

**UNIVERSITY OF PIRAEUS**



**DEPARTMENT OF BUSINESS ADMINISTRATION**

M.B.A.-Total Quality Management International

# Operational Excellence in Construction

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## ΠΑΝΕΠΙΣΤΗΜΙΟ ΠΕΙΡΑΙΩΣ

### ΤΜΗΜΑ ΟΡΓΑΝΩΣΗΣ ΚΑΙ ΔΙΟΙΚΗΣΗΣ ΕΠΙΧΕΙΡΗΣΕΩΝ

Μεταπτυχιακό Πρόγραμμα Σπουδών

στη «Διοίκηση Επιχειρήσεων - Ολική Ποιότητα» με διεθνή προσανατολισμό

#### ΒΕΒΑΙΩΣΗ ΕΚΠΟΝΗΣΗΣ ΔΙΠΛΩΜΑΤΙΚΗΣ ΕΡΓΑΣΙΑΣ

(περιλαμβάνεται ως ξεχωριστή (δευτέρα) σελίδα στο σώμα της διπλωματικής εργασίας)

Δηλώνω υπεύθυνα ότι η διπλωματική εργασία για τη λήψη του μεταπτυχιακού τίτλου σπουδών, του Πανεπιστημίου Πειραιώς, στη Διοίκηση Επιχειρήσεων - Ολική Ποιότητα με διεθνή προσανατολισμό με τίτλο:

*Operational Excellence in Construction*

έχει συγγραφεί από εμένα αποκλειστικά και στο σύνολό της. Δεν έχει υποβληθεί ούτε έχει εγκριθεί στο πλαίσιο κάποιου άλλου μεταπτυχιακού προγράμματος ή προπτυχιακού τίτλου σπουδών, στην Ελλάδα ή στο εξωτερικό, ούτε είναι εργασία ή τμήμα εργασίας ακαδημαϊκού ή επαγγελματικού χαρακτήρα.

Δηλώνω επίσης υπεύθυνα ότι οι πηγές στις οποίες ανέτρεξα για την εκπόνηση της συγκεκριμένης εργασίας, αναφέρονται στο σύνολό τους, κάνοντας πλήρη αναφορά στους συγγραφείς, τον εκδοτικό οίκο ή το περιοδικό, συμπεριλαμβανομένων και των πηγών που ενδεχομένως χρησιμοποιήθηκαν από το διαδίκτυο.

Παράβαση της ανωτέρω ακαδημαϊκής μου ευθύνης αποτελεί ουσιώδη λόγο για την ανάκληση του πτυχίου μου.

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## Table of Acronyms

AR	Action Research
BEM	Business Excellence Model
BIM	Building Information Modeling
BM	Business Model
EFQM	European Foundation for Quality Management
EPC	Engineering, Procurement, Construction
ERP	Enterprise Resource Planning
ESG	Environmental, Social and Governance
IMS	Integrated Management System
KPI	Key Performance Indicator
MBNQA	Malcolm Baldrige National Quality Award
NCR	Non-Conformity Report
OPEX	Operational Excellence
RADAR	Results, Approach, Deployment, Assessment, Review
TQM	Total Quality Management

## Abstract

The aim of this diploma thesis is to investigate the use of operational excellence and the models that has been created and established the last decades. Also, it focuses on the Construction industry, so to analyze its relations with operational excellence and find potential improvements and new research fields. This is supported also by analyzing the company “Archirodon”, so to investigate the potential improvements through operational excellence. To achieve these, firstly the review of literature was used so to analyze the situation in other industries and the related researched. Then a case study follows, that analyze in depth “Archirodon”, its management system and its internal projects that are related to operational excellence. The outcome of this study was the potential improvements that has to do with the Construction industry in general and also with specific improvements for “Archirodon”, which will contribute to its sustainability.

# 1. Operational Excellence

“There is no single more important job or initiative in this company than performance excellence”

Ronald L. Nelson, CEO of Avis Budget Group Inc.

## a. What is Operational Excellence?

Operational excellence doesn't have a specific definition. For this reason, three possible definitions are identified in the literature (1):

- *“Operational Excellence is to be understood as an integrative framework which comprises a coordinated management of the value chain in order to implement the corporate strategy.”*
- *“The basis of Operational Excellence is an extensive toolbox including improvement approaches like TQM, Six Sigma, Lean Management or the Toyota Production System. The content of this toolbox is formed by well-established best practice approaches as well as specific tools like 5S, N5W analysis, SMED, Value stream mapping, PM analysis etc.”*
- *Operational Excellence is “a philosophy of the workplace where problem solving, teamwork, and leadership results in the ongoing improvement in an organization. The process involves focusing on the customers' needs, keeping the employees positive and empowered, and continually improving the current activities in the workplace.”*

The goal of Operational Excellence is the increase of reliability and performance, so to give more value to the customer (2). Operational Excellence often doesn't include a standard methodology, but a group of principals, like daily control, visual management, workplace organization and continues improvement. An implementation of these principals can lead to waste decrease, productivity improvement, higher efficiency and capacity, better work collaboration and finally a continues improvement mindset (3).

The evolution of Operational Excellence is presented in the Figure 1 (4), and it starts in the start of 20<sup>th</sup> century with the goal of standardization of work, something that was influenced from the economies of scale and improved the specialization (4). A change came in the decade of 1970, when the operational excellence moves towards production processes, in which offered more flexible processes so to fulfill the customer needs in the lowest price (4). The last change in operational excellence came in the beginning of 21<sup>st</sup> century when the need of collaboration arises and the customers needed more reliable products/ services (4).



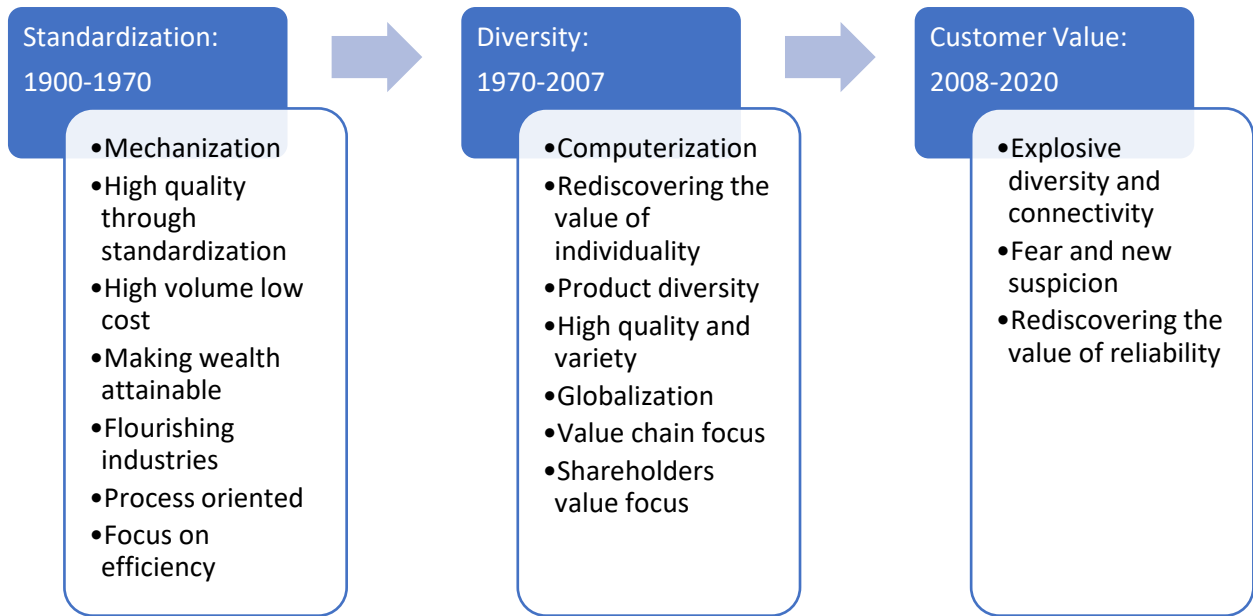


Figure 1- Operational Excellence timeframe

A common phenomenon is the use of various methods/ frameworks in order to achieve Operational Excellence. The more frequent used are presented in the Figure 2, and include methods like Lean, Lean Six Sigma, Balanced Scorecard, ISO standards and others (4). Obviously more than one can be used on each occasion so to gain the benefits for each method.



Figure 2- Operational Excellence Methods/ Tools

#### b. Evolution of Excellence

The term excellence with the modern use, first appears in the book “In Search of Excellence” (1982) from Thomas J. Peters and Robert H. Waterman and sets the beginning of the Excellence era (5). Before this there was only the Adam Smith (1776), who introduces the concepts of specialization and tasks’ division. These theories for the first time set the focus to maximization of value, in contrary with classical economic and management theory (5). After this there was not any progression regarding the excellence. The ending of World War 2 comes with very high industrial production growth, which was mainly focused on productivity, ignoring the wastes, and as a result it was far away from the meaning of Excellence (6). The first period of excellence starts in the early 80s, when the Japanese firms start to become significant competitive and taking a large part of market share (5). This growth comes from the implementation of practices like Total Quality Management (TQM) and Lean (Toyota’s Production System), which gives a competitive advance in Japanese firms (6). The western economy starts to develop an interest in these practices, and in 1981 the Pascale and Athos with the book “Art of Japanese Management”, examine

this phenomenon and concludes that there is a need to include human factors in business strategy and also organizations has to develop a new set of values that will lead to a guiding vision (5). These points were very difficult to be adapted from the western companies due to significant cultural differences. For this reason, Pascale and McKinsey develops the “7s model”, which consists of three hard variables (strategy, structure and systems), three soft components (staff, share values and style) and one dependent variable (skills), which comes from the previous six components (5). This was the first attempt to an Excellence model, but in practice was not very useful for the companies that used it (5). The next attempt comes from Peters first in 1987 with the book “Thriving on Chaos”, in which analyzes the uncertainty of the environment and the influence of the technology improvements, which make the predictions of the future very difficult (5). Later Peters states an Excellent company should be based on continues improvement, something that should be based on quality and flexibility, and proposes a five-element model to describe that (5). Later in 1990, Peter Senge with the book “The Fifth Discipline”, which focuses on the concept of learning organization, states five disciplines that leads to organization learning, building shared vision, personal mastery, working with mental models, team learning and systems thinking (which considered to be the most important) (5). This concept in parallel with Quality concepts (as depicted from Deming), are the main components of excellence and for this reason the Excellence models are related to quality and are the evolution of Quality Award models (5). The models from Deming Prize (DP), Malcolm Baldrige National Quality Award (MBNQA) and EFQM excellence prize, were used from companies during the 90s as a medium to become Excellent and become frameworks for Excellence (5). With these models, companies can develop their best practices, improve their strategies, assess themselves and perform benchmarking (5) (6).

### c. Importance of Operational Excellence

Operational Excellence (OPEX) is very important for the success of every company because it is the link between the organization’s processes and customer needs. It also contributes to the strategy formation and in the decision-making processes. It contains the concept of continues improvement, something that evolves the organization culture by promoting ideas that evolve the company and simultaneously cut costs. OPEX aims to maximize the value that the customer receives, by focusing on the processes that deliver the most value (7).

Operational Excellence is especially important for the companies globally and this become more obvious from the wide variety of literature that documents the OPEX implementation and the benefits from it. First of all, there are reports from the pharmaceutical industry in which the most important goals are the manufacturing efficiency and process optimization, something that has to be achieved by simultaneously comply with extremely strict government regulations (8). For

this reason, the OPEX benefit a lot these companies, which try to achieve this by using more automation and data-based decisions. These are the key in order to constantly deliver excellent product to the customer and in parallel the company to become more flexible and efficient (8). OPEX can be achieved with even simpler actions, like the reduction of physical documents, something that can have a significant environmental cost saving impact (8). A more sophisticated way to achieve excellence in pharmaceutical comes from Artificial Intelligence, which can be used for better data analysis so to improve aspects like clinical research and become a strong competitive advantage (8).

A different approach of OPEX happens in government businesses, in which the excellence comes from the digitalization of processes (9). The OPEX with the process centric approach help these organizations to become more adaptable, something particularly important nowadays that the pandemic has increase the requirements and the standards that a company has to comply with (9). So, the government organizations achieve excellence with techniques like “robotic process automation” and “machine learning”, which can increase the customer satisfaction, which in this case is the citizen (9).

In parallel with government, all businesses affected a lot from the pandemic, something that pointed out the significance of OPEX. There was a high demand in the customer service, supply chain and finance (10). These industries were highly affected by the pandemic and they try to find new methods to operate and overcome all the difficulties. In order to do that they had to overcome a change process so to transform and adapt to the new external environment. For this reason, there is an increase in the companies that use OPEX in order to transform (10).

OPEX is considered as a way to improvement. A survey that has conducted, support this and points out that the companies see OPEX as “A way to improve productivity and efficiency”, “A mission-critical strategy to help the organization to drive growth, manage turnaround and deliver strategic objectives” and also as “A way to improve customer satisfaction through better quality and efficiency”. These data presented in the Figure 3, with which it becomes obvious how important OPEX is for the companies (10).

## How Companies view OPEX and business transformation?



Figure 3- Opex and business transformation

In the same survey, it was identified what are the companies measure in order to control the OPEX progression (Figure 4), something that shows what are they expect to gain from this program (10).

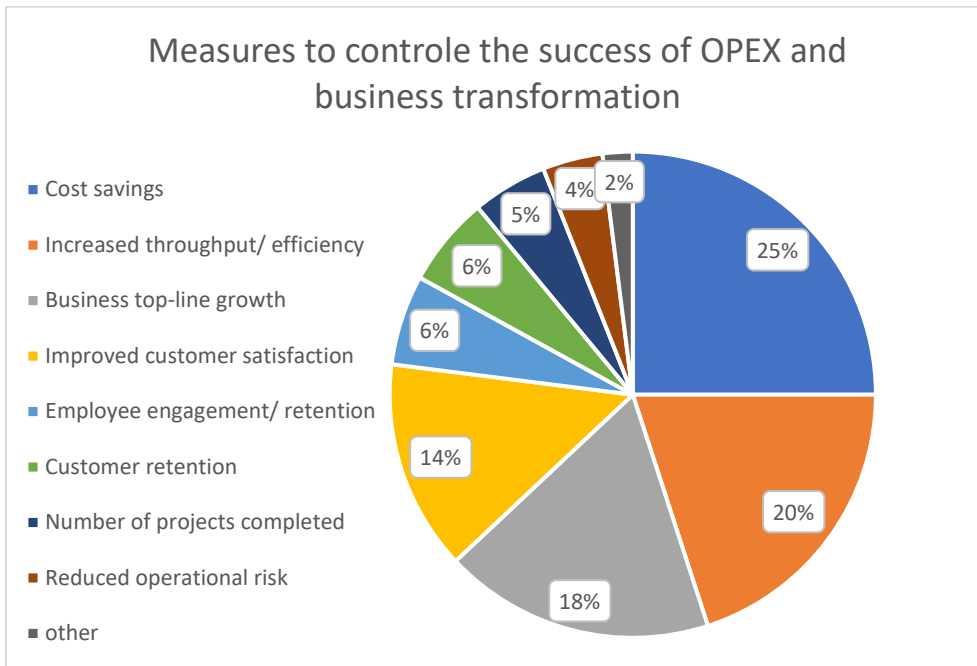


Figure 4- Measure of success for OPEX

#### d. Excellence models

Excellence models are very important for the implementation of operational excellence and for the benchmarking of the companies that follow it. Through this processes Companies becomes more competitive and also they gain recognition.

##### i. Malcolm Baldrige National Quality Award

The Malcolm Baldrige National Quality Award (MBNQA), initiated with a legislation in 1982 at U.S.A., as a measure to the declining productivity. It was based on the Deming Prize (already existing from the 1951). Later in 1987, the Malcolm Baldrige National Quality Improvement Act was signed with the following focus (6) (11):

- Help US companies to improve the quality and productivity.
- Award the achievements of those companies and give an example to the others
- Give the appropriate guidelines and criteria to all organization, so to evaluate themselves
- Provide guidance for managing quality and also make available insights from the wining companies.

The MBNQA includes five awards, for Manufacturing, for Small Business, for Service, for Education, for Health Care and for Nonprofit (11). The award's name comes from the Secretary of Commerce (Malcolm Baldrige) of President Reagan (11).

The MBNQA is based on the Baldrige Excellence Framework, which is consists from three versions, the Business/ Nonprofit, the Education and the Health care, each one with different terminology in order to represent the specific practices of each sector (11) (6). The Framework includes the Criteria for Excellence, the values, the concept and the scoring method, so to help organizations to answer the following questions (11) :

- "Is your organization doing as well as it could?"
- "How do you know?"
- "What and how should your organization improve or change?"

The criteria include seven categories (11):

- Leadership: It describes the impact of leadership to business success.

- **Strategy:** What are the strategic objectives and the action plans, and how these are developed.
- **Customers:** It examines the relationship with the customer and the customer focus of the organization.
- **Measurement, Analysis, and Knowledge Management:** This category connects all the other categories with the business results.
- **Workforce:** How the organization uses its workforce.
- **Operations:** It describes how the organization through its products and processes, deliver value to customer and achieves sustainability.
- **Results:** It includes the evaluation of objectives, customer, products, key processes, and improvement activities.

