Effective Project Management in Contemporary Developments: Case Study Burj Khalifa Tower

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Abstract - The Burj Khalifa is known to be the tallest skyscraper ever built by man and one of the most popular tourist destinations in the world. At over 828 meters (2716.5 feet) and more than 160 stories, Burj Khalifa is a multi-use development tower that includes a hotel, observation deck, restaurant, fitness and recreation club, and 37 floors of corporate offices. The project to build the Burj Khalifa tower is one of the most successful projects in the Middle East and in the world to date. It was planned by the Dubai government with the purpose of making the city a hub for finance, trade, and tourism. The project spanned for 6 years from 2004 to 2009 and was designed to be the centerpiece of the large scale Burj Khalifa Development that would rise into the sky to an unprecedented height. As listed in burjkhalifa.ae (2018), the completion of the tower has broken numerous world records such as Tallest Building in the World, Highest Number of Stories in the World, Highest Outdoor Observation Deck in the World, and many more. Agreed that that there are many iconic structures around the world, of which Dubai still plays host to most of them, the Burj Khalifa is not only the tallest and one of the most glamorous, with a lot to learn from its project design, process and implementation. The research work is designed to x-ray the entire project, its phases and the factors that led its successful completion.

Indexed Terms: Project, Management, Success, Burj Khalifa, Dubai

I. INTRODUCTION

In the ever-advancing modern society, projects are essential and abundant in almost every industry. Successful projects in businesses are believed to be one of the key foundations for long-term growth. However, to efficiently plan, manage, and execute a project is not an easy task. A project manager must be able to utilize the applicable processes and resources to accomplish a certain project. This is why Project Management has become a critical skill and competency that requires proper training.

In this case study, it is essential to review the definition and concept of Project Management in order to fully comprehend the topic at hand. In particular,

- What is a Project?
- What is Project Management?
- What are the phases involved in Project Management?
- What are the advantages of Project Management?
- What is PMI?
- What is the Project Management Framework?

We shall be looking at this in the light of the monumental structure, Burj Khalifa, which was the first of its kind, and yet, it did not just appear out of nowhere. According to Skidmore, Owings & Merrill (SOM), the architecture firm behind the design and engineering of Burj Khalifa, the construction of the tower required more than 22 million-man hours from about 12,000 professionals and skilled workers, and more than 60 consultants and contracting companies from around the world. (dubaifaqs, 2010) This project wouldn't have been a huge success if not for the collaborative effort of Project Managers and other professionals who meticulously planned, executed, and controlled every step and process towards the tower's completion.

II. LITERATURE REVIEW

According to the Project Management Institute (PMI) (2018), a project is "a temporary desire to create a unique product, service or result." A project is a temporary endeavor with a definite beginning and end. Itis unique in that it is not an ordinary operation, but a specific set of operations intended to achieve a single goal. A project's objective is mainly to produce a unique output while conforming to specific criteria.

Projects may have time, cost, quality, and resource constraints. It requires 3 main resources: financial, material, and human.

Moreover, the Project Management Institute (PMI) (2018) defines Project Management as "the application of knowledge, skills, tools and methods for project activities to meet project requirements." This would include establishing a project's details, developing project schedules, monitoring and maintaining the processes, and avoiding common project pitfalls. Furthermore, the development of a project plan, defining and confirming project goals and objectives, achieving them, defining objectives and quantifying necessary resources, as well as determining budgets and completion dates is also done in Project Management. It also includes the management of the implementation of the project plan, as well as regular controls to provide accurate and objective information about effectiveness regarding the plan and mechanisms for implementing remedial actions when necessary. In order to handle projects effectively, a competent project manager must be proactive, decisive, authoritative, a good communicator, motivator, and many more.

In simpler terms, a Project is a specific process for achieving certain goals and solving a specific business problem while Management is the management of people by a manager in an enterprise in order to achieve a positive dynamic in the development of a company. Project management, thus, is an activity aimed at achieving the objectives set, the implementation of certain plans, using the available resources - time, capital, people.

Stages of Project Management

Project management is the application of knowledge, skills, tools and methods for a wide range of activities to meet the needs of a specific project. There are four stages of project management (See Diagram A). According to Smartsheet Inc.(2018), "if the life cycle provides a high-level view of the project, the stages are the roadmap for its implementation."

