisfy non-ordinary orders	95%
Geographical area and market penetration and density	Average Number of Stores each city	16
Geographical area and market penetration and density	Average number of warehouses each city	1
Employees	Average number of hours actually worked in a day	8
E-Business	Website accessibility (1 to 10)	8
E-Business	Percentage of on-line orders	50%

Tab 6.4 System of indicators for the context of big cities and customized goods oriented strategy

The main peculiarities of this system of Indicators are:

- a) As in the previous paragraph, Flexibility becomes a key determinant. Two indicators (i.e. Percentage of customized items and Ability to satisfy non-ordinary orders) are introduced. In line with the strategy they should have high values; otherwise the investments made according to the strategy are useless.
- b) The level of the KPIs related to Stock and Warehouse Management (i.e. Volumetric saturation and Surface saturation) decreases since the strategy is not to have a high inventory of equal goods. To avoid the counter effect of a decrease in the level of Customer Satisfaction, the former decrease must be matched by investments for a fast production side of the supply chain. It is important to make people aware of the value attached to having a customized product, despite longer waiting times.
- c) Compared to the context of Paragraph 6.2, without a specific strategy, the Percentage of online orders increases because of the necessity for customers to customize items. This should be matched by increasing value of the Website accessibility.

# 7 Application in the Miroglio context

In this chapter I will analyze the current situation of the Miroglio company and I will chose the best possible system of indicators to apply to it, referring back to the contexts of chapter 6.

### 7.1 Miroglio current structure and processes

The current structure and processes of Miroglio will be analyzed, to simplify, only for the main brand: Fiorella Rubino. The logistics network of the Miroglio Fashion segment, for the Fast branch, has a converging structure: the n production sites have different locations. The goods produced are sent to the central warehouse in Pollenzo, which deals with point-to-point transport, directly to the n sales points. The logistic network is schematized in scheme 7.1.1.



Tab 7.1.1 Logistic network of Fiorella Rubino

There are around 189 stores in Italy, located in all regions. They are all single-brand. In addition to shipments arriving directly from Pollenzo to the shops (ACI), transfers or horizontal exchanges between stores (TRA) are permitted. If a store does not have at its disposal a garment of a certain size or variant, it can ask for it at the central warehouse. If the garment is no longer present, the store can call another store to ask if there is availability of a precise garment. In order to correctly evaluate the current situation of the company to elaborate possible improvements of the service offered, the company has provided data on the Italian Spring 2017 season of the Fiorella Rubino brand, which mainly include information about "Garments' flows" including all unit flows/movements of each individual item during the spring 2017 season. The analysis, for

simplicity, will consider only three product categories: Blouses, Jackets and Trousers. In this case, the day in which the flow happens is indicated with the related invoice document and the type of item handled. Furthermore, the motivations for the item's movement can be multiple since it may be a transfer of goods from Pollenzo to a shop (ACI code) in the case of initial or subsequent resupply, a sale to the final customer (VEN code), a return during or at the end of the season (REI or RFS code) or finally a transfer between stores (TRA code). Obviously, in the latter case both the shops belonging to the transaction are indicated. In general, attention must be paid on the arithmetic sign of such data (+1 or -1) depending on whether the item is entering (+1) or exiting (-1) the store taken into account at that time. For the evaluation of the current situation it has been necessary to collect other data not only about the movements of garments but also about costs as shown in Tab 7.1.2

Name	Description	Values
Annual Inventory Cost - Warehouse	Estimated value used by Miroglio coming from the ratio between the general expenses of the warehouse and the average item quantity stored	0.18 [€/item]
Avg. Production Cost - Trouser		13 [€/item]
Avg. Production Cost - Jacket	Average cost to produce Trousers, Jackets and Blouses of a Spring season.	20 [€/item]
Avg. Production Cost - Blouse		10 [€/item]
Shipment Cost	Parameter coming from the contractual agreement that Miroglio has with DHL	7 [€/package]
Max. Capacity of 1 package	Maximum number of items that on average a package can contain when it is optimized	30 [item]
Shipment Cost from Warehouse	Cost per single item shipped from Pollenzo to stores.	0.20 [€/item]

Tab 7.1.2 Economic parameters

From this data has been possible to extrapolate the following graphs:

In the first one (Graph 7.1.3) on the X-axis are indicated the weeks of every year and on the Y-axis the average value of the inventory of both three type of garments.