All these described collectively in the Figure 5 (12):

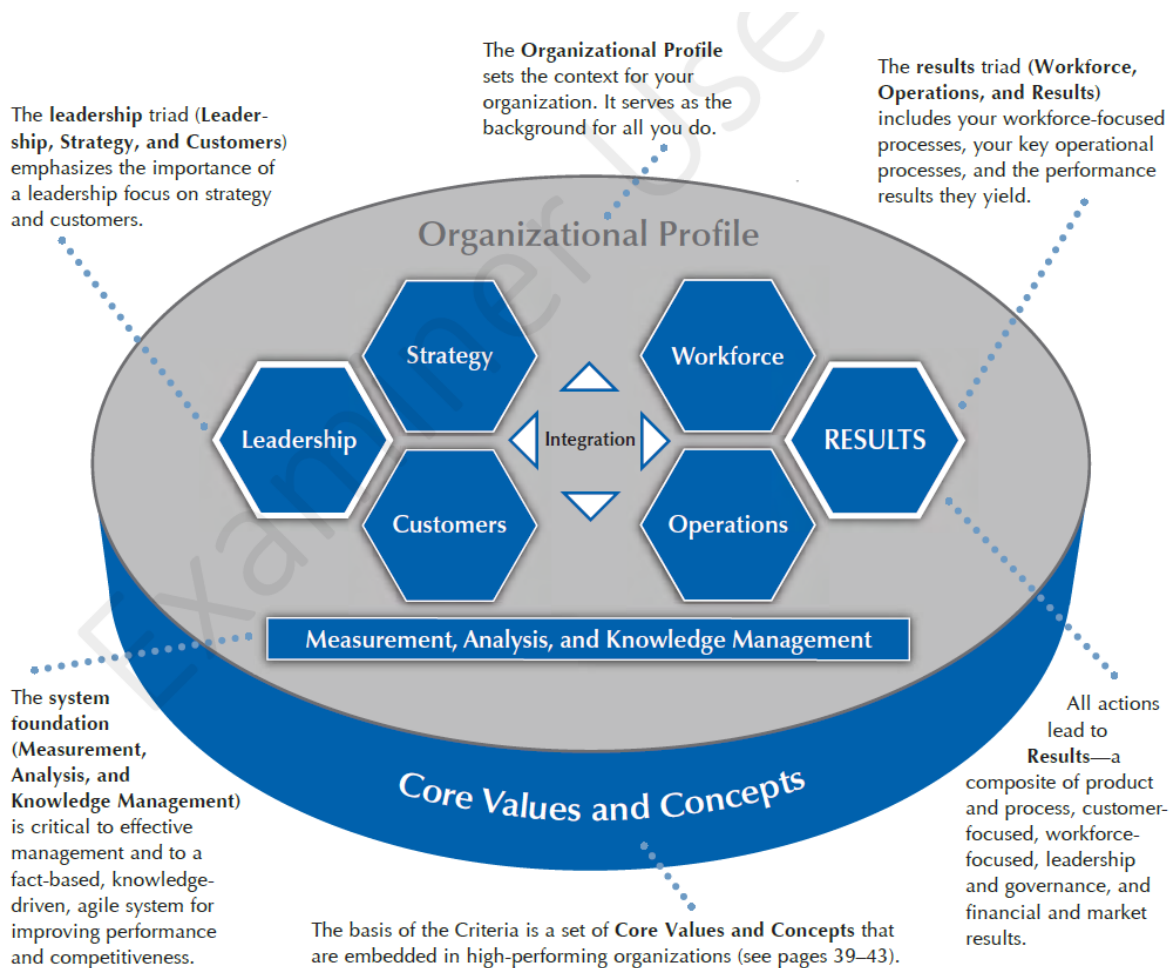


Figure 5- MBNQA framework

The whole Baldrige framework is based on the following values and concepts (12):

- Systems Perspective: Manage all the aspects of the organization as one, so to achieve its goals.
- Visionary leadership: Have a clear vision, customer focus, values and ethics. All of these should be aligned with stakeholders and contribute to the business strategy.
- Customer- focused excellence: The customer is the main focus of the organization and all the processes/ services are designed to add value to the customer.
- Valuing People: The organization in order to succeed should have an engaged workforce, which finds meaning in its work, have opportunities to educate itself and benefits from its performance.
- Organizational Learning and Agility: Continual learning and the ability to be flexible is very critical, so to be competitive and adaptive.
- Focus on Success: Plan both short and long term, so to ensure the success.
- Managing for Innovation: Create the environment and the processes that are needed so to benefit the Innovations, with which the whole organization will improve.
- Management by Fact: Manage the organization by analyzing and measuring the performance of inside and outside environment.
- Societal Responsibility: Responsibility for the impact of the organization functions and the life cycle of products.
- Ethics and Transparency: Develop the ethics and monitor the organization accordingly. Also, the senior management should be the role model for these ethics.
- Delivering Value and Results: By delivering value, the organization achieves engagement with the stakeholders. Also, it is important the performance to focus on specific results.

## ii. European Quality Award

In 1988 it was founded the European Foundation for Quality Management (EFQM) with scope to help the European Companies to become more competitive in the world market (6). The EFQM soon after its foundation, it organized the European Quality Award, similar to MBNQA, but more focused in social impact and human resources management (6). The EFQM model requires from an organization to have an effective management system and as a result it can be used as a self-assessment tool for management system (6).

The 2012 model is presented in the Figure 6 (11). This model is based on the following values (6):

- Leading with vision
- Inspiration and Integrity



- Succeeding through the talent of people
- Harnessing creativity and innovation
- Developing organizational capability
- Managing with agility
- Adding value for customers
- Creating a sustainable future
- Sustaining outstanding results

These values are included in the nine criteria of model, which are split between the Enablers and the Results (6):

- Enablers:
  - Leadership
  - Strategy
  - People
  - Partnership and resources
  - Processes, products and services
- Results:
  - Customer results
  - People results
  - Society results
  - Business results

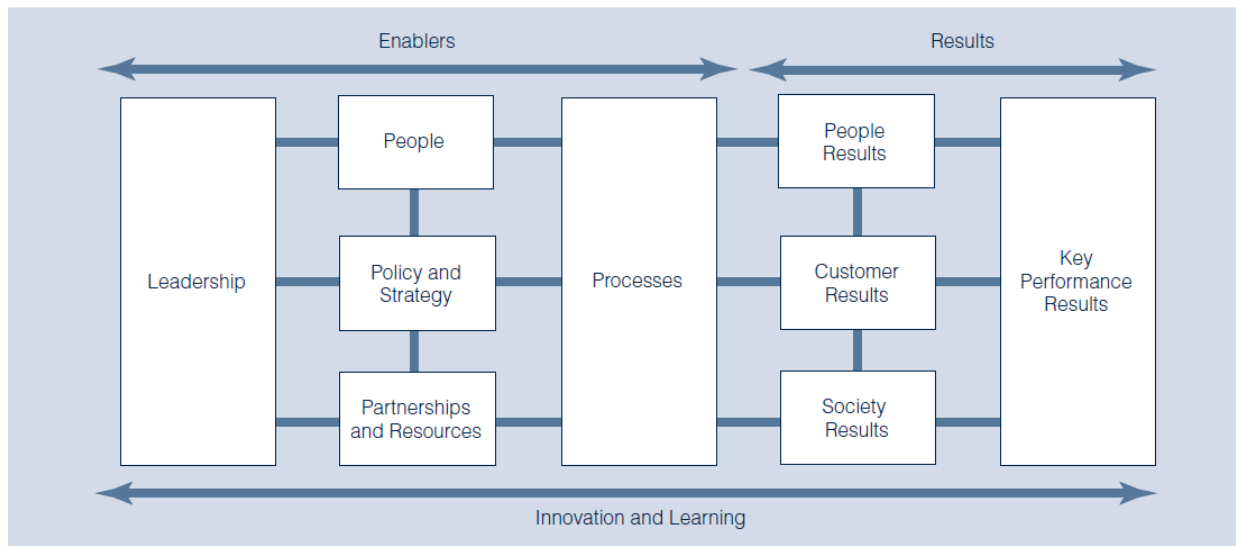


Figure 6- EFQM Model (2012)

The 2019 EFQM model is presented in the Figure 7 (13). The model is consisting of three areas, the Direction (“Why does this organization exist? What purpose does it fulfil? Why this particular Strategy?”), the Execution (“How does it intend to deliver on its Purpose and its Strategy?”) and the Results (“What has it actually achieved to date? What it intends to achieve tomorrow”) (13). Each area includes the following criteria:

- Direction:
  - Purpose, Vision & Strategy:
  - Organizational Culture & Leadership
- Execution:
  - Engaging Stakeholders
  - Creating Sustainable Value
  - Driving Performance & Transformation
- Results:
  - Stakeholder Perceptions
  - Strategic & Operational Performance

Each criteria have specific scoring points and all together gives a maximum score of 1000 points.



Figure 7- EFQM model (2019)

The EFQM model (regardless the edition), it is based on the RADAR tool, which is used for the assessing of the Organizations. The RADAR consists of the following elements (14):

- Results
- Approach
- Deployment
- Assessment
- Review

The logic behind RADAR tool is that an organization should figure out the Results that wants to achieve, develop an Approach to achieve the results now and in the future, deploy these in a systematic way and finally Assess and Review the selected approach based on the results (14). When an organization uses the RADAR tool, the Approach, Deployment, Assessment and Review elements, should be addressed for each EFQM model's Enablers criterion and the Results element should be addressed for each EFQM model's Results criterion (14).

### iii. Lean Management

Lean methodology originates in the Japan at the decades of 1950 and 1960 (6). The Japanese after the second world war visited the USA to observe how their industry works, so to increase their productivity (6). They visited the Ford car industry, in the most efficient factory in the world, where they point out a lot of wastes, like unnecessary storage and bad quality of materials (6). It became obvious that because of the lack of resources and lower productivity rates, this system would not be applicable in Japan (15). Using this this experience, they developed many modern techniques, like the "Just in Time" and "Total Quality Control" (6). These initiatives started in Toyota and they called "Toyota Production System", which is the form of Lean (15). The Lean as a term firstly showed in 1988 so to describe this system and later at 1990s it was further analyzed by determine the five major principals (15):

#### *1) Determine the product's value that the customer receives*

One of the most important scopes of Lean is to reduce all the wastes in a production process (15). These wastes are called "Muda" and basically are anything that doesn't add value to the customer (15). So, based on this logic, every activity can be value- adding or non-value adding but necessary (type one muda) or non-value adding and unnecessary (type two muda) (15). The wastes can be separated in seven categories (15):

- a) Overproduction: production of products when there is no demand, which can lead to increase of inventory and transportation costs.

- b) Waiting: when an employee (for example an operator), waits for the next task, because of material shortage, production delays or bottlenecks.
- c) Unnecessary transport: inefficient transportation of materials between processes and warehouse/ inventory.
- d) Over processing: activities that don't add value to final products, like unnecessary activities, production of scraps, or activities that produce higher quality than the demanded.
- e) Excess inventory: existence of unnecessary quantities of materials (raw materials, semi-finished, finished products).
- f) Unnecessary movement: any movement that can be avoided, like searching for tools or materials.
- g) Defects: any scrap products or product that need further processing, increase the overall cost and lead to over processing.

These categories have some overlaps and the most critical is consider the overproduction, which can lead to other type of wastes (15).

#### *2) Make a visualization for every product of its value stream*

The value stream contains all the processes from the supplier to the customer, that has to do with the product (15). The visualization of this is very important so to optimize the production process and remove any non-value add activity (15). This optimization can be achieved with the standardization of activities and more specifically with the standardization of responsibilities so to have more efficient processes (15). Another technique that can be used is the visual control, with which the processes become more transparent, because everyone has access to the production data and can monitor them mor easily (15).

#### *3) Remove the interruptions from the material flow*

In a production system is very important to have a constant flow (15). This can be achieved firstly by focusing on the product and understand the path until the finishing (15). Secondly the organization must change its thinking in more process-oriented and thirdly to reduce/ eliminate wastes by changing the processes/ tools (15). In lean the scope is to create the appropriate flow, by coordinating the production with the sales demand (15). This can be achieved with the takt time, which is the effective working time available divided by the customer demand (15). The takt time is an indicator, regarding the flow that the production should have, so to avoid the overproduction or the underproduction (15).

#### *4) Pull production system*

One important aspect of lean is the pull system. With this the customer is the one that determines the production flow (15). With this an organization can significantly reduce the work in progress and cycle time (15). The result is a smoother flow, with improved product quality and lower costs (15).

### 5) *Always looking for perfection*

This principal comes to highlight that the Lean is not a onetime thing but is a way of living (15). The organization should look always for ways to improve and become perfect (15). This continues improvement philosophy is critical for the success of the organization and can be affected from the following (15):

- Alignment of every measurement process, like KPIs' measurement, and standardization of them.
- Use an ERP system which will contain all the information regarding the production and storage processes and as a result reducing the human error.
- Training of employees so to provide the necessary knowledge and competence.

### e. Operational Excellence and ESG

The last years a lot of issues has occur that threaten the modern societies and have its roots to environmental, social or governance aspects. The ESG acronym stands for “environmental, social and governance” and attempts to face these issues and promote the sustainability of environment, society, organizations, markets, countries, etc. (16). This achieved through a ESG framework which are used for investment purposes, by evaluating an organization regarding the current and future financial performance, something that points out the sustainability and possible future development of this organization (16). More specifically the ESG framework consist of the following three dimensions (16):

- i. Environmental (E): It includes environmental factors that may have an impact (positive or negative) on the financial performance or creditworthiness of the organization. Some of these factors are:
  - Green House Emissions
  - Energy consumption/ efficiency
  - Emitted air pollutants
  - Production of wastes
  - Production of environmentally friendly products
- ii. Social (S): It refers to social matters that may impact the organization's financial performance or creditworthiness, like:
  - Child labor
  - Health and safety of Workplace or Customer
  - Discriminations, diversity and equality
  - The impact on the community
  - Training of employees
  - Supply management

- iii. Governance (G): It describes governance aspects that may impact the organization's financial performance or creditworthiness, like:
- Organization's principals
  - Accountability
  - Transparency
  - Engagement of stakeholders
  - Stakeholder rights

The Operational excellence frameworks like EFQM and MBNQA, include aspects of ESG. More specifically aspects of the frameworks like "Good Organizational leadership", "Importance of Employee management and development", "Continuous Innovations and improvement for operations", "Productive Utilization of Information and knowledge" and "Sustainable organization results to drive business excellence", are refer to ESG ideas (17). The operational excellence frameworks can be used as a base for the implementation of ESG, with the EFQM to provide currently a more suitable framework (17).

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## 2. Construction Industry

### a. Introduction

In the literature is being found the following definition for construction (18):

*“Construction is the process whereby designers’ plans and specifications are converted into physical structures and facilities. It involves the organization and coordination of all the resources for the project - labor, construction equipment, permanent and temporary materials, supplies and utilities, money, technology and methods, and time - to complete the project on schedule, within the budget, and according to the standards of quality and performance specified by the designer.”*

From this definition is obvious that the construction industry is very different from the manufacturing. In the first the products or facilities are in some extent unique, and the processes are not repetitive (18). The progress measurement is often difficult and not standardized (18). On the other hand, in manufacturing, there are repetitive continues processes, where the wastes are more easily identifiable (18). Other special characteristics of construction are the vulnerability of external factors, like the weather, the legislation, the safety standards are often stricter, and the acquisition of projects has to do usually with financial parameters (like the lower bidder) (18). Also, the cultural factor is very crucial, because the projects often include people from different cultures and as a result there are frequent conflicts (18). In addition to that, the project team is not the same, but it changes as the project progress (18). A phrase that depicts all these are the following (18):

*“In reality, most projects are like a new company being formed to produce one unique product.”*

Another aspect of Construction industry is the customer satisfaction. Customer requirements are always increases and the companies face them as the most important stakeholder (19). So, another problem is how to create more value and how to transfer it to the customer (19). Up to some point, this happened by fulfill some standard’s criteria, but today this is not enough (19). Today there are complex parameters like resource optimization (for example raw materials or labor), which often depend on the information transfer (19).

A very important part in every construction company is the supply/ procurement. Since most construction companies include many projects, the main decision maker for each project is the Project Manager, something that decentralize the decisions (20). Considering this, the Project manager is often responsible for the suppliers of the project (selecting and budgeting), by setting up a team inside the project to manage the procurement needs (20). There is also the scenario of a central procurement department that manages the supplies for all projects, but it luck often



of integration and process coherence (20). A frequent supply disadvantage that the construction companies face, is the lack of strong relationships with the suppliers, because the purchases are often small or in a short time frame (20). This doesn't let the companies to come closer to the suppliers and have leverage against them, something that is more easily in manufacturing companies that are based in scale economies (20).

## b. Trends in Construction

Construction industry is not change as rapidly as other industries (like services or electronics), but there are many new concepts that promise to evolve the way that industry works. Some of them will be presented in this paragraph with a scope to show in the next paragraphs how they can be influenced from the OPEX.

### i. Building Information Modeling (BIM)

The Building Information Modeling (BIM) is a digital representation of the construction project, which can be used for decision-making, scheduling, planning and cost estimation (21). BIM is a very important tool that can be used for more efficient management of construction projects (21). BIM connects the documentation of a project with all involved parties and because is object based can distribute efficiently the project duties (21). It integrates the conventional 3-D drawings with another aspects (dimensions), like cost and time management, taking also in consideration the risk (21). BIM also promotes the communication and collaboration of all interested parties, like project managers, engineers and labor, creating the appropriate communication channels (21). Finally, BIM contributes also to the procurement, by monitoring the material and work in projects (21).

### ii. Offsite Construction

The offsite construction comes to give a solution in many problems that exist for decades in the construction industry, like the bad scheduling and the cost overruns, by introducing a more manufacturing approach (22). This method can maximize the profit, especially for projects that adopt it as early as possible, although there are still some aspects that hold back the wide spread of this methodology (22). Most specifically, offsite construction can lead to reduction of costs, because organization can manage more efficiently the material and time wastes and also it reduces the

transportation cost of heavy machinery (like cranes) (22). At the same time, it can reduce the time that a project needs to complete, because the fabrication of construction parts (modules), can happen simultaneously with other construction activities, with also less labor (22). Another benefit for the offsite construction is the reduction of environmental impact. The repetition processes of this method can reduce the wastes that produced from plastering, concrete and rebar placement, and at the same time minimize the production of CO<sub>2</sub> emissions, making the overall process more sustainable (22). In parallel the controlled fabricated environment can improve the quality of the final product and as a result increase the customer satisfaction (22). In general, offsite construction is a very promising and can give solution in many modern problems. One of these problems is the labor shortage, because it significantly reduces the labor that needed and also it gives the opportunity to keep the labor longer, because they don't need to move between project sites, which often are in a totally different location (22). Finally, it also solves the problem of urban density and lack of space, by reducing a lot the needed space for the construction site (22).

### iii. Green Building

The construction industry is very harmful for the environment. A construction activity can have a major impact in the environment, like noise, dust, water pollution, wastes, etc. The constructed buildings consume a lot of energy and produce great amounts of greenhouse emissions, like CO<sub>2</sub> and also at some point of their life, these buildings may renovate, something that will additionally harm the environment by consuming additional resources and producing additional wastes (23). The green building comes to give a solution to all that, by reducing the environmental impact of construction industry. There are many assessment tools that attempts to rank the buildings based on how green they are and the most popular are the "Leadership in Energy and Environmental Design" (LEED) and the "BRE Environmental Assessment Method" (BREEAM) (23). The green building attempts to protect the environment, by choosing sustainable land, reduce the construction and demolishing wastes and also promotes the recycling (23). The reduction of costs is one more benefit that occurs from green building, which comes from the reduction of operating costs (like energy consumption), by more efficient use of construction materials and also by lower maintenance costs (23). These can also reduce the higher construction cost for a greener building. Another aspect that makes the green building beneficial, is the human aspect. Employees are more comfortable in a green building, because it provides better thermal efficiency and better indoor environment quality (23). This may lead to more satisfied employees/ residents or in general to more satisfied customers (23).

### c. Construction Excellence Awards

There are many construction awards worldwide that want to recognize and reward the companies or people that strive to achieve the excellence. Some of them are presented below.

#### i. Quality Excellence Award by BCA

This award is being given from the Building and Construction Authority (BCA), which is located in Singapore. The purpose of this award is to recognize the commitment and achievements of the construction companies (developers and builders) regarding the quality of their buildings. It aims to promote those who deliver workmanship excellence through quality assurance programs, so to deliver high quality buildings. The award has two categories (Developer & Builder) and three type of awards (Platinum, Gold Plus, Gold), depending on the overall score (24).