1. Project conception and initiation

The initiating phase is where the size, scope, and complexity of a project is assessed to fully understand the necessary procedures and resources. The project manager, team, plan, environment, and PMI workbook are established in this phase. An idea for a project will be carefully examined to determine whether or not it benefits the organization. During this phase, a decision-making team will identify if the project can realistically be completed.

2. Project definition and planning

This is the PM phase where the objectives, requirements, risks, schedules, and budgets are identified. This phase determines "what" is to be done, "who" will be involved, "when" activities will occur, and "how" the project will be achieved. A project plan, project charter and/or project scope may be put in writing, outlining the work to be performed. During this phase, a team should prioritize the project, calculate a budget and schedule, and determine what resources are needed.

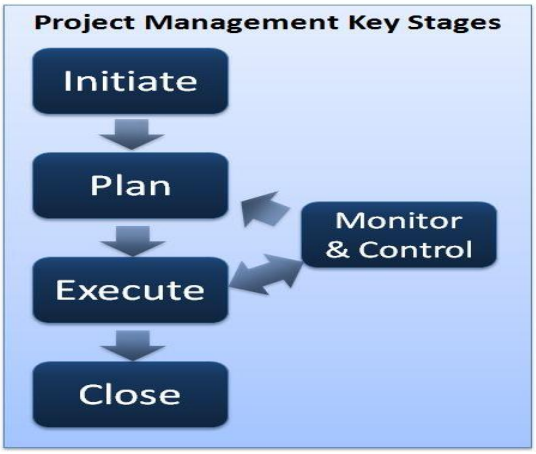


Diagram A – Project Management Phases

3. Project launch or execution

This phase of Project Management is where the planned activities actually occur. This involves project monitoring and controlling processes. A project manager may have to implement risk, change, control, and communications management according to the outcome and issues that may arise. Resources' tasks are distributed, and teams are informed of responsibilities. Thus, it is important to bring up important project related information.

In this phase, Project managers will compare project status and progress to the actual plan, as resources perform the scheduled work. Project managers may need to adjust schedules or do what is necessary to keep the project on track.

4. Project close

This is the final phase where the project has reached its end goal and the outcome is produced. After project tasks are completed and the client has approved the outcome, an evaluation is necessary to highlight project success and/or learn from project history. Final documentation and assessments are then made.

Projects and project management processes vary from industry to industry; however, these are more traditional elements of a project. The overarching goal is typically to offer a product, change a process or to solve a problem in order to benefit the organization.

Advantages of Project Management

The main advantage of Project Management is that an individual is able to manage projects effectively and efficiently. As time and money is a constraint in every project, Project Management allows you to solve problems faster and avoid errors throughout your project. The use of formal and proper Project Management would increase productivity, quality, customer satisfaction, profit margin, and work morale in a business while decreasing costs and saving time. The lack of process to manage your projects can lead to a loss of time, money, and low productivity. This is why proper Project Management would aid in better control of the project's resources and constraints.

The following are further advantages of using Project Management:

1. Improve your chances of achieving the desired result
2. Get a fresh look at your project and how it fits your business strategy
3. Prioritize the resources of your business and ensure their effective use
4. Set scale, schedule and budget from the start
5. Stay on schedule and keep expenses and budget resources
6. Increase productivity and quality of work
7. Encourage consistent communication between staff, suppliers and customers
8. Meet the various needs of project stakeholders
9. Mitigate the risks of a failed project
10. Increase customer satisfaction
11. Gain competitive advantage and increase your profits

Project Management Institute (PMI)

The Project Management Institute (PMI) is a non-profit professional organization dedicated to advancing the state-of-the-art of project management. According to the Project Management Institute (2018), their objective is "to set standards through certified education and development and by conducting research and professional conferencing". Thus, this institute aims to advance the careers of practitioners and enhance the performance of business and other organizations. The PMI is considered the world leader in project management advocacy and professional development.

As stated in Wikipedia (2018), The PMI "serves more than 2.9 million professionals including over 500,000 members in 208 countries and territories around the world, with 300 chapters and 10,000 volunteers serving local members in over 80 countries" .Its services include the development of standards, research, education, publication, networking-opportunities in local chapters, hosting conferences and training seminars, and providing accreditation in project management.