In the second one (Graph 7.1.4) there are three different graphs. On the X-axis are indicated the weeks of every year and on the Y-axis the average value of the inventory of each type of garment.





Graph 7.1.4 Stores' levels of Inventory depending on the type of garment

Transportation Costs between stores	160.330,58 €
Transportation Costs from Pollenzo to Stores	129.068,80 €
Inventory management costs in stores	246.140,86 €
Inventory management costs in Pollenzo	6.128,57 €

From this data has been possible to obtain both inventory management costs and transportation costs depending on the point of departure and arrival of each garment as shown in Tab 7.1.5.

#### Tab 7.1.5 Total transportation and Inventory management costs

Unfortunately, though this data are enough for the development of a new supply chain management model they are not sufficient for an optimal performance evaluation through KPIs.

### 7.2 A system of key performance indicators for the Miroglio context

Miroglio works in a context of both small, medium and big cities so the system of indicators will be a sort of aggregate of those described in paragraph 6.1 and 6.2. The strategy of the company is not particularly related to customization of garments or online delivery. Through the online system it is only possible to order garments to be picked up in a chosen store. The system of indicators presented in Tab 7.2.1 will take into account the specific logistic network.

System of indicators for the context of Miroglio		
DETERMINANT	КРІ	
Customer satisfaction	Degree of Customer Satisfaction (1 to 10)	
Customer satisfaction	Percentage of deliveries not successful in a given period of time	
	due to damaged goods or packaging during transport	
Customer satisfaction	Percentage on time deliveries	
Environmental impact	Percentage of deliveries by ecological vehicles	
Environmental impact	Percentage of available ecological vehicles	
Stock and warehouse management	Inventory turnover of Pollenzo warehouse	
Stock and warehouse management	Inventory turnover of stores	
Stock and warehouse management	Surface Saturation of Pollenzo warehouse	
Stock and warehouse management	Surface Saturation of Stores	
Stock and warehouse management	Volumetric Saturation of Pollenzo warehouse	
Stock and warehouse management	Volumetric Saturation of Stores	
Stock and warehouse management	Cost of inventory management in Pollenzo over Revenues	
Stock and warehouse management	Cost of inventory management in stores over Revenues	
Transportation	Average Number of vehicles necessary each day	
Transportation	Average vehicle saturation	
Transportation	Cost of Transportation from Pollenzo to stores over revenues	
Transportation	Cost of Transportation between stores over revenues	
Flexibility	Ability to satisfy non-ordinary orders	
Geographical area and market	Average Number of Stores in Big cities	
penetration and density	Average Number of Stores in Big cities	
Geographical area and market	Number of Stores in Small or Medium cities	
penetration and density		
Employees	Average number of hours actually worked in a day	
E-Business	Website accessibility (1 to 10)	

Referring to chapter 6, the main features of this system are:

- a) In the context of both Small, Medium and Big cities the "Environmental impact" is a key determinant. The values of the Key Performance Indicators related (i.e. Percentage of deliveries by ecological vehicles and Percentage of available ecological vehicles) depends exclusively on the mix of the cities.
- b) For the determinant "Transportation", all the KPIs present in both contexts of Small and Big cities are present (i.e. Average Number of vehicles necessary each day, Average vehicle saturation and Cost of Transportation over revenues).
- c) For the Determinant "Stock and Warehouse management" are present Key performance indicators for both the warehouse in Pollenzo and for stores.
- d) Indicators as the Cost of inventory management in Pollenzo over Revenues, Cost of inventory management in stores over Revenues, Cost of Transportation from Pollenzo to stores over Revenues and Cost of Transportation between stores over Revenues have particular relevance. The analysis of these values (%) highlights which is the major cause of the reduction of profits among the principal phases of the Miroglio Supply Chain (management of the Pollenzo warehouse, management of the inventory of stores, transportation from Pollenzo to stores and transfers between the stores).
- e) For the determinant "Flexibility" only one indicator is present not specifically related to a strategy as that described in paragraph 6.3 and 6.4. In fact the Key performance Indicator Ability to satisfy non-ordinary orders is not related only to the customization of garments but also to the capability to quickly accommodate every kind of customers' requests also in terms of place or date of delivery (this can happen to a big Brand as Fiorella Rubino).
- f) No particular information are given for the determinant " Employees" but if necessary some indicators can be added from those described in paragraph 4.1.7
- g) For the determinant "Geographical Area and Market penetration and Density" are present two important KPIs are present that allow us to understand the actual context in which the company works.
- h) For the determinant "E-Business" only the indicator related to the Website accessibility is present since the strategy of the company in this moment does not include the direct delivery to customers of customized products.
- i) "Customer Satisfaction" remains as in every context the main Determinant.