#### ii. Constructing Excellence Awards by BRE

The Constructing Excellence Awards is a yearly program that selects the best UK construction organizations. The participants are the winners of the 8 regional awards in each of the 15 categories and from all of them the 15 National Winners occurs. The mission of this program is to “Positively disrupting the industry delivery processes to transform performance” (25).

#### iii. Construction Awards of Excellence by NFB

The Construction Awards of Excellence claims to be the only independent construction award and refers to UK companies. It aims to recognize the people and companies that have the best standards in construction industry. Also, the award contains 14 categories and the winner for each category is decided from a judge committee. The vision of NFB is “To help our members build prosperous businesses and create optimal conditions for the construction industry” (26).

#### iv. LABC Building Excellence Awards

This award focus in companies with the best technical innovation and construction quality, with scope the raise of construction quality level in England and Wales. The selection of winners is based on the creativity for solutions regarding the sustainability, energy efficiency and cooperation. The award is being given by the LABC, which represents all local authority building control teams in England and Wales (27).

#### v. LCI AWARDS

The Lean Construction Institute (LCI) awards has as scope the recognition of individuals for their accomplishments in the Construction industry, using Lean methods (28). There are three Award categories, the Individual Award for Pioneer, which been given to people that evolve Construction industry using Lean, the Chairman's Award, which been given to people that contribute to the Institute, and the Team design Award, which been given to teams that produce outstanding designs for Lean Projects (28).

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### 3. Literature Review

There is a wide variety of literature that has to do with excellence and with the respective frameworks. Most literature concentrates on MBNQA and EFQM models. Each study gives a different perspective in these models and offers new knowledge. This study tries to categorize the available literature in four categories:

- Framework Implementation
- Self-Assessment
- Framework analysis
- Framework proposal

There are obvious overlaps between these categories, but the point of categorization is the better understanding of literature and what it has to offer. So, the scope of this literature review was the identification of best practices regarding the Business Excellence.

#### a. Framework Implementation

There is a wide range of literature that studies the implementation of Business excellence models, so to investigate the benefits of these models. These studies have to do with both MBNQA and EFQM models, as well as new models that was based on these two.

A study from US tries to determine if there is a relationship between the acceptance of the Baldrige Model as a School improvement model and professional development opportunities offered to staff to implement the Baldrige criteria (29). Also, it has as secondary objective to examine the relationship between staff acceptance and school improvement, by studying the literature (29). The tool that has been used is a Questionnaire, which used to measure the staff acceptance of Baldrige criteria. This tool measures the acceptance, by using a Seven Stages of Concern Likert Scale, in a 35-item questionnaire (29). The findings indicated that districts that conducted building-based training had greater teacher/staff acceptance of the Baldrige Model and more wide-spread use of quality process throughout the school district (29). Also, access to technical support as a follow-up to training was also viewed as an important contribution to staff use of the Baldrige Model and the role of district and building leadership was also seen as a key to effective implementation of the process (29). Collectively, administrators, teachers, and support staff reported success in the Baldrige Model as a school improvement model and all reported a greater focus in addressing improved student achievement (29). There was a greater alignment of district, building, and classroom mission and goals and all reported a greater use of data in the

decision-making process (29). The professional development offered to staff appeared to be more purposeful, systemic, and systematic in working towards improvement in each district (29). So, it is obvious from this study that the Baldrige model can benefit a lot an Institution and also it is very interesting the fact that when the staff were previously trained, they were accepted more easily the model.

A similar study that has to do with the EFQM model, examines the implementation of the model in a UK University (30). The aim of this study is to examine the implementation process, so to create a framework for similar implementation and specifically wants to find the issues that can occur during this implementation, examine the effectiveness of this implementation in the case study organization, find and analyze the approaches that have been already used and finally explain the success or failure of some EFQM implementations (30). The methodology that is followed includes a literature review for the developing of a theoretical framework and then a series of case studies for the analysis of EFQM implementation in UK Universities (30). Firstly, the author identifies the issues form the literature review of EFQM uses of the model through all the departments, the self-assessment approach, the use of RADAR logic, the scoring and the terminology of the model (30). From the literature review regarding the effective implementation of EFQM, the author points out the issues that emerge, like the management commitment, resistance to change, culture, project management, education/ training, communication, teamwork, momentum, and integration (30). After considering all the issues from the literature review, the author develops a theoretical framework to be used in the case studies (30). Four cases have been selected and the data collection will include structured interviews (30). Regarding the first case, the implementation took over 3 years, with very little progress made, and it is believed from the researcher that due to lack of management commitment there will be not more effort to this (30). In the second case the use of the model was very limited and there is little possibility to be implemented, due to lack of motive, but the results were a little better in the third case, in which the model was used, but only for one self-assessment (30). According to author, it is possible the model to have more extent use in this case, because of the well-trained staff (30). The most promising results come from the fourth case, in which the model have been used for three self-assessments and it integrated in the management processes (30). The main challenge in this case is of sustain the use of the model, something that can be threatened from the changed of top management (like the Dean) (30).

A similar study in the banking sector, investigates the factors that affect the service quality of companies (31). This attempts to achieved through three case studies of three different banks in Syria (31). The author points out a lack of empirical studies regarding the quality in banking sector and especially in the Arabic countries (31). To fill this gap the author investigates the banking sector of Syria and tries to find what are the factors and how they affect the implementation of EFQM in Syrian banking sector (31). The methodology that this study follows, includes a case-

studies as the main method (31). These studies include semi structured interviews with managerial personnel (from three managerial levels) of the studied banks, some direct observations, and study of the bank's documentation (31). After the analysis of the data, the author concludes in the following factors (31):

- Leading with Vision, Inspiration, and Integrity
- Adding Value for Customer
- Succeeding through People
- Managing by Process
- Building Partnerships
- Achieving Balanced Results
- Taking Responsibility for a Sustainable Future
- Nurturing Creativity and Innovation

After comparing the different banks, the author concludes that the Islamic Private Bank is more likely to achieve excellence than the others (31). The other two banks show some negative practices that hold them back (31). This private bank takes more seriously the customer satisfaction and has plan to be certificated for ISO 9001 (31). As a result, the study concludes that this bank is closer to the EFQM model (31), something very logical, because the model is very customer focus.

There is also a study that concentrates in the Arabic world and tries to find the factors that affect the implementation of Business Excellence Models (BEM) and examine these factors in the Abu Dhabi (AD) Police (32). They are trying to do this by using many methods, like literature review, surveys and interviews (32). The initiative for excellence started from the UAE government and while the AD police responded to it, they find out that there are challenges to achieve their strategic goals and therefore they could implement a BEM to achieve excellence in performance (32). Through the literature review, the author identifies 18 factors that influence the implementation of BEM in public sector and concludes that the Arab culture influence this implementation differently than the western countries (where most literature comes from) (32). During the implementations of BEM, the AD police have done many changes and the factors that influence this are (32):

- Top management commitment
- Setting a shared long-term vision
- Understanding the use and purpose of the BEM
- Establishing an excellence steering committee
- Stimulating a change culture
- Implementation plan
- Supportive organizational structure



- Developing internal capabilities
- Aligning BEM with the strategic planning process
- Effective communication
- Aligning BEM with organizational processes
- Developing a recognition scheme for BEM implementation
- Providing sufficient training
- Employee involvement
- Employee empowerment
- Aligning BEM with the performance measurement system
- Aligning BEM with information systems
- Developing an action plan

The researcher develops a framework for this implementation, based on the case study results and the 18 factors that the literature suggests that influence the BEM implementation (32). The study concludes that all the key factors that find in literature influence the AD police and they are important for the implementation of BEM (32). It points out that the Arabic culture has to do with how much these factors influence the BEM. The researcher suggests that to have a successful implementation, first there must be a commitment of top management, the organization should be adaptable enough to implement the changes, then during the organization should be consistent about its requirements, so the implementation to be controlled properly (32). The most interesting aspect of this study is that it points out how important is the culture to the implementation of a BEM and also the difficulties of studying a literature that is base mostly on western countries, with much different culture.

Concentrating more in the implementation process, there is a study that investigates this implementation in an energy company (33). This study examines a division of an energy company, on their ability to implement Operational Excellence (33). During this study, a survey shared to the employees of the division, so to find out the extent of organizational effectiveness in the implementation of OPEX, regarding the employee comprehension, engagement and leadership awareness, and also if the variation of this effectiveness can be explained by independent variables (33). The methodology that has been followed was quantitative and tests if the demographic variables can be used a statistically significant predictor (33). For this purpose, a questionnaire with 30 questions and a 5-point Likert scale was used (33). After the analysis of the data, the author concludes that the employees that have already some experiences of OPEX (like participation in a similar program) are more aware and interested to participate and also the senior employees showed more comprehension and engagement to OPEX activities (33). They found that business unit and field of study (engineering or construction management) were statistically significant predictors of many of the dependent variables (33). The employees from the Public Sector unit were less likely to respond that the management actively emphasizes OPEX

expectations, something that shows a gap between the company's expectations from the managers and what public sector employees perceived (33). Furthermore, the employees with engineering or construction management background were more likely to respond that the OPEX is meaningful for their work (33). Another interesting finding is that the OPEX comprehension and engagement was not significantly related with how long an employee works for the company (33). Also, the work environment, the highest level of educational attainment, the current organizational structure or the geographic location, were not statistically significant predictors (33). So, the main point of this study is the significance of organization culture in OPEX implementation, something that seems to become a problem regarding the public sector employees. Also, for one more time it seems that the trained employees are more easily to use the OPEX practices, probably because it is more likely to understand the benefits in their job.

In order to analyze further this implementation, a study analyzed a company that implemented in the past the OPEX and attempts to answer questions like, how to organize efficiently the operational processes, what are the steps to OPEX implementation, what are the essential steps in the implementation planning, how to enroll OPEX in a business of the analyzed organization (2). The methods that have been used were the Focus group method and the Action Research (AR) method, which focused on the service level, lead time, Product life cycle, the market positions, the supply chain and the stock model (2). The focus group method was selected so to generate knowledge, explore opinions, attitudes and attributes (2). The AR method was selected because it is an iterative process involving researchers and practitioners acting together on a particular cycle of activities, including problem diagnosis, action intervention, and reflective learning (2). This research concludes in a structured approach for the implementation of OPEX, in which the first step is the communication with the management so to agree in the deliverables of the program and set a timeline (2). Then follows the analysis of existing data, like product life cycle, stocks, sales, etc. and next is the modeling, which is based on the analysis (2). A simulation is done so to conclude in the best set of variables, like delivery time, service level and lead time and follows the implementation of the new inventory model, forecasting process, reported KPIs, service level and delivery conditions (2). The result of all these is the reliability of the whole process, by achieving safety, stability, sustainability, scalability, predictability, provability (2). This study gives a better understanding on how an OPEX implementation could work, so to be successful.

A more specific study concentrates in the implementation of Malcolm Baldrige Framework in a medium size financial institution (34). This company wants to align its processes and strategy to the Malcolm Baldrige framework, so to improve the efficiency and the ability of taking intelligent risks, so this research wants to investigate how this company aligns to the framework, what are its strengths, what are the opportunities, what are the lessons learned, what are the recommendations for a company that wants to apply this framework (34). The methodology that has been followed was the analysis of the answers to the Malcolm Baldrige framework questions (34). The

assessment process that has been used was the same with the Baldrige assessment process and the result of this assessment shows that the company's strategic planning processes include principles that align well with the Baldrige framework (34). The company's mission, vision and values are clear and also cycles of learning and innovation are present (34). However, the researcher noted that operations closer to the front line are missing a clear connection to the company's mission, vision and values and cycles of learning and innovation are unclear (34). The company could improve the effectiveness of its strategic execution process, and therefore alignment with the Baldrige framework, by considering the 3 Cs of Strategic Execution (Communication, Commitment and Change) and by using the Hoshin Kanri method for a more effective strategic execution (34). This is an example on how a BEM can be used for self-assessment, so to find the strengths and weaknesses of a company.

A unique study examines how the Business model (BM) of a firm relates to Operational excellence (OPEX) and also wants to investigate how the OPEX affects the remaining business elements (4). BM are models that describes how an enterprise works. There are two definitions of business models, one that focuses on how the firm does business in a holistic way and the other that emphasizes in value creation (4). A more generic definition states: "The business model is a statement of how a firm will make money and sustain its profit stream over time" (4). This study gives emphasis on "Lean", "Business Process Management", "Balanced Scorecards and Dashboards" and "Six Sigma", and how all of these affects the BM (4). Through a case study, the author wants to find out the connection between the OPEX and BM (4). The BM that applied in this case study is the M. W. Johnson because it is easy to use (4). In parallel the examined firm pursues OPEX, by running OPEX projects for achieve High quality products, Low-cost operations and Health & Safety standards (4). During the coexistence of OPEX and BM, it is determined that new operational excellence techniques will irrevocably affect the other BM elements (4). This study concludes that it is difficult to measure how much the OPEX affects the BM, although there is definitely a correlation between them (4).

In the mining industry there is a study that analyzes the OPEX implementation in raw material companies of Austria, by conducting interviews (1). In these, the person interviewed were asked to define the OPEX and describe their experience, so areas where mining companies have applied OPEX and they show an increase in their performance to be identified (1). These interviews showed that the OPEX is known in the mining industry, because the last 10 years there were some relevant initiatives that have to do with cost saving and productivity improvements and mainly leaded by consultants (1). Also, some methods from the "Toyota Production System" were implemented, like kaizen, the quality circles, Standard Work, etc. (1). Another method that identified is the "Total Production Management", with which some of the maintenance duties move from the maintenance department to the operators and also the 5S also applies here (1). The last set of tools that have been used in mining industry was the "Lean Management" (1). The

researcher identifies the need for processes that work more efficiently and products with higher quality and suggests that this will be achieved through the education of all the employees in the concepts of OPEX (1). Also mentions that there are fields in mining industry that the OPEX has not yet applied, something that may result to further improvement and concludes that the mining industry should focus on innovations that have to do with operational technology and improves the value chain (1).

Another very interesting industry is the pharmaceuticals. There is a study that attempts to give some guidelines to how a pharmaceutical manufacturer in an emerging market, can implement an Operational excellence program (35). To achieve this the researcher does two literature reviews, one for the emerging markets and one for the OPEX and then he does a benchmark for the OPEX practices in pharmaceutical manufacturing sites, so to set the requirements for the OPEX implementation (35). Finally, an OPEX framework is designed to support these companies to implement an OPEX program (35). During the literature review for the emerging markets, it is concluded that there is a culture different in comparison with advanced markets, because of the different mindset and attitude of the employees (35). Also, after the literature review for OPEX, it becomes clear that the cultural dimension influences the OPEX and its success (35). After the analysis of the pharmaceutical industry, the author concludes to some external and internal barriers of OPEX, that presented in the Figure 8 (35):

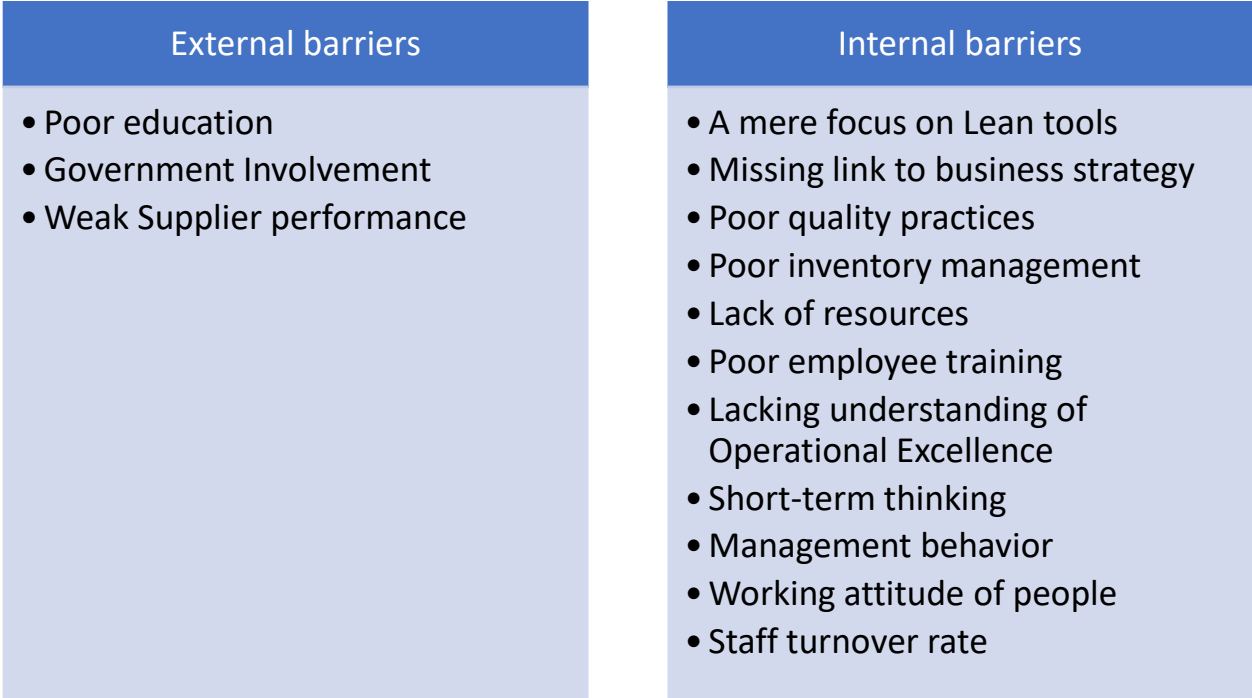


Figure 8- Barriers in OPEX implementation for pharmaceutical industry

In literature there are also many papers that examine the implementation of BEM, by focusing on the factors that affect this or the benefits that comes from it.

An interesting paper focuses on implementation of EFQM model in a Purchasing Department and tries to identify the relationship between the Quality management practices, the internal customer satisfaction and the business performance (36). A survey was conducted between a sample of 1200 purchasing managers, from which 306 was the responders and 14 were from construction (36). The results show a direct positive relationship between the Model enablers and the customer satisfaction, and positive relationship between the enablers and the performance (36). Finally, it was found a direct relationship between the quality management practices and the performance (36).

A similar paper tries to connect the MBNQA with the performance and find their relationship (37). For this purpose, a questionnaire was created and it sent in senior or middle manufacturing managers, located in Korea (37). The results indicates that the quality results affected from the internal quality drivers and quality information analysis and it concludes that the organization success depends not only in quality programs like strategic planning, customer and market focus, but also in programs that involves HR and process management (37).

The organizational context is also a very important factor in the implementation of BEM, for this reason there is a paper that analyzes this, by examine how the Leadership style, Strategy, structure and Technology affect the success of implementation, regarding the improvement outcomes and the ease of process (38). The results indicates that the more informally structured companies may have more chances to successfully implement a BEM and also the less complex organizations have also more chances in successful implementation (38). Finally, there was no relationship between the leadership style, strategy, technology, and the implementation of BEM (38).

