

Mastering Innovation in Project Management: Innovation Grading and Impact Application: U.A.E. History, Present and Future

Marwane Smaiti

MSc., Eng. Researcher

ABSTRACT

*A project manager has a given amount of resources. To improve his management of the project, he can either introduce innovative technology, or manage his resources in an innovative way. We call it in this paper: **Innovative Substance, or Innovative Use**. For innovative substance, we will develop a **novel user-friendly model** to guide project managers, senior and top managers, cities' councils, and political leaders in their choices of technology utilization in projects, and mega-projects. For Innovative use, we will present the case of the U.A.E. showing that once Innovative Substances are created and developed, Innovative Use is a natural and quasi-systematic result. Besides, we applied our method to Burj Khalifa, and to the potential application of smart technologies based on artificial intelligence in this innovative edifice of the second generation of founders of the country: Sheikh Khalifa bin Zayed's generation.*

Keywords- Innovative Substance, Innovative Use, Guide Decision Making, Innovation Grading, Ultra-Advanced Innovation Grade, Novel Emirati Project Management Era

INTRODUCTION & MOTIVATION

Project Management is rapidly changing with advancements in technology, and in management techniques, empowered by technical and/or human input. However, project managers, senior managers, decision makers, and political leaders face two main challenges, with, of course, different intensities:

1. They don't have an idea about the gain they will make if they utilize a given technology. Thus, it is hard for them to decide about a given investment if they don't know the return-on-investment. That becomes a critical question with the recurrent breakthroughs in novel knowledge fields
2. They need to make sure they improve their utilization of available resources.

The first point can help to develop the second

Therefore, it is necessary to provide proof of innovation in Project Management to overcome these challenges.

To that end, we introduce in this paper the following notions, which correspond to the stated two challenges:

1. **Innovation as a novel substance**
2. **Innovation as a novel use**

We schematize these two kinds of innovation in the next figure:

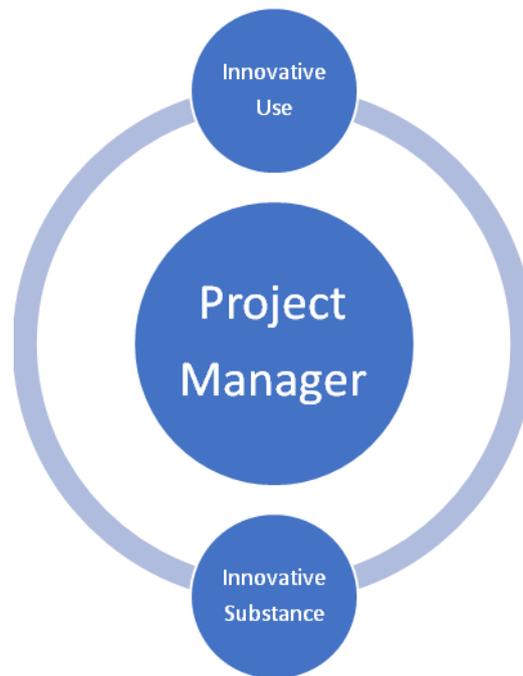


Figure 1: Innovative Use & Innovative Substance in Project Management

We would argue that **innovation as substance is at the origin of all kinds of innovations** [1]. We will demonstrate that by providing the example of the U.A.E. after explaining “**Innovative Substance**” in the next chapter.

II.INNOVATIVE SUBSTANCE

In each project, novel innovations can be adopted, adapted, or developed according to need and objectives. In a modernized and globalized world, it is necessary to look for the gain one can make out of technology in long and short term, especially with the development of cutting-edge revolutionary technologies. To address this issue, we will introduce a simplified model to assess the impact of technology utilization, and the profit to make consequently.