To serve its members and the profession, PMI has created industry standards, such as the Project Management Body of Knowledge (PMBOK), the Standard for Program Management, and the Standard for Portfolio Management, Practice Standard for Work Breakdown Structures and Organizational Project Management Maturity Model or OPM3. (World Print, 2018)

In an effort to institute generally accepted project management practices as well as develop a common project management language, the PMI publishes the

Project Management Body of Knowledge Guide. The PMBOK Guide is now in its 4th edition with over 2 million copies in circulation worldwide and has been recognized by the American National Standards Institute (ANSI).

In addition to the guide, the PMI maintains a current library of 11 global standards documents addressing the themes of Projects, Programs, People, Organizations and Profession. (Upland, 2018)

As the PMI understands the importance of impartiality in carrying out its certification activities, the continue to manage conflict of interest and ensures the objectivity of its certification activities. The PMI maintains a program of professional credentials which are recognized worldwide by individuals and organizations. This credentials program holds an ISO 9001 certification in Quality Management Systems.

Project Management Framework

Statement

In the locality of Dubai alone, projects are abundant in every sector – real estate, hospitality, food business, retail, transportation, and many more. The success of these projects has helped Dubai become the ever-growing and thriving metropolitan that it is today. However, one project that has greatly changed and improved the city's economy, reputation, and image is the construction of the Burj Khalifa Tower. Ever since its establishment, the Burj Khalifa project continues to be a paradigm of a well-managed and executed grand-scale endeavor in the field of Project Management.

In line with the researchers' Project Management course, this case study aims to look at some of the problems or challenges faced in the process of the project and write, conduct an in-depth review and analysis of the planning, execution, maintenance, and framework used by the Burj Khalifa project management team in successfully building such a monumental infrastructure in the United Arab Emirates. Through this, the information collected together with an analysis on the subject could further enhance the knowledge and understanding of Project Management and its importance, as well.

III. METHODOLOGY

This case study utilized data, information, and details of the Burj Khalifa Tower project from several sources available throughout the internet, such as news articles, reports, research papers, books, and more. These have been collected and analyzed in order to discuss the preparation and procedures undertaken by the Burj Khalifa management leading to its inauguration. Furthermore, the information provided was used to assess the project's over-all success and shortcomings.

IV. RESULTS

Burj Khalifa, a single place where tourism, hospitality, professionalism and leisure come together. Home to more than 1000 residences, Burj Khalifa accommodates a hotel, an observation deck, a restaurant, fitness and recreation club and also 37 floors of corporate offices. It brings in a concept of a vertical city with all the luxurious amenities made available on the top of the world. For the tourists and visitors coming to see this marvel, it is a long and a memorable journey of a lifetime. (burjkhalifa.ae, 2018)

1. Project Management Phases of the Burj Khalifa Project

A. Initiation

The aim of Burj Khalifa was not just to build the tallest building. The United Arab Emirates previously relied on petrol as its main source of income. The decision to build Burj Khalifa was based on the UAE government's goal to diversify from an oil-based economy to one that is service and tourism-based. Projects like Burj Khalifa was said to be necessary to be built in order to garner more international recognition and investment in the UAE.

A. Planning

Owner/Developer	Emaar Properties
Design Architect, Engineer	Skidmore, Owings & Merrill LLP Chief Architect: Adrian Smith
Project Manager	Turner International LLC Project Manager: Christopher Harris
	Grocon Construction (founding advisor)
Supervision Consultant Engineer	Hyder Consulting Project Manager Contractor: Rob Pickering
General Contractor	Samsung Engineering- Korea base contractor
	Besix- Belgium base contractor
	Arabtec- Dubai base contractor

(Source: Skyscraper Center)

- Objectives

1. Build the tallest building/free-standing structure in the world
2. Become a milestone of ingenuity, inspiration, and achievement in the M.E.
3. Apply a mixed structure type between reinforced concrete and steel frame
4. Increase safety and security against the strong winds from the coast

- Scope

Location: Sheikh Mohammed bin Rashid Boulevard, Dubai, United Arab Emirates

Start and end date: (planned) January 2004- December 2008, (final) September 2009

Cost: (planned) $876 million, (final) $1.5 billion

Work Breakdown Structure (WBS)