The health system is a very unique environment, in which the customer satisfaction is very important and the BEM have great applicability. There are two papers in literature that examines the BEM implementation, one in Jordan and one in Netherlands (39) (40). In both papers, the model that is being examined is based in EFQM model and the staff are trained in this model (39) (40). The most significant result was in the Jordanian hospital, which after the assessment it has a score of 32.4/100, which is very good for a company that had not done anything similar in the past and also it is estimated that within a year this score will be more than 45/100 (39).

In parallel with Health organizations, there are also the Non-profit organization, which are also very different from the usual companies, because they focus on sustainability and not in the profit. For this type of organization there is a paper which investigates the applicability of BE model to Nonprofit organizations, to improve their sustainability (41). This study analyzes a UK organization, using a case study methodology to gather the appropriate data (41). The interviews that were conducted shows that the criteria of EFQM are relevant to the Nonprofit organizations, although the weights of the criteria are not appropriate (41). Comparing the EFQM with the

Baldrige model, it was concluded that regarding the Nonprofit organizations, the EFQM seems to have more advantages (41).

#### b. Self-Assessment

Using a BEM for self-assessment, is a very common practice, with which a company can determine how it compares with the model criteria, find its strengths, its weaknesses and monitor over time how these are change. For this reason, there is a lot of literature that investigates how companies perform this assessment and also what are the benefits/ opportunities of this procedure.

There is a study that tries to enhance its OPEX practices and to find possible issues and challenges in a logistic organization (42). For achieving these, the researcher started by review the literature and then continue in data collection through interviews, observations, documentary analysis and questionnaires (42). The main data collection tool was the semi-constructed interviews, because of the flexibility that offers and also another useful tool was the documentary analysis, in which the researcher analyzes the documents and records from the company (42). The results shows that the strategy that the company follows was not clearly communicated although the employees know what brings value to the customer (42). There were also issues with the company's structure, and as a result this caused conflicts (42). The researcher identifies a problem of operating efficiency in logistics and more specifically if the company tries increase the operating efficiency, they may increase the cost or decrease the customer satisfaction (42). So, it concludes that the monitoring of processes is critical, in order to control this (42). The researcher identifies that the trust of the customer is a key value driver for OPEX and can lead in competitive advantage (42). The sharing of knowledge was something that the interviews show that needs more focus and finally concludes that the main key value drivers are the company values, like keeping promises, which determines that is much appreciated by the customers (42).

There are also some studies regarding the Bank Sector. The first study tries to analyze how the quality in bank's customer service measure and implemented (43). This analysis will happens using the EFQM Excellence model and by using quality measuring theories, alongside with EFQM model and RADAR-logic (43). The research method that has been followed has a case study form (43). Net Promoter Score (NPS) and Customer Effort Score (CES) was gathered from the examined company, and it is worth to mention that the sales were left out of this research (43). Also, a questionnaire was designed for collecting information, and the two main questions was how excellent quality is measured and how excellent quality is implemented (43). According to the results this bank has excellent processes and also have them documented (43). The possible opportunities that occurred during this study was the involvement of employees in building processes (43). Also, the evaluation of KPIs seems to take too long (6-12 month), so it was recommended

to give more short term KPIs (43). A very important aspect of this bank was the way they lead the staff, so to have a healthier and more efficient environment (43). Regarding the customer feedback, they are involved in customer journey workshops and continuously develop channels, although there is not clear how the availability in different service channels was related to the quality measurement at the organization (43).

Another study that has to do with the Bank sector tries to investigate the applicability of EFQM framework in a Greek bank (44). To achieve this the researcher started with gathering information through exploratory research, regarding the customer satisfactions and the service quality (44). Then a questionnaire was designed, with 56 questions and Likert scale (0 to 5) and the sample that was taken, consisted of 112 employees that answer the questionnaire (44). The results shows that the employees' satisfaction from the management is good, something that has to do with the top management behavior, the employee satisfaction from the policy and strategy of the bank is average, and it is the results of new policies regarding the performance measurement (44). The level of employees' satisfaction from human resources is below average, because of the lack of involvement of employees in initiatives (44). In the criteria of cooperation and resources, the result was bad, which has to do with the lack of communication with the external environment (like the customers) (44). In the criteria of processes, products and services, the results were satisfying, which has to do with the access of employees in managerial knowledge and as a result it is easier for them to do their duties (44). The results of customers' criteria were low because the customers don't be involved in decision making (for example by considering the customer complaints) (44). Finally, the employees don't seem to be satisfied in the criteria of business results, something that has to do mainly with the inefficient operation of the bank (44).

Very similar with the Bank sector is the public sector. Research investigates a Greek water company and wants to find out if it meets the EFQM criteria (45). So, the research questions that this study sets, are how the employees perceive the quality and what actions of them meets the criteria of EFQM framework (45). The methodology that will be followed is case study approach and the tools that had been used were the interview and the questionnaire (45). The questionnaire is based in the EFQM model and consisted of the following four sections (45):

- The structure of the company (regarding, the vision, the policy and the strategy)
- The administration regarding the quality
- The quality control system
- The role and action of top management regarding the quality

The results regarding the first sections, shows that there is no long-term strategy, only short term, there is no measurable quality targets and there is a lack of policy's communication (45). The top management knows the needs of the customers and tries to understand their needs (45). In the

second section, the company runs training programs when it is needed, but there is a lack of clear definition of quality in some departments (45). In the third section, the company doesn't use statistical tools for the quality control procedures and the customer complaints, and there is a lack of assessment of employees and of customer satisfaction (45). The reward system regarding the customer support, although it exists, it is not usually used (45). In the final section, it is noted that the employees don't get involved in company decisions, but they are satisfied regarding the trainings and seminars that they receive (45). There is a lack of clear culture, something that doesn't encourage initiatives and it is concluded that although the company had a significant staff reduction in the last years, there is a significant potential for improvement regarding the quality (45).

Regarding the small to medium-size companies, there is a study of the company's practices compared to Baldrige Criteria for Performance Excellence (46). The methodology that has been followed is the comparison of company's processes with the Baldrige criteria and more specifically these criteria firsts transformed to single requirements, then the examination happened through three different levels of the Criteria and the case example strategic plan (46). The results have to do with the items of the criteria that the company meets and also the results contain the combined values and a weighted percentage (46). The comparison in this study happens in three levels, so to have two examination results, one that depicts how many of the company's strategic plan items relates to Criteria and the second to show the combined evaluation of applicable criteria relatable to strategic plan items (46). The first Level comparisons provides the framework for comparisons of the proceeding levels and the second Level comparisons consisted of the case example strategic plan objectives and the Criteria overall requirements items (46). The third level consisted of the case example strategic plan goals and the Criteria's multiple requirements items (46). The results show that the strategic plan addresses only 17% of applicable Criteria requirement items is correct and also this study concluded that the strategic plan addresses 129 Criteria requirement items is also correct (46). The evaluations performed on the first two levels of the Criteria, the basic and overall requirement levels, provided a relative high percentage of linkage between the strategic plan and the Criteria with 50% and 41% respectively (46). The third level of evaluation of the Criteria, on the multiple requirement level, did not render a high percentage (12%), however the total volume of Criteria items identified as relatable to at least one strategic plan items (79) demonstrated the case example organization practiced a high number of principles behind the Criteria multiple requirement items (46). This study concludes that the case example organization practice principles of the Criteria without direct knowledge of the Criteria, and also the case example organization's strategies to achieve organizational success directly align with the principles that formulate the Criteria (46).

Finally, there is a study that implements self-assessment in a Greek manufacturing company (47). The scope of this study is the self-assessment of a steel painting division based on the EFQM



model and the research is based in the EFQM Excellence Model Quick Check tool and the EFQM Excellence Model Business Excellence Matrix (47). The first will provide a quick view of the situation and the second will go deeper in the organization's performance, by rating the results in a scale of 600 (and not to 1000 like the EFQM Excellence model) (47). The results shows that the organization was very willing to participate in this self-assessment, something that shows its desire for continues improvement (47). The results of the two methods were the same (47). The self-assessment shows that the "Leading with vision, inspiration & integrity" is the key part of the company that leads to "Achieving Balanced Results", something that is the strength of the company (47). In the other hand the main weakness is the "Management by Process" and "Adding Value for Customers" (47). The total score of the company was 371/600, which characterized from the researcher as slightly positive and shows the need for improvement (47). The research concludes that the strengths of the company were the processes and results regarding the Human Resources, the supplies and the management of resources and also they have a very improve system to communicate the strategy and manage the KPIs (47).

In the literature there are only few papers that examine the implementation of self-assessment. One of these describes the implementation of Baldrige framework in a department, so to investigates the applicability of this model in a department level (48). The examined department started with learning and training on TQM concept and then they come in contact with a consultant regarding the Baldrige criteria (48). The department team trained in the Baldrige criteria and then applied them in the organization by suggesting improvements based on every criterion (48). The team also prepare the application for Baldrige award to find out its scoring and after the assessment, the strengths and area for improvement were identified (48). This initiative showed that the Baldrige criteria can be applicable and beneficial to even a part of a company like a Division or a Department (48).

There are also two papers that try to help in the self-assessment process, with the first one to provide a framework, which is based on EFQM model and consists of eight levels (from zero to seven) (49). The level zero includes the initial decision of applying for the EFQM award, the level one describes the components for the assessment, the level two describes the understanding of the criteria, the level three focuses in the sub criteria, the level four categorizes the organizations in seven categories, the level five includes the radar logic, the level six give a guide to assess each criteria of EFQM and level seven weighs the final scores (49). The second paper that is in the same logic, tries to find the best practices to conduct a self-assessment base on the EFQM model (50). This research finds out that in order to achieve continues improvement, a self-assessment process is needed (50). The best practices that were concluded are the followings (50):

- Improvements to be reviews by managers.
- Involvement of CEO
- The self-assessment to be conducted by trained employees

- The whole process to be started from the management level
- Decide the use of results prior to assessment
- All employees that will be get involved should be trained.

Simultaneously the research points out some bad practices (50):

- Not involving the psychological factor in the assessment
- Only involvement of quality department
- Small companies without TQM experience may not be able to benefit from this.

### c. Framework Analysis

Another category in literature is the studies that analyze the frameworks, by examine their components and their impact in business results.

A very interesting study wants to find out what elements of the Malcolm Baldrige criteria, positively influence an organization (51). The author recognizes a problem in modern organizations regarding the implementation of strategy (51). He notes the 7-s framework, in which stated that “our claim is that effective organizational change is really the relationship between structure, strategy, systems, style, skills, staff and something we call superordinate goals” (51). The problems in strategy’s implementation results in neglection of all seven elements of 7-s framework and the author notes that with the Malcolm Baldrige criteria, it is possible the leaders to make better decisions regarding the strategy (51). For this reason, the scope of this study is to quantify the elements that lead to successful strategy implementation and the main question is if the organizational process always produces positive organizational results (51). The methodology that has been followed is called “action research methodology”, with which the researcher is planning a change, then observes the consequences and finally replans a new change (51). With each cycle the researcher learns something new about the processes and in parallel data are gathered from the scoring sheets of the past MBNQA recipients (51). Through the statistical analysis of these data, the researcher tries to construct a predictive model, which relates the processes with the overall score (51). The results shows that there is a positive relationship between Results and Scores (R-squared ~99%) and concludes that the criteria “1.1 Senior Leadership” and “5.2 Workforce Engagement”, can increase the effectiveness of a company, by dedicating the minimum resources (51).

Another study with multiple scopes, first tries to compare the three most known quality award frameworks (MBNQA, DP, EFQM), second assess the effectiveness of Baldrige framework in a government organization and compare it with other industries and lastly propose a new Baldrige

framework, which will be more associated with the Supply chain management (SCM) (52). When it comes to model comparing, it finds out that the DP has a focus on the operations, internal knowledge management and leadership and also concentrates in “core quality system”, when the other models concentrate in business results (52). The EFQM model focuses more on sustainability, by promoting factors like supplies, societal and environment and the MBNQA often is the base of many quality awards because it balances the competitive power with the sustainability (52). During the study of MBNQA in government companies, it is found that this award category has the same customer focus as the other categories, with more focus in the strategic planning (52). The influences of each MBNQA category on results are determined with a survey and the item of this survey matches the MBNQA criteria (52). The results show that for a government organization, the leadership, workforce focus and operations focus, are the most critical and contributes the most to the success of the organization (52). Regarding the restructured framework, the researcher develops a new framework and this is tested with three studies, each study used survey data from different time periods of MBNQA framework (52). The results show a good model fit, although there were some different in the statistically significant, from study to study (52).

Finally, a study that concentrates in the innovation, attempts to investigate the correlation of Baldrige performance excellence program with the innovation capabilities of organization, by analyze twenty-four organizations that have implement the Baldrige program (53). The methodology that follows, includes data collection from two sources, the first is from the assessment of Baldrige program and the second if from a survey tool that measures the innovation capabilities (53). The scope is to find a relationship between these two data sets. The hypotheses that included in this model are the following (53):

- Baldrige assessment framework has a positive impact on Organization’s value for innovation.
- Baldrige assessment framework has a positive impact on Organization’s behavior regarding innovation.
- Baldrige assessment framework has a positive impact on Organization’s innovation culture.
- Baldrige assessment framework has a positive impact on Organization’s innovation’s resources.
- Baldrige assessment framework has a positive impact on Organization’s innovation processes.
- Baldrige assessment framework has a positive impact on Organization’s innovation’s measurement.

After analyzing the results, all the hypotheses are confirmed, so is concluded that the Baldrige framework has a positive effect on innovation capabilities (53). Also, this research concludes that

the Baldrige model improve the organizations advance capabilities and more specifically it points out that the improve the leader's ability to guide innovation efforts, by creating the appropriate culture (53). Finally, the Baldrige program improves the organization overall performance, by improving internal processes and promoting the alignment in the organization (53).

Regarding the analysis of the frameworks, there are many papers that analyzes them. There is a paper that reviews the major quality awards and their connection with excellence (54). This paper concludes that the ISO 9000 series includes the basic features that a quality system must have (54). The Deming prize describes the TQM philosophy, but doesn't include companies' aspects like procurement, storage, etc., Baldrige and EFQM include more business aspects like Human resources, resources development, management, etc. but they lack in mater of documentation (54). So, the Author concludes that there is no model that is complete and all has something to offer (54). Also trying to understand better what the frameworks gaps are, there is a paper that does a literature review for the period of 1995 to 2014, concludes that the BE frameworks have many gaps regarding the effectiveness of the organization (55). These gaps are the lack of strategic drivers, the static nature, the lack of agility drivers and the non-organization specific concept (55). In parallel with these results there is also a study that comes to add the lack of leadership involvement in BEM, something that is crucial for an organization (56).

A very interesting paper tries to find a correlation between soft factors, quality improvements and organization performance (57). This research takes three hypotheses, first that the soft factors have positive influence on quality improvements, second the soft factors have positive influence on Organization Performance and third the quality improvements have positive influence on organization performance (57). To support these hypotheses, the author run a survey between 275 managers that work in electrical and electronics firms in Malesia (57). The results shows that all three hypotheses are confirmed and concludes that the relationship between soft factors and quality improvements is very high, so it is very important for the managers to prioritize the improvement of soft factors (57).

There are also papers that concentrates in the MBNQA model. One of these tries to examine the relationship of Baldrige Framework categories (58). The data for this analysis come from state quality awards that are based to Baldrige framework and the results shows that the Leadership affects significant all the framework aspects, except the strategic quality planning and information management, which were not tested (58). Also, it is supported that good human resources practices and employee involvement are very important for the quality progress of the organization (58). It concludes that Human resources management is very important for the product and process effectiveness, the customer focus and the management relationship and finds out that information management, human resources management and customer focus are crucial for customer satisfaction and business results (58).

Another study concentrates on how people use this model and conducts a survey in recipients of Baldrige criteria and the responds was categorized to the recipients that didn't use, have use, or plan to use the criteria in 15 predefined areas (59). The results indicates that the recipients that use the criteria, used it mostly as a source of information for business excellence or as a tool to create quality processes (59). In the other side the most rarely used reason is to communicate (and especially to communicate with public sector) (59). The responders that plan to use the criteria are few and among them the most frequent future use is to improve or create processes (59). Finally, the paper also points out that for most users the criteria exceeded their expectations (59).

In parallel there are many papers that analyze the EFQM model. One of these analyze if the EFQM Excellence Model includes TQM concepts like the difference between technical and social issues, the holistic approach of TQM and the correlation between TQM procedures and organizational performance (60). The method that it was been followed was a survey in Spanish firms, which were selected with the stratified sampling method (60). This paper concludes that the EFQM enablers represent the technical and social dimension of TQM and also both dimensions are inter-related (60). It states that the excellent result is related with the level of deployment and is depicted from the result criteria (60). In addition, the enablers influence a lot the excellence results and it concludes that the survey results confirm the assumptions regarding the dimensions relationship, the holistic approach and the enablers-results criteria (60).

Another paper that examines the EFQM model, tries to find what the managers think about the using of a BEM (61). For this research 19 organizations that have applied the EFQM model had selected and the results shows that the BEM provides the organization with tools and techniques that help in organization improvement (61). More specifically organizations use the BEM as a standard framework in parallel with ISO 9000 (61). In addition, this framework is useful for assessment and change management, but is used most often for measurement and benchmarking (61). Also, it is used as a tool that supports the process planning, because it provides an organization overview (61).

Regarding the quality management in university, there is a paper that tries to find if the enablers of the EFQM model can serve as framework for this (62). The methodology that was followed was a survey in the senior staff of the university and the results shows that the "leadership and commitment of the senior officers" influence positively the quality management (62). Also, the "policy and strategy" can be used for the design of staff policy and also for resource management (62). In addition, the management of people is very important for management of processes (62).

#### d. Framework Proposal

The next logical step after analyzing the existing BEMs, is to try and propose new models/ frameworks. These models could try to fill the gap of the traditional models, propose something new or try to improve the weakness aspects of BEMs. In the literature there are many studies that tries to do exactly that and it is very interesting to observe this process.

In this scope, there is a study that tries to develop a maturity model based on EFQM model for maintenance departments of public organizations (63). The maturity model is a tool that reveal the capabilities of an organization and with this an organization can identify the maturity level and design appropriately their strategy (63). A model like this can consist of five six or seven levels, and it is believed that the higher the level, the more professional is the organization (63). The methodology consisted of four steps, the firsts is the literature review, the second is the conduction of interviews so to get the appropriate feedback form the experts, the third step is to construct an assessment sheet to measure the maturity level and the fourth step is to conduct a second round of interviews, so to test if the assessment sheet is relevant to maintenance departments (63). From the literature review is decided to choose the Public Commissioning Maturity Model that measures the professionalism in commissioning the public organization in the built environment area, but also focuses on the Capability Maturity Model, as a basic model in this research (63). Also, it defines the use of EFQM model, by using the Enablers of this model, so to analyze the important factors of maintenance departments (63). Based on the interview results, most of the respondents are agree that the proposed sub-aspects are important to be incorporated in the maturity model for maintenance departments (63). A few slightly different opinions exist for some sub aspects (63). The lowest relevancy is coming from the “people” enabler (63). The sub aspect of “control in organization” is considered by some respondents can lead the organization to over control and less creative (63). However, more than 70% of the respondents agree that this sub aspect is relevant (63). The other sub aspects reach 85%-100% relevancy according to the interviews (63). Several enhancements are implemented for the maturity levels development, which has a difficulty in which the resource of each stage is based on the researcher’s interpretation toward the results of literature reviews and interviews (63). The assessment sheet was designed, so to be usable by all maintenance departments, despite of their organizational structural differences (63).