# **8** Conclusion

The goal of the thesis was to outline a system of Key Performance Indicators to define a performance dashboard, useful to control trends and progress of a fast-fashion company and to take possible corrective actions to ameliorate the management of the supply chain. It is important to take into account the various steps of this thesis in order to draw further insights from new data, or decisions the company might take in the future. The fourth chapter of the work outlines eight determinants of the "last mile logistics": Customer satisfaction, Environmental impact, Stock and warehouse management, Transportation, Flexibility, Geographical area and market penetration and density, Employees, E-Business. According to the analysis of the specifics of each determinant, 62 key performance indicators are identified. Obviously, a performance dashboard cannot contain such a huge number of indicators, and one must ponder carefully on which of these should be inserted in it. This decision is based on two aspects: on one side, the relationships between the determinants forming a system of Key Performance Indicators. On the other, the context or scenario in which the indicators operate.

About the first side, the main relationships emerging from the analysis are: Transportation-Customer satisfaction, and Stock and warehouse management-Customer satisfaction. The first one is described by a strict correlation: 90% of the variation on the value of the key performance indicators representing the Customer Satisfaction depends on the time of delivery, which is in turn strictly influenced by the Transportation. The second relationship is likewise described by a strong correlation: indicators related to Customer Satisfaction are influenced by indicators related to Stock and warehouse management, such as the percentage of orders that can effectively be accepted and processed.

For what concerns the second aspects, the three main scenarios analyzed in this work, related to the size of the city where goods are to be delivered, are: Small city, Medium large city and Big city. Different weights are assigned to each Determinant in each scenario. The weights are not objective values, but only reasonable values, and they describe the most important determinants in each scenario. The performance dashboard is composed precisely of the indicators resulting from this context dependent considerations.

What emerges from the analysis proposed here is that in the context of small cities, Transportation is a key determinant, since it is not possible to exhaust the vehicles' capacity, because of the low demand; nor is it possible to optimize the routes, since small cities usually have only one or very few stores. This brings the cost of transportation to be one of the biggest causes of the reduction of the company's final profit. In this scenario, however, the Environmental impact is not relevant
as there are no particular limitations to the types of vehicles that can circulate. This consideration takes into account only the interests of the company, although the damage procured to the environment cannot be neglected.

In the context of big cities, on the other hand, there are strong limitations to the type of vehicles that can circulate (take the examples of Turin or Paris, where it is often prohibited to diesel vehicles to circulate), so that the determinant Environmental impact assumes relevance. Still, Transportation sorts here less of an influence on the reduction of profits, because the vehicles are loaded (higher demand) and routes can be optimized (more stores). On the other hand, Stock and warehouse management becomes a relevant determinant because of higher rents and the need for more staff.

A system of indicators in the scenarios previously analyzed is then defined. In this phase, a possible strategy for the company is inserted in the context of these scenarios. Take the example of a Customized Goods Oriented Strategy presented in the thesis: here the determinant Flexibility assumes major importance, which means its indicators must be factored in the system of key performance indicators. In general terms, greater the importance of a Determinant more the details needed, which means more indicators to be factored in the system.