January 2004	Excavation started
February 2004	Piling started
March 2005	Superstructure started
June 2006	Level 50 reached
January 2007	Level 100 reached
March 2007	Level 110 reached
April 2007	Level 120 reached
May 2007	Level 130 reached
July 2007	Level 141 reached - world's tallest building
September 2007	Level 150 reached - world's tallest free-standing structure
April 2008	Level 160 reached world's tallest man-made structure
January 2009	Completion of spire
September 2009	Exterior cladding competed
January 2010	Official launch ceremony

(Source: Burjkhalifa.ae)

- Human Resources: 380 engineers and on-site technicians, 7500 construction workers
- Design: The design of the Burj Khalifa tower was derived from geometries of the desert flower, which indigenous to the region, and the patterning systems embodied in Islamic architecture.
- Materials: Foundation- 3.7m concrete mat thick; Concrete and steel- 330,000 m^3 of concrete and 39,000 tones (43,000 ST; 38,000 LT) of steel rebar; External Cladding- reflective glazing, and aluminum and textured stainless steel spandrel panels; etc.
- Risks: weather, wind, fire hazards, workers' safety, natural catastrophe, budget constraint, delayed completion date, etc.

B. Execution

The key considerations for this project idea was the ability for it to withstand Dubai's extreme summer temperatures and impact of wind forces at a great height. According to Bart Oomens (2017), The

Structural Health Monitoring Program and Network *(SHM)* aided to measure the sustainability of the tower during construction process, and also after tower occupation. The structure was designed very safely to withstand the effect of wind and gravity load, even during stages of construction. There were numerous cameras installed that could detect the unsafety condition and number of people inside the building.

The tower was made up of 160 stories and was scheduled to be completed within given periods. The project adopted a new construction technology called the "3-day cycle", a method which aims to raise the entire construction one story per every three days. (Abdelrazaq, 2010)

During this time, the quality and safety control management of the project was greatly monitored and maintained. This included the following procedures:

- Implementing the tools and mechanisms for constructing the building
- Transporting a large amount of steel and concrete higher into the air
- Dealing with weather changes that would complicate the construction process
- Performance measurement and monitoring inputs in all departments
- Investigation of incidents or accidents
- Implementing Risk Management
- Regulating Information Systems

Despite the outstanding output, some aspects of the Burj Khalifa project were poorly managed. The size and scope of this project was on a large scale that some problems were inevitable. Firstly, the original duration of the project was set for 47 months (January 2004-December 2008). However, due to an economic crisis in the UAE in 2008, the construction of Burj Khalifa suffered a 9-month delay (September 2009). The project also exceeded its planned costs of $876 million, with a final cost of $1.5 billion caused by the increase in inflation and change in design. Another major problem faced was the poor labor condition. Construction workers were paid very low wages compared to the overall cost of the project. According to the report from Human Rights Watch Study (2006), some workers were reportedly earning less than $10 a day.

C. Closing

The opening of Burj Khalifa was held in January 2010. The ceremony featured a display of 10,000 fireworks, light beams projected on and around the tower, and further sound, light, and water effects. (FlashyDubai, 2011) Hundreds of media outlets from around the world reported live from the scene. In addition to the media presence, over 6,000 guests attended and witnessed the opening of this momentous event.

II. Project Management Framework

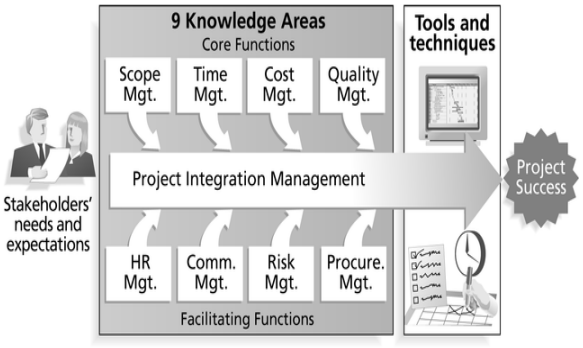


Diagram B – PM Framework (Source: Kidskunst)

The Project Management Framework shows how essential it was for a project to identify the scope, time, cost, quality, human resource, communication, risks, and procurement processes in order to achieve Project Success (See Diagram B). For a project such as the Burj Khalifa tower construction, these nine main knowledge areas, along with the management to integrate these core and facilitating project functions, is vital for a time and cost-efficient outcome that minimizes profit and maximizes quality.