There is also a study that tries to develop an operational excellence framework for the value stream processed, through a case study (15). The company that this study focuses on, provides innovative vehicle solutions and various acquisitions and has developed a system, to establish a culture of continuous improvement (15). The author recognize that this model has some

problems with the KPIs, which don't align with the strategy and is not fully implemented in organizational level, because is more focused in the production (15). The last concern that the author states is the lack of support (mainly from management) and ownership for the implementation of this model (15). This study tries to solve the model's gaps, through the integration of EFQM model (15). For the understanding of the current situation, this study runs interviews and observations and after the analysis of current situation, the author does a redesign of the company's structure (15). The major improvements are the new corporate logic, the redesign of current model framework, the development of modules and approaches and the transformation of the Tier model (15). The transformation of the model presented in the Figure 9 (15).

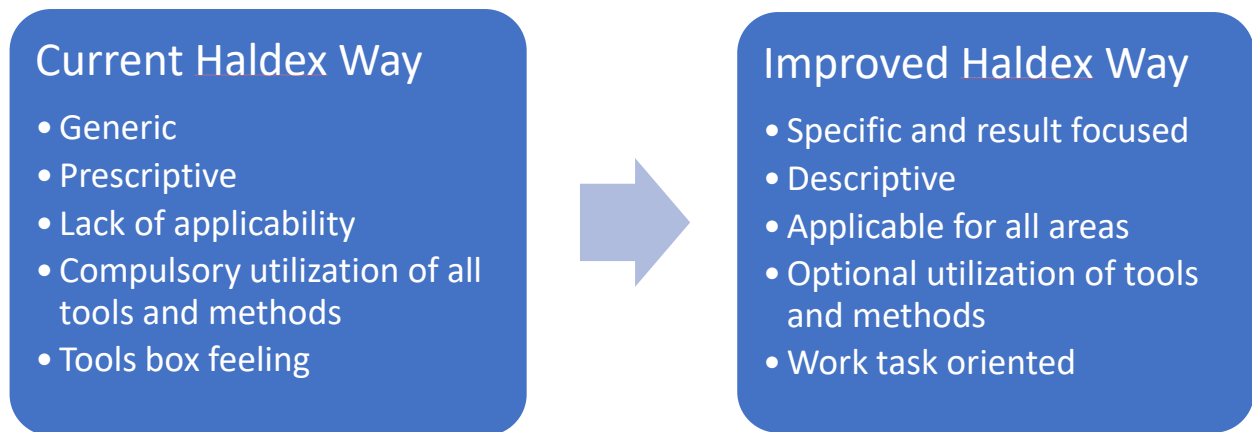


Figure 9- Haldex Way

Another study analyzes the current situation of a logistic service provider, with a scope to propose improvements regarding the performance of their services predictability, the stability and uniformity of their operations and the quality (3). The researcher visited the organization's sites, where he conducted semi-structured interviews so to understand the current situation (3). More specifically the methodology that followed consisted of two parts, the first was the empirical data collection, through observations and semi-structured interviews in the sites and the second was the literature research, for establishing the theoretical framework (3). After the analysis of the current situation, it was recommended to establish targets and strategies based on the companies' vision, organize the time for activities and tasks that expect to be value adding, educate and involve all the employees, make controls in the projects daily, organize the communication between shifts, create a continues improvement system which will be visible and finally create training documents for the employees (3). This study concludes that the OPEX implementation doesn't be affected by company's restrictions, like luck of time and budget and also identifies the company's areas that negatively affect the OPEX, which are the low motivation, waste of time and resources, uncertainties, low effectiveness and low transparency (3). Finally, it concludes that there are direct and indirect relationships between organizational structure, systems for

daily control and visual management, workplace organization, and improvement work (3). These relations directly affect the implementation of operational excellence initiatives (3).

Regarding the Health care section, there is a study that tries to develop a framework for prioritize improvement opportunities (64). To achieve this, first the significant factors are identified through Fuzzy Delphi Method and then the improvements prioritized through Hierarchical Fuzzy Interface System (64). The methodology that is followed presented in the Figure 10 (64).

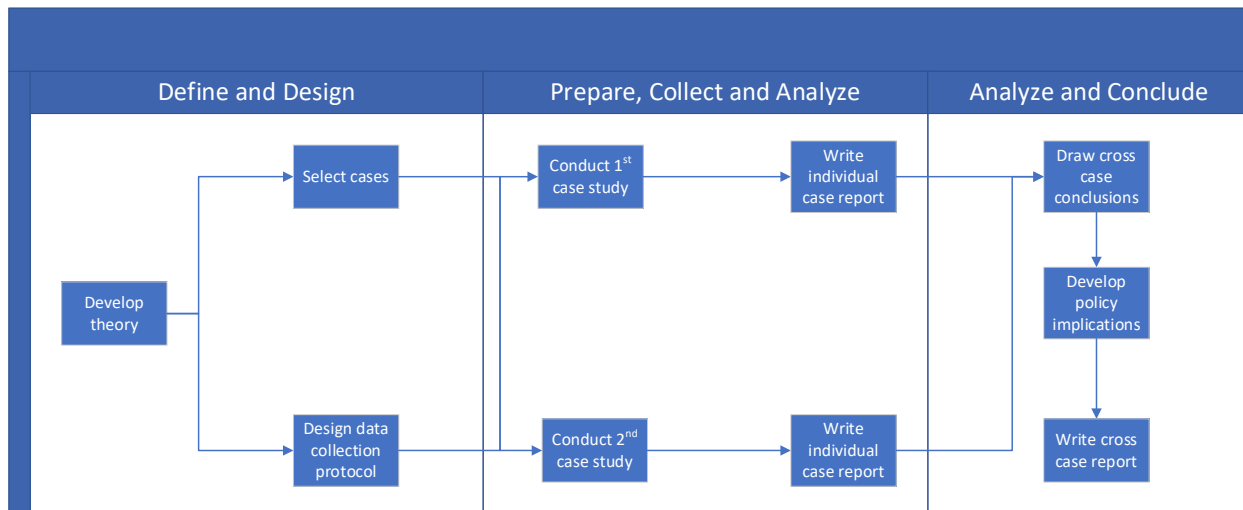


Figure 10- Framework for prioritize improvement opportunities

After a literature review and gap analysis, the researcher suggests a framework and attempts to validate this framework, by implement it in two case studies (64). After analyzing the results of these case studies, it is concluded that the top management considers the internal stakeholders to be the most important for the decision-making processes (64). Also, it proves that the healthcare’s stakeholders have a different perspective and can bring new ideas for the selection process (64). It is found that there are some common critical factors between the two case study hospitals, which are the health and safety, reputational image, sustainability, and patient satisfaction (64). Finally, the results prove that the framework is feasible and can be used to for compare improvement opportunities and select the best (64).

Looking deeper in literature there are many papers that propose new frameworks or additions to existing ones. One of these investigates how able are the Business excellence model are in regards of sustainability (65). The examined models are the EFQM and the Baldrige, and the author analyzes the existing model criteria and points out some possible changes in order to address the sustainability better (65). These changes have to do with focusing more on sustainability, differentiation of effectiveness and economic value, including knowledge management, social and environmental aspects, etc. (65). The study concludes that there is a gap in standards regarding the organization’s sustainability and the changing of BEMs could cover this (65). In parallel



with sustainability, there is some gaps in performance measurement and for this reason a paper points out the need of an appropriate performance measurement system, to achieve business excellence (66). A system for performance measurement is proposed, which is based in Kanji Business Excellence Measurement System (KBEMS), because it includes criteria with which organization performance can be measured (66). The author concludes that this system with the advantages that it has, provides the tools, the methods and the concept to achieve business excellence (66). In parallel there is another paper that has to do with performance (67). This paper suggests a business excellence framework, which attempts to improve the measurement, management and delivery of competitive performance (67). The proposed model has four dimensions, the operational excellence, the strategic fit, the capability to adapt and the unique voice (67). The research attempts to validate this model with a case study and the results shows that the managers had more clear understanding of measures, they focused on their own best practices, they learn to adapt better in the business environment and redefined their targets (67). This paper concludes that the proposed model is value driven and as a result is suitable for organizations (67).

Another gap is regarding the initiatives, which a paper come to fill out by showing how a business excellence model can be used to manage improvement initiatives (68). To achieve this, the author develops a model to manage these initiatives and shows how with this model, an organization can achieve the Business Excellence (68). To develop this model, literature review and semi structured interviews were conducted (68). This paper concludes on how the enabling criteria of a business excellence model can be included in the proposed model, so to manage multiple initiatives (68). Finally, the proposed model gives guidance to the organization, so to achieve Business excellence (68).

#### e. Literature regarding Construction

The construction industry is a unique business sector, with its own challenges, but with the same need for excellence. The construction is a big part of the economy for each country, although in many times the industry seems to underperform, something that leaves a big margin for improvement (69). The characterizing of construction as an inefficient sector is common and for this reason there is a need for more economically, socially and environmentally friendly products (70). For this reason, the achievement of excellence is very critical so the construction companies to be more efficient, with better products and increased customer satisfaction (69) (70). So, in order to achieve this the Construction industry should adopt new models, like BEMs that are already used in different industries (69).

In the literature there are significant less studies compared with other sectors, like manufacturing, Health, Public sector, etc., however the existing literature shows the benefits of BEM in Construction. An existing literature review points out that Operational Excellence practices in Construction are not complicated, the contrary (69). It is stated that a company must manage the processes and value streams, with focus in customer's value, and also focuses on cost reduction as a competitive advantage (69). All these can lead the organization to excellence (69).

There is a paper that investigates the implementation of EFQM model in construction companies and more specifically tries to validate the modern structure of EFQM model by searching if all the criteria contribute to the same factors (71). Also, it investigates if the model is applicable for the construction industry and if the weights that the model uses are applicable in the construction (71). The method that has been used is the self-assessment procedure (according to EFQM 2005), that applied to the construction industry of southeast Europe (71). The results shows that the model is valid (Enablers and results are separately identifiable) (71). Regarding the construction industry the results shows that the EFQM model is not applicable for every management perspective and also the weights are not properly aligned with the construction (71). The results shows that the EFQM model is suitable for Contractor organizations but is not for Consultants and Investor organizations (71). Finally, the author proposes the development of a new framework that suits better the construction companies (71).

Another paper tries to analyze the criteria and sub criteria of an excellence model for construction contractors, so to calculate the weights of these criteria (72). This model presented in Figure 11 and it includes two sets of criteria, the Enabling and the Results (72). According to this model the leadership is the initiator of change and improvement and also leads the customer focus, people and the other stakeholders, which are part of strategic planning (72). This planning should translate into processes, which should be implemented both in the projects and the whole organization (72). This implementation can increase the results of internal stakeholders (like employees, suppliers and others) and subsequently the Project results can also increase (72). Also, the culture and information analysis have strong correlation with leadership and affect the other Enabling criteria (72). The two-way relationship between information analysis and the other criteria leads to information cycles between the criteria (72). To measure these criteria and sub-criteria, a survey was used and the results were gone through statistical analysis (72). The questions focused in three aspects, the importance of each criterion regarding the business performance, the enabling criteria and finally the results criteria (72). The results shows that the criteria and sub criteria proposed by the model, are confirmed from the survey's data and at the same time the weights are also calculated using the empirical data (72).

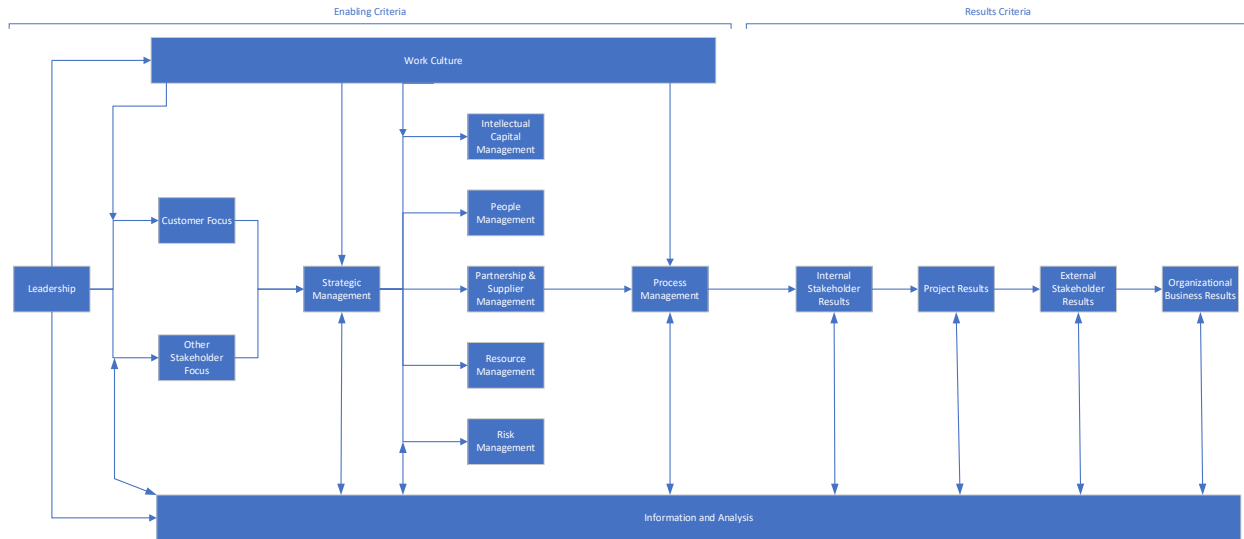


Figure 11- Model for Construction Contractors

The Lean Managements seems to be very effective tool for the Construction industry, for this reason a paper studies the operational performance of Malaysian construction companies and how the Lean con-tributes to this (69). A survey is conducted between these companies and the results shows that these companies has adopt some principals from the Lean Production System and that this influences the operational performance (69). Also, they have included continues improvement practices like new idea gathering (69). It points out that they don't consider the wastes as important issue and as a result they don't understand the factors that produce waste (69). The author finds that the "Just in Time" principal can have a positive influence only in concrete mixture and in the other materials it is more efficient to buy them bulk (69). It is also proposed that the integration of suppliers and flexible information systems can have many benefits in long term, although it requires some investments (69). This study concludes that the construction companies must focus on elimination of waste by planning the production processes and workflow and also apply Lean Production System in a way that will improve the processes and supply chain (73).

Another paper that analyzes the Lean in Construction, addresses the increased complexity of a modern construction project, which includes the cooperation of many subcontractors /consultants and also suppliers that send materials from all around the world (74). To improve the efficiency in this environment, the construction industry has adopted Lean practices (similar to the ones from manufacturing), which called Lean Construction (74). The author concentrates in the Engineering to Order (ETO) principles from manufacturing and how this can be applied to Construction (74). This paper proposes a framework for implement operational excellence by adopting the Lean Construction (LPS model) and new technologies (like BIM) (74). The author concluded that the most important aspect of today Construction industry is how to manage the

information supply chain, by evolving business processes and tools (74). The industry needs to think more about operational efficiencies and use benchmark to calibrate themselves (74).

A study that has to do with Lean tools/ methods, applies process mapping and benchmarking to construction company, so to find non-value-added activities (20). The method that has been followed was firstly the observation of the processes and then the process mapping of them, so to depict the current situation (20). Then a benchmarking was conducted so to compare the current situation with other companies and finally improvement suggestions were made (20). The main data gathering tool was a survey and also interviews and observations were conducted (20). The author points out that if the sourcing process lead time is reduced, there will be more time for the implementation phase, which is more important and also this will be a chance to develop better relationship with the suppliers because of the more frequent communication (20). The suggestion that this study proposed is to remove the unnecessary steps from the sourcing procedures so to reduce the time consumption (possible reductions by 17%) (20). Another suggestion is the improvement of the relationship with the suppliers, which can reduce the process lead time by 14.1% (20).

So far is obvious that for a construction company to achieve business excellence, a lot of research is needed. For this reason, there is a paper that analyzes how R&D can be the key factor for a company to become more effective (70). An R&D department will develop more efficient processes, materials, technologies, procurement routes and managerial structures (70). All these could become a competitive advantage for the company (70). The author states that all the advancements that the R&D has to offer, could give more value to customer and also give more efficiency and effectiveness to contractors (70). This paper concludes that the success of R&D in construction affected a lot by the availability of resources, the coordination and communication processes (70).

#### f. Summary

Operational excellence is an integral part of modern economy, which all these years assist in the improvement of our society and probably will continue to contribute to evolvement of all industries. Especially in Construction industry, operational excellence may be the medium to improvement in a very difficult economic environment, in which the resources abundance is not given. Construction should learn from the other industries and produce new knowledge and experience which will improve its sustainability. For this reason, the focus should be first on the people that consists of these companies, by investing and properly managing them, so to take advantage of their unique abilities and create an ideal culture that will benefit improvements. The leadership

of each company should be the initiator of every improvement and invest in new (for the Construction) ideas and concepts, like Business Excellence Models.

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## 4. Analysis of Archirodon Case

In the next chapters, it will be presented the Case of a Construction Company (Archirodon) and how close their processes are to the Operational Excellence practices that have been identified in the literature.

### a. Company's Presentation

Archirodon is an EPC (Engineering/ Procurement/ Construction) company that was form as a joint venture in 1959, between one Marine and one Road construction Company (Archimidis & Odon-Odostromaton) (75). The Company starts its action in the 60s by taking Marine Construction Projects in Libya and Lebanon and in the next decades will take over many marine projects (like ports), energy projects (that has to do with oil, LNG, petrochemicals, etc.) and other construction projects (like roads, bridges, railroads, industrial facilities, etc.) ) (75). Its activity covers many regions, by having offices and projects in many countries like Saudi Arabia, the U.A.E, Switzerland, Qatar, Oman, Kuwait, Egypt, Libya, Morocco, Greece, Cyprus, Turkmenistan and Kazakhstan (75). The Company has an Integrated Management System (IMS), which contains all the processes, documentation and general knowledge, which have concentrated over the years, and also complies with the International Standards ISO 9001, OHSAS 18001, ISO 14001 and the Technical Specification ISO/TS 29001 (75)<sup>1</sup>.