Following from the analysis of the conditions of operation of the fast fashion company Miroglio, central to this study, it is possible to reach the final objective: the creation of a hypothetical system of key performance indicators for the fast fashion industry, consistent with the criticalities of the "last mile logistics". The analysis of the conditions of operation of the industry does not consist only in the description of their characteristics; it also aims at relating these conditions of operation to the scenarios proposed in chapter 7 of the thesis. In this sense, such scenarios constitute the analytical basis for the creation of a system of key performance indicators. This system of indicators will have a dual purpose: it will represent not only a "thermometer" to assess the effectiveness and efficiency of a supply chain, but also allow benchmarking between the Company's and the competitors' supply chain management strategies. In the general context of the project, the same system of indicators can be used to determine which of the following phases of the Miroglio supply chain, is the major source of the reduction of profits: management of the warehouse in Pollenzo, management of the inventory of stores, transportation from Pollenzo to stores or transfers between the stores. That phase would require more attention in view of developing new logistics management models.

This is only a partial result, due to a lack of precise information and data for the outline of the key performance indicators. Available data allow only the economic evaluation of the costs of transportation and management of the inventory. No detailed information about logistical aspects

related to other determinants was available, nor information about strategy of the company, especially in terms of long and short-term investments. This lack did not allow to analyze the other determinants in the detail needed to be able to understand which of them should play a more relevant role in the system of key performance indicators. As of now, the system presented in the thesis is not capable of monitoring the full performance of the Miroglio Company. On this basis, it was not possible to offer an instrument from which to draw a set of possible corrective actions for the management of logistics.

Nevertheless, this thesis can be used to outline the most appropriate system of indicators for a more defined context of the Company, given the availability of the necessary information.

## References

## Books

- Afuah A. (2004). *Business models: A strategic management approach*, McGraw-Hill/Irwin.
- Benjelloun A., and Crainic, T.G. (2008). *Trends, challenges and* perspectives in City Logistics. Proceeding of Transportation and land use interaction. Procedia-Social and Behavioral Sciences
- Caniato F., Caridi M., Castelli C. and Golini, R. (2011). Supply chain management in the luxury industry: a first classification of companies and their strategies. International Journal of Production Economics.
- Jabali O., Woensel T., and de Kok A. G. (2012). Analysis of Travel Times and CO2 Emissions in Time-Dependent Vehicle Routing. Production and Operations Management.
- Macharis C., De Witte A., and Ampe J. (2009). *The multi-actor, multi-criteria analysis methodology (MAMCA) for the evaluation of transport projects: Theory and practice.* Journal of Advance Transportation.
- Maisano D., Galetto M., Franceschini F. (2007). *Indicatori e misure di prestazione per la gestione dei processi*. Gestione d'impresa e innovazione. Il Sole 24 Ore.
- Punakivi M., Saranen J. (2001) *Identifying the success factors in e-grocery home delivery*. International Journal of Retail & Distribution Management

- Ross J. and Harradine R. (2011). *Fashion value brands: the relationship between identity and image*. Journal of Fashion Marketing and Management.
- Rotem-Mindali O. and Weltevreden J. W. (2013). *Transport effects of e-commerce: what can be learned after years of research?*. Journal Transportation

## Web sites

- Stefano Giordani (2017). Corso di Logistica
   (http://people.uniroma2.it/stefano.giordani/didattica/logistica/Dispense/Intro
   duzione.pdf )
- Hyuk-Soo Cho (2014). Determinants and Effects of Logistics Costs in Container Ports: The Transaction Cost Economics Perspective. (<u>https://www.sciencedirect.com/science/article/pii/S2092521214000303</u>)
- Joerss M. (2016) How customers demand are reshaping last mile delivery. (<u>https://www.mckinsey.com/industries/travel-transport-and-logistics/our-insights/how-customer-demands-are-reshaping-last-mile-delivery</u>)
- Robinson A. (2017). What is Last Mile Logistics and Why are more Shippers looking at this transportation function.
   (<u>https://cerasis.com/2017/09/19/last-mile-logistics/</u>)
- Badawy M. (2016) A survey on exploring Key performance indicators (<u>https://www.sciencedirect.com/science/article/pii/S2314728816300034</u>)
- http://www.mirogliogroup.com/