A. Stakeholders

Stakeholders are defined as "the people who have an interest or concern in something, especially in business" (IGI Global, 2018). The most concerned stakeholders of Burj Khalifa are the following:

- Government of Dubai
- Architecture group – SOM, Chicago
- Consultant Group – Hyder Consulting
- Construction and foundation designer – Baier and Middle East foundation
- Main Contractor – Samsung Engineering, Besix, and Arabatec (The contract cost of the project was 876 million dollars.)
- Brookfield multiplex – responsible for constructing of foundation
- Others – Otis as lift contractor, Al Ghurair Group as cladding contractor, Dorma as door contractor, etc.

General Overview of Stakeholders:

- 78 Companies
- 16 Consultant
- 14 Contractors
- 3 Financial Institutions
- 2 Owners
- 2 Real Estate Companies
- 3 Sub-contractors
- 38 Suppliers

B. Scope Management

The main scope of the project was to develop the World Tallest Skyscraper. The decision to build BurjKhalifa was based on the United Arab Emirates government's goal to shift the country's oil-based economy to tourism, finance, and trade-centered economy. (Wikipedia, 2018) Furthermore, it was designed to be a milestone of ingenuity, inspiration, and achievement. With this, the government of the United Arab Emirates aimed to make Dubai new universal business hub recognized around the world. In order to garner more international recognition and investment in the UAE, projects like Burj Khalifa was said to be necessary to be built along with other revolutionary projects and infrastructure, as well.

C. Time Management

One of the key factors of the Burj Khalifa project was the definite date of start and finish. As this was a highly anticipated project not only for Dubai and UAE but for the entire world as well, time was highly sensitive in this process. Originally, the planned duration was set for 47 months (January 2004-December 2008). However, due to an economic crisis in the UAE in 2008, the construction of Burj Khalifa suffered a 9-month delay. This period was called the "Dubai shock", caused by the bubble in real estate investment. (Brach & Loewe, 2010)The whole construction period of the project was 57 months (January 2004 to October 2009). The change of design that occurred in the middle stages of construction affected not only the costs, but also the duration of the construction as well. Additional work was required with respect to changes in the design planning. This shows that the schedule of the Burj Khalifa construction project was poorly managed by the project managers due to unforeseen economic and construction hindrances to the project completion.

D. Cost Management

In terms of cost, the project exceeded its planned budget of $876 million, with a final cost of $1.5 billion. This was due to several reasons. Firstly, a rise in prices of raw materials had gone up significantly due to the downturn of the global economy in 2008. According to report of Dr. Horst Stipp of Statista (2018), the price of iron had increased by 75% in 2008. Other materials such as aluminum and cement, which were planned to be mainly used in the construction of the Burj Khalifa tower, also increased. In return, these increase in price of commodities increased the total construction cost of the project.

Secondly, the mid-way change in design was also responsible for the cost increase. Emaar Property, which was the owning company of the project, decided to change the final height of building— the final construction was over 100 meters higher than the original design (Strabala, 2008). Thus, unexpected costs were incurred.

Moreover, changes in interior design planning were another reason for the increase in costs. Since the Burj Khalifa aimed not only to have an awe-inspiring exterior, but to have luxurious interior and faculties as well, Emaar decided to make a contract with luxury

hotel chain Armani. (UK Essays, 2016) Armani wanted to change the initial interior design of hotel. The project then had to allot more money to change the design of the lobby and to add more luxurious fittings and furnishings to the rooms as requested by Armani.

Aside from construction changes, another major problem faced was the poor labor condition. Construction workers were paid very low wages compared to the overall cost of the project. According to the report from Human Rights Watch (2006), some workers, such us those from India and Pakistan, were reportedly earning less than $10 a day. The monthly salary of these laborers from 2005-2009 were reportedly 500-1,500 AED (136-408 USD) per month. (dubaifaqs, 2010)

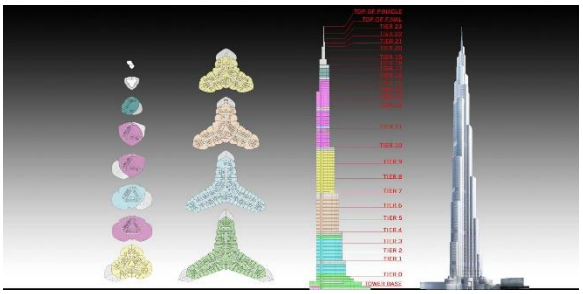
These low wages posed negative reactions from workers, causing a strike which halted work on the tower in March 2006. As reported by Nakhoda of the Global Nonviolent Action Database (2011), about 2,500 workers at the Burj Khalifa site walked off the job site and went on strike over pay and working conditions. Strikers committed extensive property damage to construction vehicles, cars, and offices.