### b. Quality In Archirodon

Quality in Archirodon is managed from the respective Quality Department, head of which is the Quality Director. Each Project has its own Project QC/QA Manager, who is reporting both to Quality Director and Project Manager. The Mission of the department is described below:

*“To fulfil the requirements of the Company’s mission and policies by maintaining quality in Company’s operations and by supporting and assisting in the implementation and maintenance of an effective Company IMS, that complies with the ISO 9001 Standard and meets Employers’ quality requirements, at all levels of Company operations, whether at Corporate, Regional or Project”*

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<sup>1</sup> The Information and Processes that will be presented in this chapter are property of Archirodon N.V. and are protected according to copyright laws.

The main activities of the department are the following:

- Coordinating the establishment of the IMS at Project level
- Controlling the quality of the construction works at projects
- Liaising and cooperating with Employers regarding quality issues
- Auditing the IMS in Corporate, Regional and Project level
- Monitoring the IMS implementation and reporting to Top Management
- Coordinate the continuous improvement of the IMS by supporting the Corporate Departments, Regions and Projects
- Controlling of IMS documents
- Providing required support and documents for Tenders
- Staffing of Quality Department and development of its personnel
- Training staff regarding ISO 9001 and IMS requirements

The Quality in Project level is controlled through the process “Control of Inspection and Testing”, which is presented in Figure 12. Each project bases on the Contract and the project scope, is define its own inspection plans, so to assure the quality level of the construction.

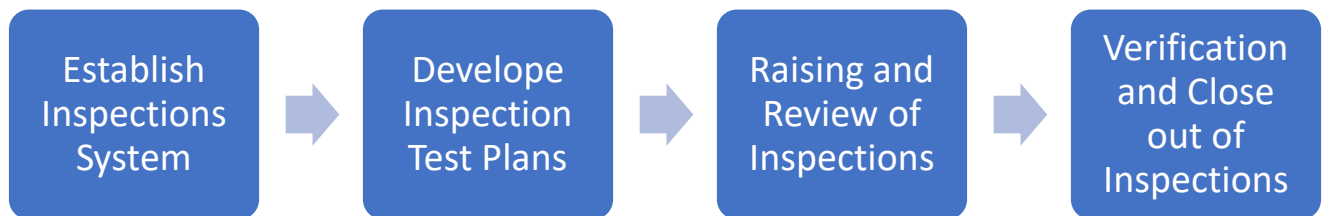


Figure 12- Archirodon Process: Control of Inspection and Testing

In parallel the Quality Assurance both in projects and Offices is controlled with scheduled internal Audits. The process with which the Audits performed is presented in Figure 13 and with this process the organization control the compliance of projects and offices with IMS and ISO 9001.

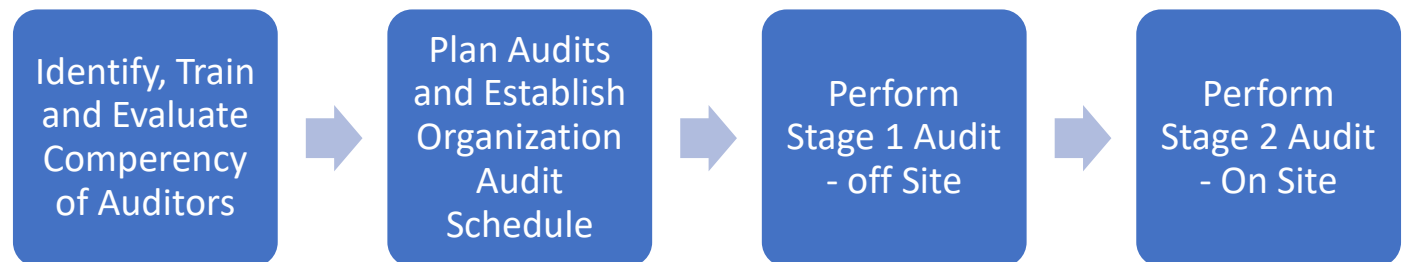


Figure 13- Archirodon Process: Audits

The non- conformities with the IMS system is managed with two separate processes, the “Control of Non Conformities” and “Control of Observations”. The difference of these procedures is the

severity of non-conformity. The Observation is used in minor non-conformities of in potential non-conformities.

The performance of quality overall and per project is measured with specific KPIs, which are related with the previous procedures and monitored periodically.

### c. Analysis of processes

In this section will be analyzed how Archirodon's processes compares with the literature and more specifically how covers the best practices that mentioned in previous chapters. The presented workflows are generated from the Archirodon's IMS.

#### i. Planning of production processes

As mentioned in the literature (69) (31), the planning of production processes is particularly important for a Construction Company. Archirodon follows two processes for the planning of the activities, one for Planning and Scheduling and one for Organizing and Executing Permanent Works.

##### 1) Planning and Scheduling

This process contains three sub-processes that present in the following Figure 14. The scope of this process is to develop the schedule of the contracted works and to monitor the actual progress of works against it, in order to be able to effectively complete the works within the contracted time.

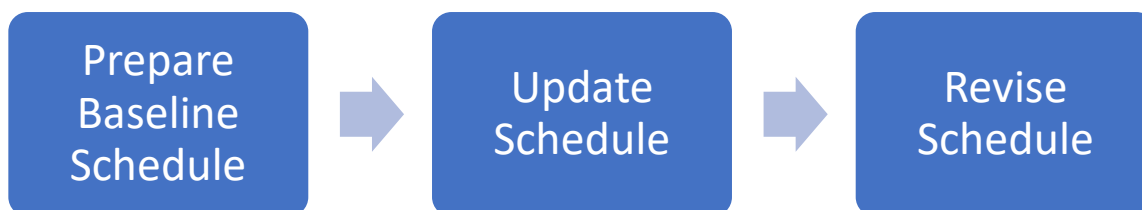


Figure 14- Archirodon Process: Planning and Scheduling

##### 2) Organizing & Executing Permanent Works

The Process includes two sub-processes that presented in the Figure 15. The scope is to define the steps to organize and execute the Permanent Works.

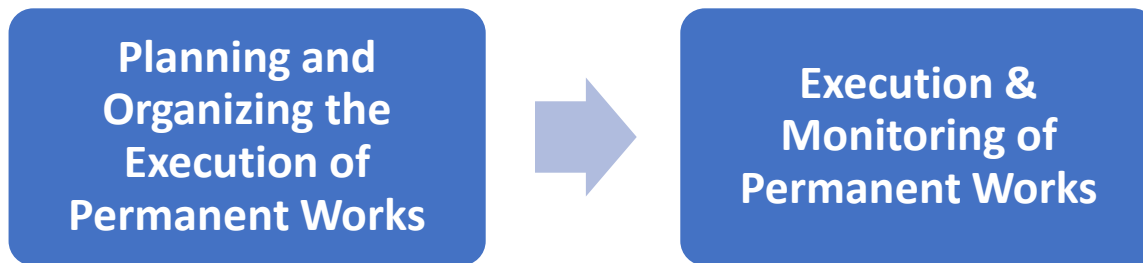


Figure 15- Archirodon Process: Organizing & Executing Permanent Works

- ii. Manage the processes with focus on customer

The Customer focus is very important for Operational Excellence (69), because one of the main goals of Operational Excellence is to maximize the value that the customer (employer) receives. Archirodon involves the customer in most of its processes, something that from the one side is mandatory by the Contracts, from the other side it builds a better relationship between the customer and the Company.

*1) External Reporting*

This process defines the steps required for reporting the progress of works to the Employer. It consists of two sub processes (Figure 16).

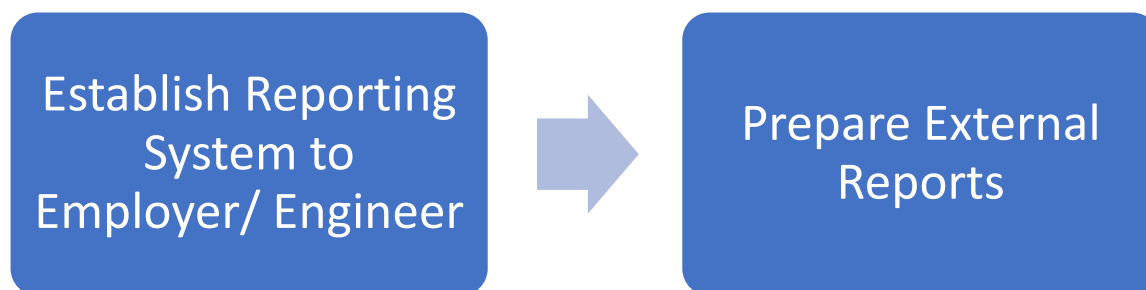


Figure 16- Archirodon Process: External Reporting

*2) Management of Changes*

This process has as scope to effectively manage changes to the scope of works in projects. It consists of three subprocesses (Figure 17).

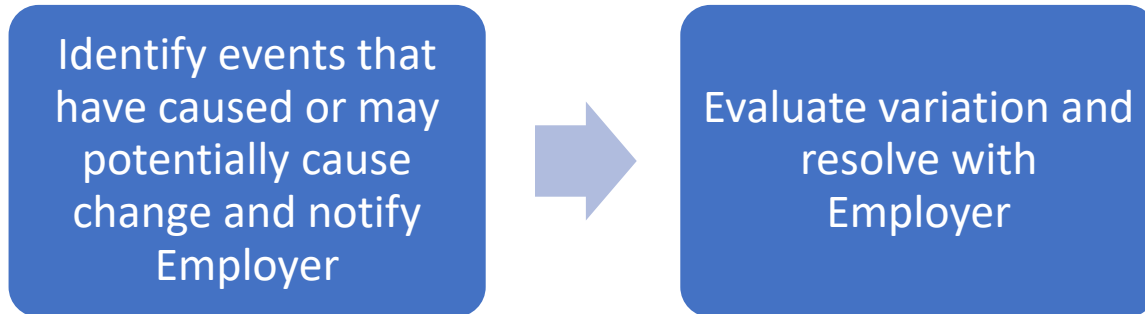


Figure 17- Archirodon Process: Manage of Changes

### 3) Initial handing over of the Works

This process determines the steps required to initially hand-over the Works to the Employer. The employer has a constant overview of the progress in every project, but in the handover it will be decided how satisfied will be from the final result. It includes two sub processes (Figure 18).

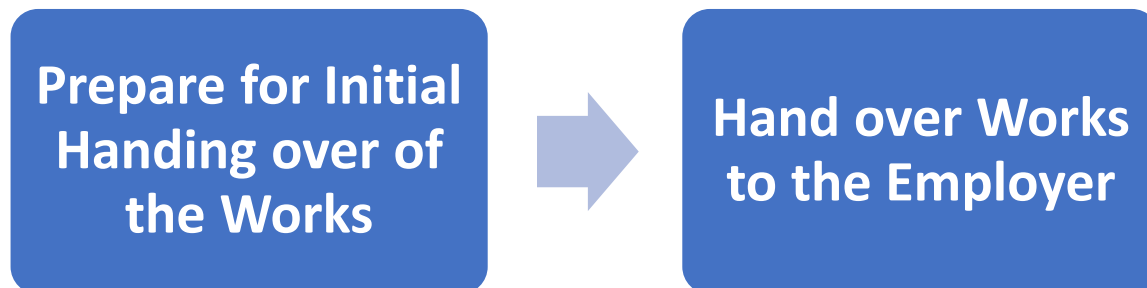


Figure 18- Archirodon Process: Initial handing over of the Works

### 4) Project Management

The scope of this process is to set out the minimum required steps, which will enable the success of a project. It describes all the basic activities that the project manager is responsible for, regardless the type of construction project. This process includes six sub-processes (Figure 19).

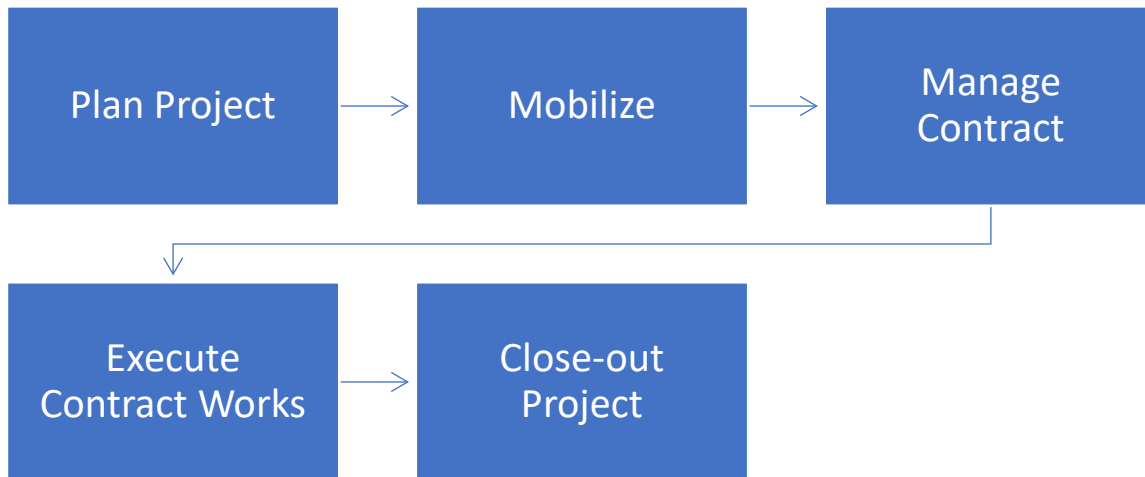


Figure 19- Archirodon Process: Project Management

5) Record a Received NCR from Employer

This process clarifies the necessary steps for the recording of an employer’s NCR (Non-Conformity Report) in order to inform corporate level and ensure proper allocation of the failure (Figure 20). The existence of a separate process for the management of Employer’s NCR shows how important it is for the company and also helps to measure them and analyze them more efficiently.

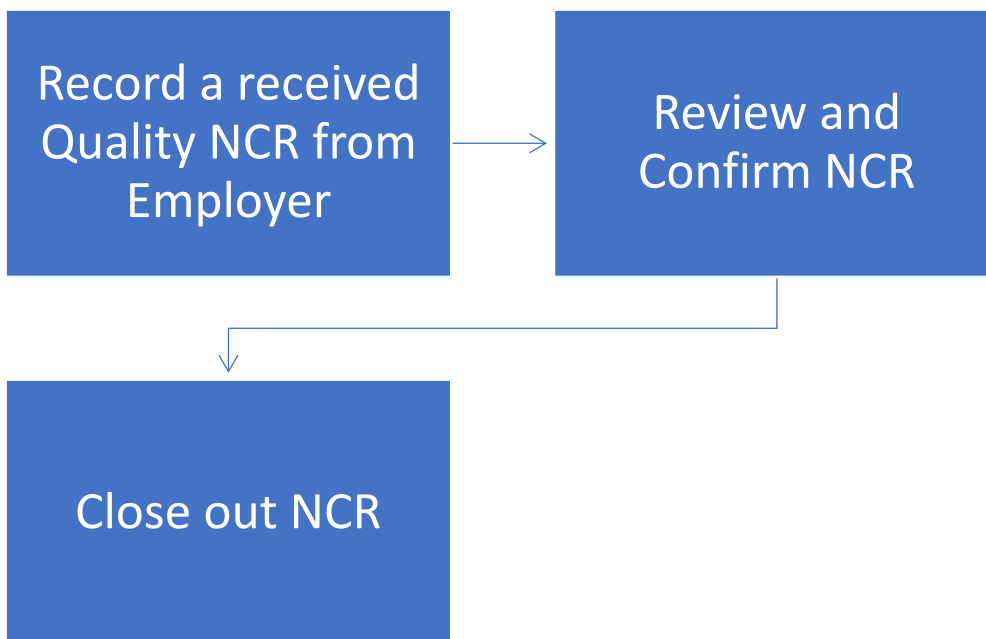


Figure 20- Archirodon Process: Record a Received NCR from Employer

iii. Supply Management

The supply management is an overly critical aspect in the Construction Industry and based on the literature it seems that it also affects the Operational Excellence implementation (20) (69) (70). Archirodon has a specific department that manage all the aspects of the Supply Chain and regarding the management of supplies, it has two processes.

1) *Project Procurement Strategy & Procurement Plan*

The objective of this process it to define the development of Procurement Strategy and Plan, which will be used in every Project. It consists of five subprocesses as presented in the picture bellow (Figure 21) and it is obvious that it is affected a lot from the Tender phase, in which the customer's requirements are defined.

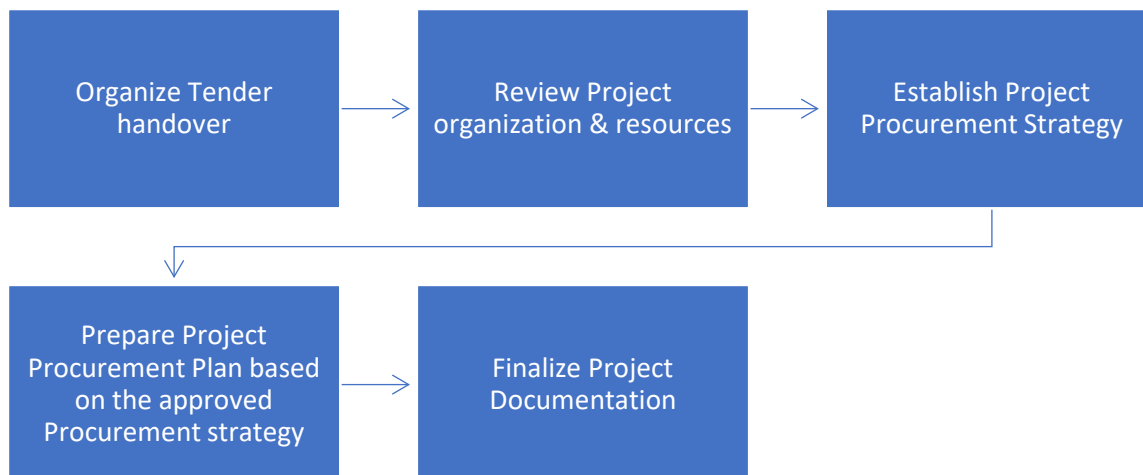


Figure 21- Archirodon Process: Project Procurement Strategy & Procurement Plan

2) *Procurement of Materials, Equipment, Subcontracts & Services*

This process defines the steps required to procure permanent materials /equipment and critical non-permanent materials. It contains five sub-processes as presented in the image bellow (Figure 22).