Due to these variables, the Burj Khalifa project management team suffered an overrun of its initially planned budget. Therefore, the project's cost management did not perform well.

E. Quality Management

Quality was one of the major aspects of this project that the Burj Khalifa team prioritized. In order to build a skyscraper that surpasses all else in the world, top-quality architecture, material, and workers were the key. The Burj Khalifa project's quality planning method included the identification of their suppliers and contractors, method of construction, the utilization of logistics, resources, and training required. (University of Lincoln, 2017)

The Burj Khalifa aimed to enhance reducing the disruption to nearby environment. According Belleza (2010), "they identified the quality activities needed to uphold impact caused by wind and utilizing the practicality of elevators and water systems". The External cladding system was designed to withstand Dubai's extreme summer temperatures and consists of reflective glazing, and aluminum and textured stainless steel spandrel panels. The architectural glass provides solar and thermal performance as well as an anti-glare shield for the intense desert sun, extreme desert temperatures, and strong winds (CW Staff, 2010).



The tower's frame, on the other hand, used a mixed structure type between reinforced concrete and steel frame. The Burj Khalifa official site (2018) explains that "over 45,000 $m^3$of concrete, weighing more than 110,000 tons were used to construct the concrete and steel foundation, which features 192 piles buried more than 50 m (164 ft) deep. Burj Khalifa's construction will have used 330,000 $m^3$of concrete and 39,000 tons of steel rebar, and construction will have taken 22 million man-hours."

Diagram C – BurjKhalifa Structural Design (Source: SOM)

In addition to this, the type of concrete used for construction was a similar material to make-up conventional concrete, with the addition of super plasters and agents to increase the viscosity of the mix. Many consider the concrete technology the most innovative feature of the project requiring fluidity and strengths to be pumped to over 600 meters (one of the building's many records) at extreme temperatures of more than 40°C. (UK Essays, 2016) The following are other components:

- High fluidity of mix allows concrete to compact under its own weight.
- Does not require vibration.

- provides for assured consolidation in highly reinforced or congested areas.
- Shortens construction period since vibration is not required.

Before the construction began, the quality testing period of materials and the sustainability of the architecture was a lengthy process. The Burj Khalifa engineers did a number of various tests in a closed laboratory, with an actual model of the proposed infrastructure design. Structure design softwares were used to simulate and analyze construction. (Al Shami, 2014) This was done to test wind tunnel, high temperature, and earthquake sustainability, as well as to ensure that a building of such aimed height can withstand any risk. Through this, they were able to determine the type, quantity, and measurements required for the construction materials. The following are some of the research and testing done for the Burj Khalifa tower:

- Wind Engineering
- Stack Effect
- Vertical Shortening
- Building Services System
- Coordination of Services

Another aspect of this project's quality planning was the design of the tower itself. The architectural characteristic of the tower is that it represents a flower on the desert to express a sense of national characteristic and prosperity. Furthermore, in order to increase safety and security against the strong winds from the coast, Burj Khalifa adopted a Y-typed plan shape. This would provide a breakthrough in architectural possibilities (Baker, Korista & Novakm, 2007), aiming for a revolutionary and unique infrastructure. Frigenti and Comninos (2002) adds, "This helps identify new organization risk area, enabling management to develop and implement timely risk management strategy."

The tower reached 160 stories and each level was scheduled to be completed within given periods. In order to achieve this, the project adopted a new construction technology called the "3-day cycle", a method which aims to raise the entire construction one story per every three days (Abdelrazaq, 2010). As aforementioned, due to the exceptional efforts and quality required for the construction of this tower, the project could be regarded as a technological innovation.