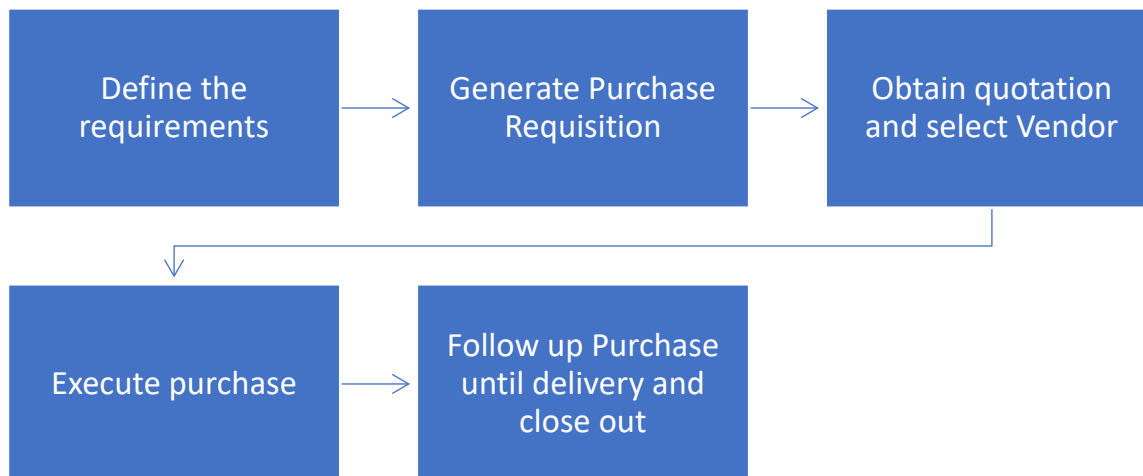


Figure 22- Archirodon Process: Procurement of Materials, Equipment, Subcontracts & Services

#### iv. Benchmarking

The Benchmarking is a general good practice for every business, but also is a strong driver for Operational Excellence initiatives (20) (61) (74). Archirodon has two related processes, one for internal benchmarking and one for external.

##### 1) Internal Reporting

The scope of Internal Reporting procedure is to define the steps required to inform Regional & Corporate Management of the Status of the Project (Figure 23). This process also contains the “Select Best Performing Project” sub-process, in which the performance of all active projects is measured (based on KPIs) and the best of them is selected. This is an internal Benchmarking procedure, which helps to compare the projects and develop a healthy competition between them.

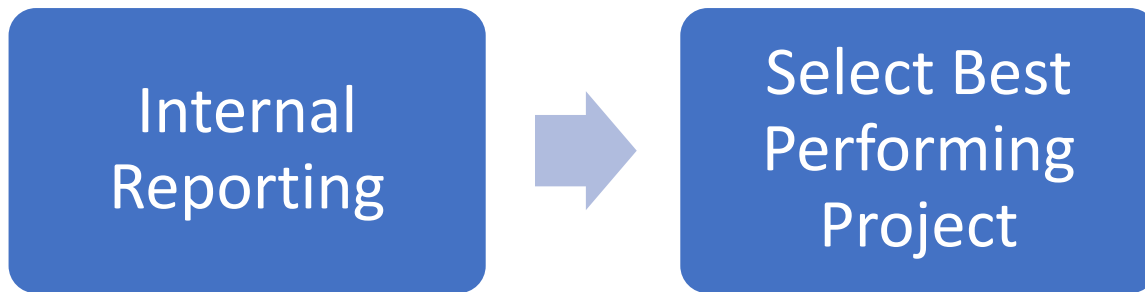


Figure 23- Archirodon Process: Internal Reporting

2) Procurement Tendering

This process has as scope to involve procurement during tender, so to achieve cost optimization through better knowledge and pricing from the supplier market, increase the overall probability to win bids and mitigate risks during execution (Figure 24). This process evaluates and compares the possible Vendors/ Suppliers so to always have the best service in the best price.

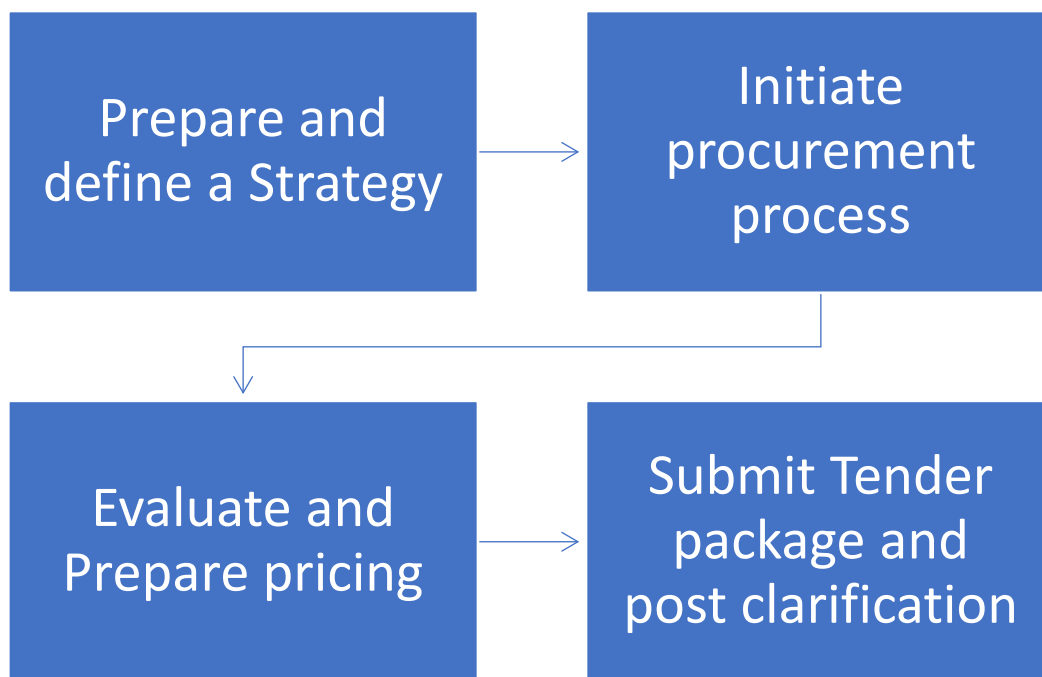


Figure 24- Archirodon Process: Procurement Tendering

- v. Training, involvement and engagement of the employees

The key aspects in every operational excellence project are involvement and training of employees, so to have the proper knowledge and engage with the project (29) (30) (33) (35) (58).

Archirodon have two processes for the recruitment of employees, so to choose the ones with the proper competence, and one for training the employees.

### 1) *Learning & Development*

This process has two scopes, the first is to introduce New, Transferring and re-engaged employees to the Organization, its processes and their role, in order to enable them to do their work in a new profession, project or job role. The second scope is the timely identification and planning of Learning & Development needs of employees, so to enhance the knowledge and skills of its employees while providing information and instructions on how to better perform specific tasks and reaching their full potential (Figure 25).

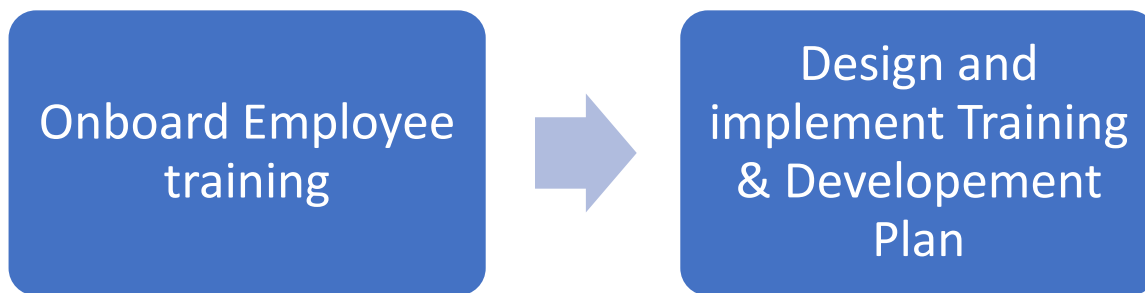


Figure 25- Archirodon Process: Learning & Development

### 2) *Recruitment*

The scope of this process is to manage the recruitment in Projects and Offices (Figure 26). This is a very important process for the organization because every construction project has increased needs in employees and labor. So, if the organization is not able to hire people efficiently, will not be able to meet initial schedule and also the overall cost will increase.

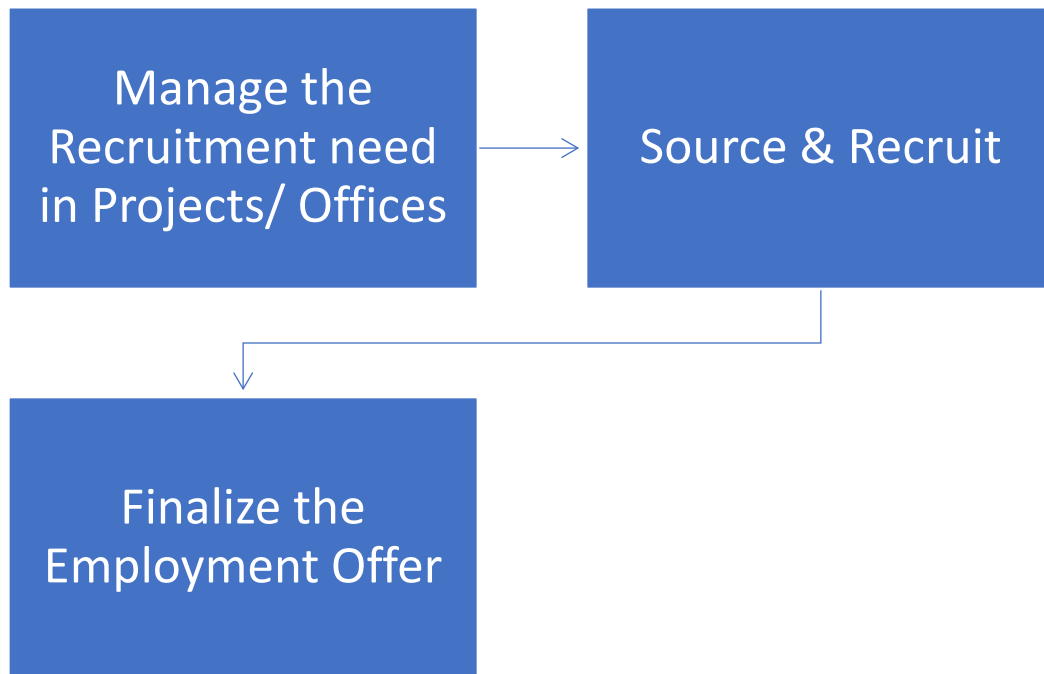


Figure 26- Archirodon Process: Recruitment

vi. Adaptability

Adaptability is a very important for the sustainability of every organization, because it defines how resilience is. Also, it seems from the literature that it is also a very important aspect for the operational excellence implementation (32). Archirodon has three processes from three different departments that define the adaptability of the company.

1) *Management of Changes*

This process is also presented in "Manage the processes with focus on customer" and it also covers the adaptability aspect of the projects, by defining how to manage any disruption that may occur during the implementation phase (Figure 17).

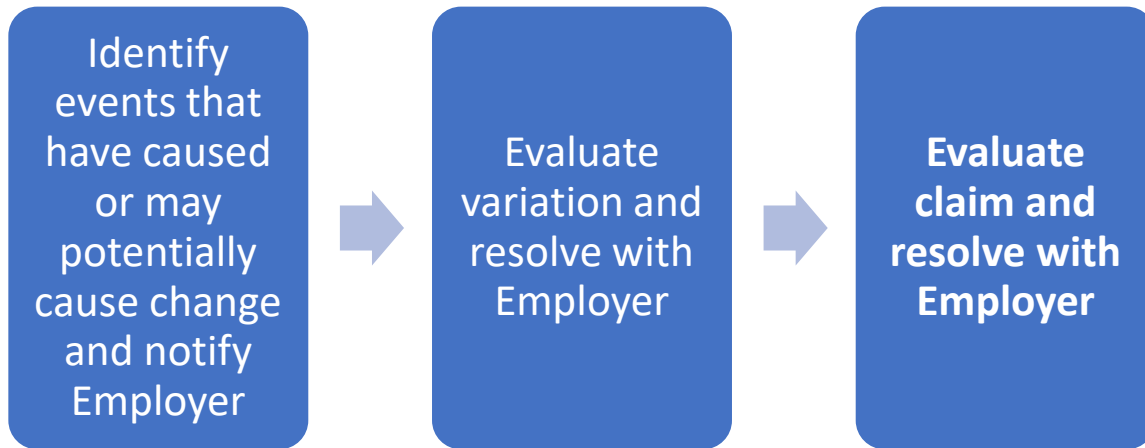


Figure 27- Archirodon Process: Manage of Changes

### 2) IT Change Management

The objective of this process is to receive and evaluate a change request from business departments (Figure 28). Archirodon is a company that has invest a lot in digital tools/ solutions, so the adaptability of them is crucial.

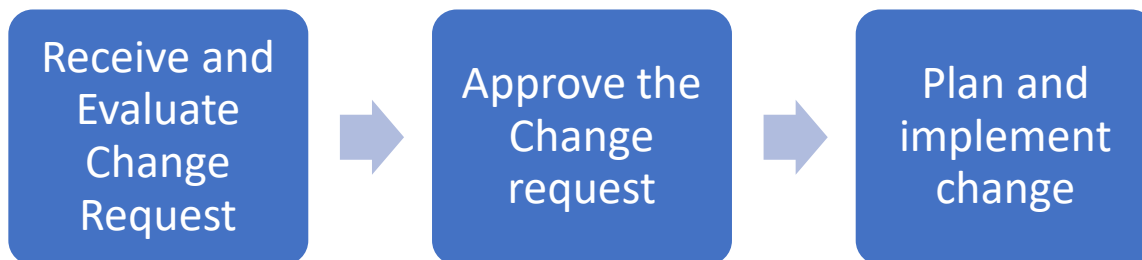


Figure 28- Archirodon Process: IT Change Management

### 3) Change Management in "Selection and management of Engineering Subcontractors"

This is a subprocess of the process "Selection and management of Engineering Subcontractors" and has as scope the management of changes during the selection of Engineering Subcontractors and define the critical aspects of managing Engineering Subcontractor's activities to ensure their work complies with Project requirements.

### d. ESG

Archirodon does not have a particular ESG focused strategy, but as it will be obvious in the following passages that it covers many aspects of the ESG. This happens both from its ISO certifications as also from their initiatives/ internal projects.

## i. Environment

The Focus of Archirodon to the Environment aspect of ESG is proved through the ISO 14001 Certification and the implementation of a Green Building Rating System (Breeam model). Also, Archirodon has to comply with the local regulations regarding the environment, something that is very challenging especially considering that its activities take place in many countries with very different laws and culture.

### 1) ISO 14001

Every company has to develop a management system that focuses on the environment, both for satisfy the interested parties and for comply with the local legislation. Especially in the developed countries in EU, the environmental legislations are especially strict and usually oblige the companies to follow it. Many of them choose also to develop its environmental management system according to ISO 14001. This ISO is first published in 1996 and the last update was in 2015, with a scope to improve the environmental performance of the company (76). The ISO requires the development of procedures that will have as focus the scope of the standard and this whole system can be certificated by a third party, which it is also a requirement from many customers (76). So collectively the ISO 14001 provides the following benefits in the organization (76):

- Reduce the negative environmental impact
- Enhance the continual improvement culture inside the organization
- Requires a structural (process) approach in every problem that the organization phases
- Encourage the employees to be a part of the management system

### 2) BREEAM

Another aspect of environmental sustainability of a company is Green Building Rating System. This system is a tool that is used to evaluate and/or enhance the sustainability of a construction company and also it provides guidance through data analysis and benchmarking of the results (77). In general, these systems aim to (77):

- Improve the operational performance of a building
- Minimize the impacts to the environment
- Measure the effect that a building has to the environment
- Evaluate the development of the building

The Green Building Rating Systems have a similar rating to Business Excellence Models, in which projects/ buildings are taking a rating in some standardized categories (77). Some of the most used systems are the Estidama Pearl rating System, GSAS, LEED and BREEAM (77). Archirodon

uses the last one with a scope to certify its office in Athens. BREEAM stands for “British Building Research Establishment Environmental Assessment Method” and first launched in UK in 1990 (77). There are many options for BREEAM certification based on the scope of work, which are listed below (78):

- BREEAM Communities: Aims to local authorities, planners, developers and investors, which want sustainability assessment for the design of communities or regeneration projects
- BREEAM New Construction: For new buildings which will be assessed based on their social and environmental impact
- BREEAM In-Use: A framework for sustainability and performance improvements, which can be also used for benchmarking, assurance and validation of the building
- BREEAM Refurbishment: For refurbished buildings which will be assessed based on their social and environmental impact

The process for BREEAM Certification can be summarized in Figure 29 (79):

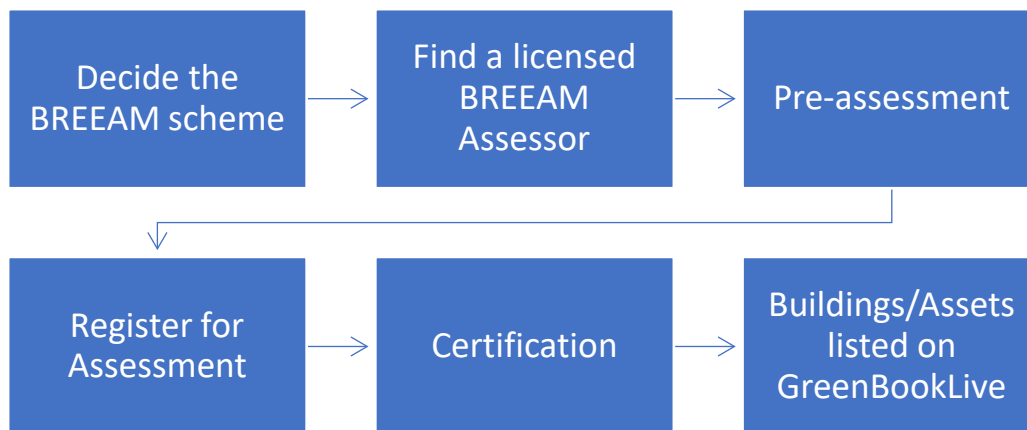


Figure 29 - BREEAM Certification Process

The categories in which this system evaluates a building are the Management, Health and Well-being, Energy, Transport, Water, Materials, Waste, Land Use and Ecology, Pollution, and Innovation, from which a score is obtained (77).

Archirodon is under certification process for the “BREEAM Refurbishment”. In this framework the organization is evaluated based on a set of criteria, which are organized in ten Categories (each category has its own subcategories (80):

- Management: 5 subcategories
- Health and Wellbeing: 7 subcategories
- Energy: 9 subcategories
- Transport: 5 subcategories
- Water: 4 subcategories
- Materials: 6 subcategories

- Waste: 6 subcategories
- Land Use and Ecology: 5 subcategories
- Pollution: 5 subcategories
- Innovation: 1 subcategory

The criteria of the assessment are depending on the scope of works for each project and are categorized in parts:

- Part 1 - Fabric and Structure:
  - Building façade
  - Roof
  - Windows
- Part 2 - Core Services:
  - Central air handling unit
  - Heating boiler
  - More than 50% of heat distribution
  - Chiller plant
  - More than 50% of chiller distribution
  - Water services (sanitary fittings in core)
  - Building management system
  - Community heating system
  - Low and zero carbon technologies.
- Part 3 - Local Services:
  - Replacement of more than 50% of light fittings, system and controls
  - Upgrade of zone controls
  - Local ventilation
  - Local heating units (including sources not connected to core services)
  - Local cooling units (including sources not connected to core services)
  - Point of use water heaters.
- Part 4 - Interior Design:
  - Remodeling or changes to interior spaces including two or more of the following:
    - Wall coverings
    - Floor coverings
    - Ceiling covering or systems
    - Partitions
    - Raised floor system
    - Furniture and fittings
  - AND at least one of the following:
    - Sanitary fittings
    - Equipment
    - Local electrical installations



Each category has its own weight depending on the scope of work, something that presented in Figure 30 (80).