F. HR Management

For the Burj Khalifa project, the employees, managers, consultants, engineers, and more professionals had to be recruited through a rigorous process that would ensure efficiency throughout the entire project. The Burj Khalifa team consisted of 12,000 professionals and skilled workers from around the world. (dubaifaqs, 2010) The SOM team alone, the architecture firm behind the design and engineering of Burj Khalifa, consisted of more than 65 people, including architects, structural and MEP engineers, and administration personnel. In addition to this were 380 engineers and on-site technicians along with 7500 construction workers. With the collaborative effort of the Burj Khalifa Project Management team, along with other professionals, the project was able to achieve its goal to build the World's Tallest Tower.

G. Communications Management

As communication is the backbone of any business in society, the Communications Management for this project was of great importance. An organization must create a harmonious relationship with all levels and departments (vertical or horizontal) through clear and constant communication. With more than 65 separate consultants and over 12,000 professionals and skilled workers engaged by Emaar on this project (dubai faqs, 2010), exceptional communication and regular reporting was required to ensure smooth progression and effective management of the budget and expectations.

At the start of the Dubai Tower project, communications in and around the construction site were accomplished using traditional walkie-talkies. However, Chang Geun Lee, project manager for Samsung Corp (2016), stated "When the building exceeded thirty floors, problems with our communications system surfaced". As the tower grew, the walkie-talkies became less and less reliable, creating delays and safety concerns. Chang Geun Lee

continued, "We started to experience delays or no connection between the thirty-first and the ground floors, particularly in the core of building." (2016)

With a delay in communication means a delay in construction. This caused the Burj Khalifa management to explore solutions to improve communication capabilities for the construction crew with the help of Samsung Corp (Firetide, 2016). To solve this issue, Samsung came up with a wireless mesh network to provide clear voice communications and real-time video streams and surveillances. This wireless mesh resolved a critical communication problem, enabling construction to continue safely and on schedule.

H. Risk Management

The main risks during the design and construction procedure were the following:

- Building load (gravity)
- Wind load
- High speed elevators
- Evacuation. Since the attacks of 9/11, a new important factor is considered in skyscrapers. Evacuation is full of challenges for such a tall structure. However, the tower claims to have a perfect evacuation system (Al Shami, 2014) having refuge rooms that are fire and heat resistant for up 2 hours. These rooms are also provided with air pumps.
- Collapse. Despite the seismic activity is moderate in the UAE, Burj Khalifa still has risks for being a tower with more than half a kilometer of height. This was solved by designing it was a triangular shape. According to the tests conducted, the building is able to resist up to 6 Richter's. (Al Shami, 2014)

I. Procurement Management

Collaboration was another key ingredient for success. Suppliers were involved very early in the planning process to implement state-of-the-art innovations in concrete design and pumping, jump formwork or elevator technology. (Future of Construction, 2017) Close and early engagement with the government authorities, utility companies and other key stakeholders was the third key theme to convert the vision into reality.

Below are the companies that collaborated and worked hand-in-hand with Emaar Properties to provide the material and services required for the Burj Khalifa project:

- Cladding – Jordahl; Halfen; Al Ghurair
- Elevator – Otis Elevator Company
- Façade Maintenance Equipment – CoxGomyl
- Fire Proofing – Hilti AG
- Paint/Coating – Jotun
- Sealants – Dow Corning Corporation
- Steel – ArcelorMittal

As explained by Future of Construction (2017), the three major communication connections characterize this project: first, a highly experienced international team, allowing effective knowledge transfer, diligent front-loaded planning and optimized logistics; second, close and proactive collaboration with innovative suppliers; and third, early engagement with government and other major stakeholders.

V. CONCLUSION

Ever since its establishment, Burj Khalifa has greatly contributed to the society and economy of Dubai. People across the globe paid great attention to the skyscraper and it became one of the most famous tourist attractions in the world. After a thorough review and analysis of this project, the Burj Khalifa management was able to cope and finish the project successfully. With the combined effort of countless architects, designers, engineers, and workers all under the guidance of a competent Project Manager, the successful completion of the Burj Khalifa project created what is known today as the Tallest Building in the World— a shining crown jewel of Dubai, UAE.

Recommendation

Throughout this study, Project Management has proven to be one of main reasons for a project's success. To the readers, the researchers recommend giving importance to the field of Project Management and continue to develop one's project managing skill in business.

Lastly, the researchers recommend to the Burj Khalifa management to continue its maintenance of the building. As it is one of the top tourist destinations in the world, constant cleaning and maintaining is required.

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