Environmental section (rounded)	Project specific weightings (rounded)						
	Core weightings (rounded)	Part 1 only (rounded)	Part 2 only (rounded)	Part 3 only (rounded)	Part 4 only (rounded)	Part 1 and 2 (rounded)	Part 3 and 4 (rounded)
Management	12.00%	15.00%	16.70%	16.50%	20.00%	13.00%	14.10%
Health and wellbeing	15.00%	14.80%	14.40%	15.30%	19.90%	11.00%	15.90%
Energy	19.00%	16.40%	24.50%	24.30%	2.50%	18.80%	22.50%
Transport	8.00%	10.00%	11.20%	11.10%	13.40%	8.60%	9.50%
Water	6.00%	5.00%	7.50%	7.40%	10.10%	5.70%	7.10%
Materials	12.50%	15.60%	5.40%	5.30%	19.30%	13.40%	13.70%
Waste	7.50%	9.40%	9.30%	9.20%	11.20%	8.10%	7.90%
Land use and ecology	10.00%	12.50%	5.00%	0.00%	0.00%	10.70%	0.00%
Pollution	10.00%	6.30%	11.00%	10.90%	3.60%	10.70%	9.30%
Total	100%	100%	100%	100%	100%	100%	100%
Innovation (additional)	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%

Figure 30 - Weighting for BREEAM Environmental Categories

In each category the achieved credits are estimated and then the percentage of achieved credits to available credits is calculated. Then the category score is calculated by multiplying this percentage by the weighting of the category. The final score is calculated by summarizing all the categories' scores (example in Figure 31) (80). Depending on the score a building can take the characterization of "pass classification" for up to 30 % score, "Good" for up to 45%, "Very good" for up to 55%, "Excellent" for up to 70% and "Outstanding" for 85% or more (77).

BREEAM section	Credits achieved	Credits available	% of Credits achieved	Section weighting (fully fitted)	Section score
Management	10	20	50.00%	0.12	6.00%
Health and wellbeing	17	22	77.27%	0.15	11.59%
Energy	16	34	47.05%	0.15	7.05%
Transport	5	11	45.45%	0.09	4.09%
Water	5	9	55.56%	0.07	3.89%
Materials	10	14	71.43%	0.135	9.64%
Waste	3	13	23.07%	0.085	1.96%
Land use and ecology	5	5	100.00%	0.10	10.00%
Pollution	5	13	38.46%	0.10	3.85%
Innovation	2	10	20.00%	0.10	2.00%

Figure 31 - Example of BREEAM rating

ii. Governance

The Governance of Archirodon is based on ISO 9001 & ISO 22301, which shows the focus of the company to customer satisfaction and the sustainability/ continuity of organizations’ operations.

The ISO 9001 is a standard for the development of Organization’s Quality Management System. It provides guidelines with which the Company can create and systematize its processes and procedures and harmonize them with the Customer needs/ expectations (81). This standard can be also certified by an accredited institution, which certifies the compliance of processes, procedures and documents (81). The ISO 9001 is the most usually applied standard and it shares many common requirements with other standards (like ISO 14001), something that is described from ISO as a “High-Level Structure”.

Regarding the ISO 22301, the scope of this standard is to improve the current management system in order to reduce the likelihood of any disruptive incident and also to prepare the organization in order to face these incidents (82). With this standard Companies can manage the risks and

vulnerabilities more efficiently and provide a confident to the stakeholders about its resilience (83). The Business Continuity procedure is presented in Figure 32 and includes the following steps (82):

1. **Business Impact Analysis:** In this step the organization firstly defines the impact categories and its criteria that may affect the organization. Then it evaluates the impact over time to the organization activities, so to analyze the disruption of them. The result is the estimation of time period, after which the impact level will become unacceptable, and also the organization set the objective time frame within which the disrupted activities will be resumed in a minimum capacity. Through this analysis the activities can be prioritized and also define the resources that are needed in order to meet the objectives.
2. **Risk Assessment:** During this step the organization shall identify possible risks (disruption scenarios) and estimate the likelihood of them to happen and also the impact that may have at business activities, according to the decided time frames from Business Impact analysis. The outcome of this analysis is the evaluation of risks and what treatment is needed.
3. **Business Continuity Strategy and Solutions:** Using the information of the previous analysis, the organization can define a strategy for facing the possible risks. This strategy should include measure to reduce the likelihood of a risk, shorten the period of disruption, limit the disruption impact and also define the available resources.
4. **Business Continuity Plan and Procedures:** The organization shall prepare plan and procedures that will guide the employees (and any other interested party), so to face a disruption. These should be very specific and define the responsibilities, the communication means, the appropriate actions, and the recovery of organization, possible to a new normal.
5. **Exercise Program:** The organization should periodically test these plans so everyone to be familiar with them and also evaluate its effectiveness.
6. **Evaluation of Business Continuity:** The Business Continuity system should be constantly evaluated for its suitability, effectiveness and adequacy. This evaluation can result to better disruption scenarios with updated risk levels and also to more effective plans/ procedure/ documentation. In parallel all interested parties should be evaluated, like the vendors and the suppliers.

The successful implementation of this standard provides a competitive advantage to organization by increasing its credibility and resilience.



Figure 32 - Business Continuity Procedure

#### e. Summary

Archirodon shows a significant potential regarding the operational excellence, by having a very advanced management system and by promoting initiatives like ESG. For this reason, the implementation of a Business excellence model would be very feasible and may provide a lot of benefits for the company. Also, the investing in its strengths, like focusing on Social aspect and evolving the current or creating new processes, could create a competitive advantage for the organization. Finally, Archirodon could combine all of these and in parallel focus in Lean ideas/ techniques, so to reduce the wastes and increase it profitability and sustainability.

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## 5. Conclusion

The outcome of this study is the potential improvements as occurred from the previous chapters. More specifically, this study will conclude with the potential improvements both for the Construction industry, based on the literature review, and also for Archirodon based on its current situation.

### a. Potential Improvements for Construction

From the literature regarding the Construction, there are many potential improvements from the implementation of operational excellence, something that can be achieved either from a BEM or by other methods like Lean. In a glance, the better planning of production processes can lead to elimination of waste and in general to excellence (69). Also, the supply management is very crucial and usually is the most difficult part in a construction. For example Just In Time, which is very helpful for construction, is frequently not applicable in a Construction project (69), although a good relationship with the suppliers is always beneficial (69) (20) and also there is plenty room for improvement in the procurement processes as well (20). The information flow is also very important in the Construction industry, as well as other common Business techniques like Benchmarking (74). Finally, further research is obviously needed, even inside each company, so to improve the processes, the practices, the overall efficiency and as a result to give more value to customer (70).

From the analysis of the literature of the other industries, it is obvious that there is a lot of space for improvements and many practices that have not yet been tested and may help a lot the Construction. First of all, it is very obvious that the human aspect is crucial for operational excellence. It seems that each company should be very careful about the management, training, involvement and engagement of the employees. This aspect has many benefits for the organization. A better educated personnel can lead to higher efficiency and to higher quality products (1) (44) (58), something that can be achieved not only by hiring personnel with higher education, but also by providing training to the existing. Similar results can also be achieved with a better HR management (44) (58) (51), like listening more to what the employees want or have to offer, and also providing them with a better working environment. These are obviously some of the results of operational excellence. However, in order to gain these results and all the other that come with operational excellence, it is important to go through an implementation process.

The success of this implementation process is very important in order for the operational excellence program to be successful and for the organization to become excellent. A key factor in this

implementation is the employees. The personnel should receive a proper training about the BEM that will be implemented. This will improve the acceptance of the model/ method (29), because the employees will understand in more depth the benefits that will come from this. Also, a training prior the implementation will lead to more extent use of model (30) and also the employees will be more interested in the new OPEX practices (33). In parallel with this, the involvement of employees both in implementation and after this, can lead to any benefits like increased satisfaction and effectiveness (44) (51).

Another crucial factor for the implementation of OPEX, is the culture. A company that locates in Europe can have completely different implementation needs/ problems in comparison with a company that locates in Asia. But even if the company locates in Western world but a great amount of its employees are from developing countries, may need a very special approach. All these has to do with the different culture, because each culture has different needs, different goals and different way to work. So, the implementation of OPEX can be affected from the different mindset and attitude of employees because of culture reasons (35). Also, the creation of the appropriate organization culture can be very important and can affect both the efficiency and the innovation capabilities of the company (53). The cultural aspect is very important for the Construction industry. Most of construction companies have employees of various regions and more specifically it is very common the labor to be from developing countries and the managers to be from developed countries. This can easily lead to a gap between these two groups and as a result to be an obstacle to any OPEX initiative.

In parallel with all these, the aspect of Leadership is also very important. Any OPEX implementation should have the proper support from the leadership, something that also defines the effectiveness of the project (29). A more important role in implementation has the top management, which can directly affect the success of the OPEX and also how the employees will face it (32) (44) (58). Even the involvement of company's CEO is a good practice (50). A top management with high commitment in OPEX can increase drastically the effectiveness of the company and increase the employee satisfaction (44) (51). In parallel with OPEX initiatives, a leadership with high commitment can be also beneficial for the overall quality management of the organization (62). Finally, the leadership is responsible for the creation of culture that as mentioned in previous paragraph can influence positively initiatives like OPEX (53).

Another Business aspect that can help Construction companies, is the adaptability of the company (32). This can help in the implementation because a more adaptable company is more ready to implement new initiatives and also this has a direct relationship with the sustainability of the company. It is not by chance that the less complex organizations are more likely to successfully implement an BEM (38), because they are not restricted from established practices, which may be an obstacle for OPEX. Maybe this is the more difficult aspect for a Construction company, because most companies are based in very old practices and are often not very adaptable.



The aspect of strategy is also something that can be change in a Construction company in order to become excellent. Firstly, the creating a strategy should be in a structured way, by using methods like Hoshin Kanri, which will help having quantified goals (34). Secondly, the implementation of strategy should be bases on the 3 Cs of Strategic execution (Communication, Commitment and Change), which will improve the effectiveness of strategy (34). These two will affect positively the alignment of the company with the implemented BEM (34).

Other good practices that can help an organization toward OPEX, are the involvement of the whole organization and not only the quality department and the creating firstly of a basic quality background (like the implementation of ISO 9001), because an organization without this cannot benefit from an BEM (50). Also, the whole OPEX project should involve all the employees and not only the leadership (50) and finally should have a customer focus logic, because the overall scope of the project is to give more value to the customer (31).

Something that hasn't mention yet in the literature, is how a Construction company can benefit by using a BEM for self-assessment. This process can be very beneficial for a construction company because it can reveal possible risks and opportunities. This process is not a simple task, so the company should be careful during the implementation. For this reason, the self-assessment should be conducted from trained personnel, which understands both the BEM requirements and also the Company's need (50). In addition, the managerial review should be included, all employees should be involved and finally the psychological factors should be considered (50). A structured self-assessment process implementation may include the following steps (49):

- i. Decide the BEM that will be applied
- ii. Ensure that the organization is ready for the assessment (for example ensure the management commitment)
- iii. Define and understand the criteria
- iv. Define and understand the sub criteria
- v. Set a scale that will categorize the OPEX maturity of the company, according to assessment results.
- vi. Use the RADAR logic for the evaluation
- vii. Set a guide for the assessment and also set the objectives (according to the criteria), which will take a score.
- viii. Set a weight for every objective.

Finally, as mentioned previously, the current literature regarding construction, focuses a lot on the supply chain of the organization. For this reason, a good process for improving the supply chain is the following (2):

- i. Communicate the program with the top management and set the deliverables and the timeline.

- ii. Analyze the existing organization's data (life cycle, stocks, sale, etc.), so to have an overview.
- iii. Make model based on the gathered data and conduct a simulation, so to find the best set of variables for the company (like change the delivery times and lead times).
- iv. Implement this new model.

#### b. Potential Improvements for Archirodon

Regarding the case of Archirodon, there is a lot of potential improvement. More specifically there are many practices in the literature that can be implemented and lead to significant improvements or they can be the trigger for an Operational Excellence initiative.

The first improvement is the development of a process, which will describe the creation of business strategy. The strategy is a crucial aspect for the implementation of operational excellence and it connects directly with the success of the company (32) (38) (62). One very useful tool to develop business strategy is Hoshin kanri (34). This method is the contrary of the traditional Top-Down strategy formulation and includes in the decision process the suppliers, the customers and the employees (11). It starts with the top management vision, which then communicated with the departments and then they define long term strategic plans. These plans then split to medium and short term (11). So, the vision is translated in specific objectives and plans, which are developed with the participation of employees, and the organization can go from a vague vision to something detailed (11). A visualization of all these is presented in Figure 33 (11), in which are presented also the negotiations processes (referred as "catch ball") in which the objectives are discussed between the managerial levels.

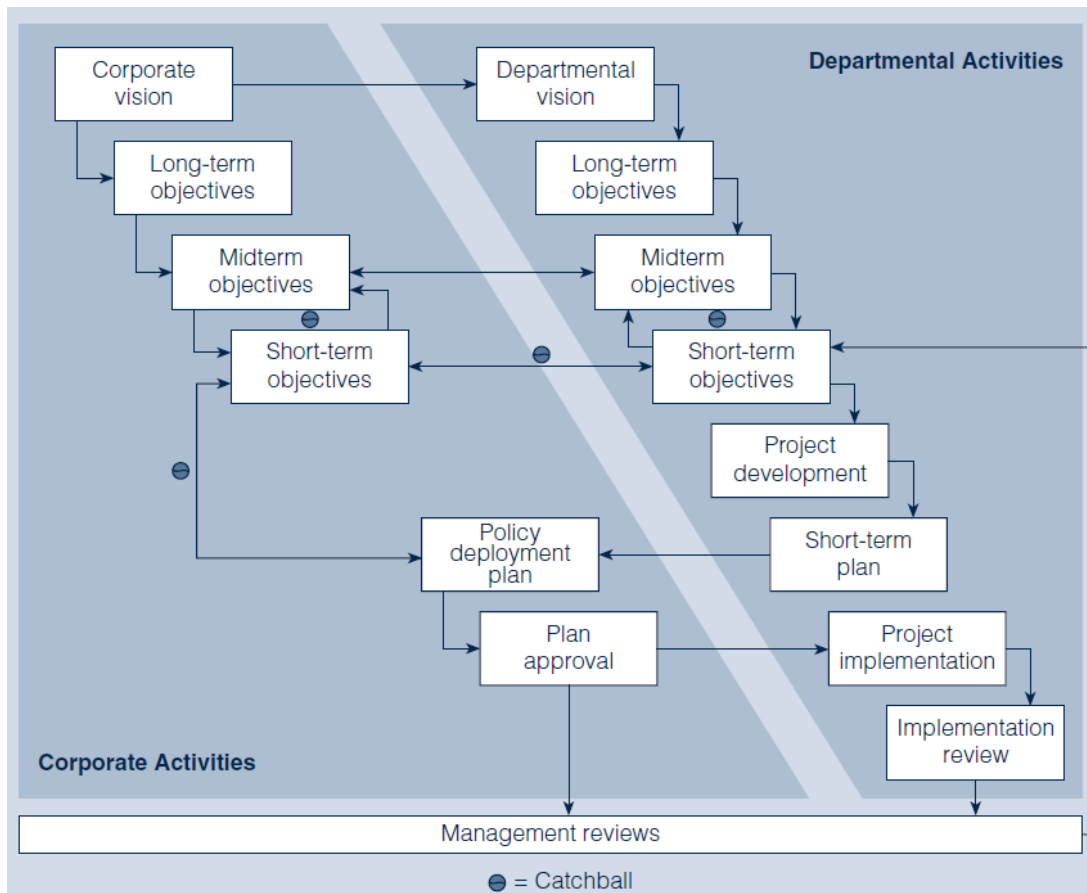


Figure 33- Hoshin Kanri method

In parallel, the organization can implement some tools of lean Management. Lean is the most common operational excellence method that has been used in construction according to the literature (20) (69) (74). Also, there is the “Lean Construction Institute”, which has as mission to transform the industry through the thinking and tools of Lean (84). So maybe based on that the safest operational excellence medium is the Lean. Archirodon could implement some Lean tools both in their processes and in their construction activities. Some possible tools that can be applied are the following:

- 5s method: It comes from the terms “sort”, “set in order”, “shine”, “standardize” and “sustain” (11). It is a tool for workplace organization and standardization, which helps the arrange of materials/ tools/ equipment in a way that they are more accessible and easier to find (11). It helps in reduction of time (like searching for a specific tool) and also contributes to the safety of the employees (11). The 5s can be implemented in many organization’s aspects, from the offices to the workshop.
- Visual Control: A set of indicators that are accessible to all employees, so to everyone have access in the status of production activity, materials, tools, etc. (11). So, if an issue occurs everyone will be able to act immediately.

- Efficient layout and standardized work: The design of processes/ operations, so to maximize the efficiency and the standardization of them, so to minimize the wastes (muda) (11).
- Total production maintenance: A set of predefined maintenance procedures, which is designed so the equipment is operational and available whenever is needed (11).

Another potential improvement for Archirodon is the development of a self-assessment procedure. This will be a holistic evaluation of the organization, which will answer questions like “How are we doing”, “What are our strengths/ weaknesses?”, “What areas should be improved?”, etc. (11). Self-assessment can influence a lot the continues improvement of the organization, by addressing the following (11):

- Involvement of Leadership
- Product design and how this can cover customer need
- Product control system that concentrates on the prevention of defects
- Customer and supplier communication
- Quality improvement
- Employee participation
- Education and training
- Quality information

For self-assessment can be used various methods which are based on BEM, like the Baldrige program and EFQM. More specifically the Baldrige provides self-assessment tools, like the “Are We Making Progress?” that have as scope to capture the voice of employee and the view of top management regarding the measurement of organization progress (11). Alternatively, the organization can use the Baldrige or EFQM criteria and compare its practices directly to them, by using internal or external examiners, or even by applying to the awards (11).

Finally, the operational excellence aspect of the organization can be enforced by fully implementing an ESG framework. As it was analyzed Archirodon has already planned many initiatives regarding the Environmental and Governance aspect, so a potential improvement can be an “investment” in Social aspect. ISO 26000 can provide the framework, so the organization focus more on social responsibility (85). The scope of this standard is to provide a constructed way so the organization to develop an integrated social responsibility behavior, in order to increase the contribution to sustainable development (85). The standard is not meant to be the base for the development of a management system, but it can provide guidance for organizations that starting the development of social responsibility (85).

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