A given project incurs costs to reach a given objective. **Costs** are related to the number of **production units** (e.g. personnel, vehicles, infrastructures, etc.). Each production unit has a given **unit cost** and a given **unit production** towards reaching the aimed **ProjectObjective**. We provide names for each one of these parameters as follows:

| Parameter | Meaning |
|-----------|---------|
| C | Cost |

| | |
|-------|----------------------------|
| C_u | Average unit cost |
| N | Number of production units |
| P_u | Average unit production |

The Project Management problem can be modeled as follows:

$$\begin{cases} \text{Cost} &= N \times C_u \\ \text{Objective} &= N \times P_u \end{cases}$$

A Manager, a top manager, a political leader, an investor, each one at his level, aims to the following:

$$\begin{cases} \text{Reduce Cost} \\ \text{Reach Objective} \end{cases}$$

The question researchers ask, each in his own way, is how, hence, to reach the objective, even exceed it, while reducing costs. **The most obvious way is to reduce production units. However, that will lead to not reaching the objective (i.e. $N \times j$).** If this paper, we suggest reducing production units, and thus reducing cost, and introduce innovative technology to increase productivity, and thus make sure to reach, if not exceed, the objective. Unfortunately, this innovation one wants to introduce has a cost, hence the overall cost will experience an increase. We define L_{inv} to be the innovation investment cost:

| Parameter | Meaning |
|-----------|--------------------------------|
| C_{inv} | the innovation investment cost |

Therefore, the new situation project managers/leaders/sponsors will find themselves in is the following:

$$\begin{cases} \text{Cost} &= N_{inov} \times C_u + L_{inv} \\ \text{Objective} &= N_{inov} \times P_{u,inov} \end{cases}$$

While N_{inov} is the reduced required production unit number after introducing the innovation, and $P_{u,inov}$ is the production acquired after introducing the innovation:

| Parameter | Meaning |
|------------|--|
| N_{inov} | the new required number of production units number thanks to |

| | |
|-------------|---|
| | the innovation |
| $P_{u,inv}$ | the new obtained average unit production thanks to the innovation |

At this point of our work, and to help Project Managers make a convenient decision, we introduce **Innovation Grading Concept**(adopted and adapted from our work in [1]).

1. **Sub-optimal:**

$$P_{u,inv}(N_{inov}) = a \cdot N_{inov}^{\alpha}, \alpha < 1$$

That is when production units are under performing. Here we are talking of a **distraction**, or a **limitation** that lowers the performance. **This is not an objective of our work**

2. **Linear–Manual:**

$$P_{u,inv}(N_{inov}) = a \cdot N_{inov}$$

That takes place when production units are proportional to outcome; this is a typical case of manual work using no technologies, or utilizing rudimentary ones. This is the case of small projects, in which, typically, project managers don't need advanced skills.

3. **Advanced:**

$$P_{u,inv}(N_{inov}) = a \cdot N_{inov}^{\alpha}, \alpha > 1$$

That takes place when well-advanced technologies are used, where production units lead to results, which are unproportionally better than outcome; **this is a typical case of replacing manual tasks in supply chain or in production line by machines through automation**

4. **Ultra-Advanced:**

$$P_{u,inv}(N_{inov}) = a \cdot e^{\alpha \cdot N_{inov}}, \alpha > 1$$

That takes place when production units are **super-performing**. This model is crucial to keep up with the last decade ideas and breakthroughs, and to implement and develop them in innovative ways. In this context, we can mention:

- **Data mining algorithms**
- **Big data modeling**
- **Aerospatiale technology** introduction in operations
- All the above combined, and integrated with **artificial intelligence**, which ensures a continuous and intense improvement procedures, techniques, algorithms, and processes

This model is convenient to look at the case of the U.A.E. unique advancements. That will be presented and detailed in the next chapter

We present the effect as follows:

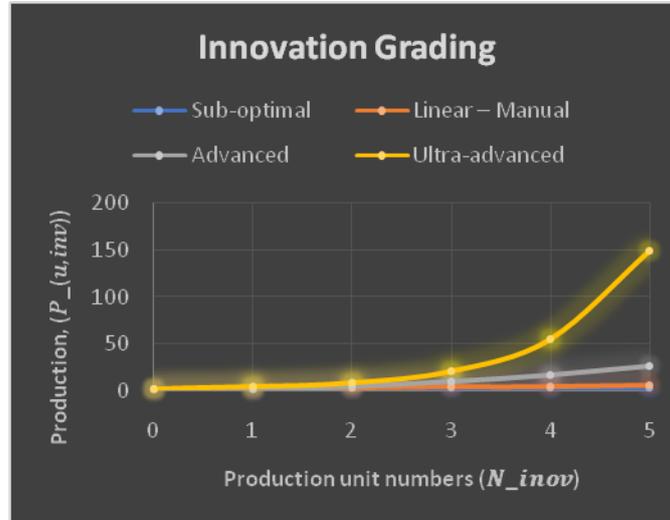


Figure 2: Innovation Grading

We assume that the Project Manager/Leader/Sponsor of a mega-project (e.g. city level, country level, global level, a large construction project, a major oil & gas or telecommunication project etc.) decide to utilize or to develop an **Ultra-Advanced Innovation**. Hence, the new problem will be as follows:

$$\begin{cases} \text{Cost} &= N_{inv} \times C_u + L_{inv} \# \\ \text{Objective} &= N_{inv} \times a \cdot e^{\alpha N_{inv}} \end{cases}$$

Thus:

$$\begin{cases} \text{Cost} &= \frac{\text{Objective} \times C_u}{a \cdot e^{\alpha N_{inv}}} + L_{inv} \# \\ \text{Objective} &= N_{inv} \times a \cdot e^{\alpha N_{inv}} \end{cases}$$

We denote the **Ultra-Advanced Innovation Grade**. The above means that, since the term grows very fast as shown in *Figure 2*, the term goes fast to , and ultimately, in due course¹, the **Project Manager/Leader/Sponsor** will succeed to metamorphose his initiation traditional problem to the following innovated one:

$$\begin{cases} \text{Cost} &= L_{inv} \# \\ \text{Objective} &= \text{very large (outstanding result)} \end{cases}$$

¹ Note, we are talking here about a meg-project, on a large scale, thus mentioning long term makes sense

Therefore, from the analysis above, we can infer the following points:

- Using Ultra-Advanced innovations in megaprojects, the Project Manager/Leader/Sponsor will be able to reduce the long-term cost to basically **the innovation investment cost**
- Using Ultra-Advanced innovations in megaprojects, the Project Manager/Leader/Sponsor will be able to exceed its planned objective to unlimited and unpredicted outstanding results
- The used innovation will be a **quasi-free** (free except amortization) assess for future Project Managers. Hence, the cost saving for these projects will be even more significant than in the initial project, in which the ultra-advanced innovation has been introduced. Therefore, we can talk about a **generation offounders** (that took in charge the investment L_{inv}) which made it much easier for the following generations to manage projects and reach success much easier and cheaper

III.APPLICATION: U.A.E.HISTORY, PRESENT AND FUTURE

The U.A.E. enjoyed a unique **generation offounders** which directed their ambitious investment, at each period of the country history time, to **Ultra-Advanced** innovations. These investments have gone through **two major phases**, which correspond to two **generations of founders**. Using our model, that can be represented as follows:

$$L_{inv} = L_{inv,generation 1} + L_{inv,generation 2}$$

Then, each generation invests in Dubai, Abu Dhabi, and the other Emirates, driven by the leaders and their ambitious projects. Therefore:

$$\begin{cases} L_{inv,generation 1} = L_{Sheikh Zayed} \\ L_{inv,generation 2} = L_{Sheikh Khalifa bin Zayed} \end{cases}$$

Therefore, we can define two **Ultra-Advanced Innovation Grade** , in the history of the U.A.E.:

$$\begin{cases} \alpha_{inv,generation 1} = \alpha_{Sheikh Zayed} \\ \alpha_{inv,generation 2} = \alpha_{Sheikh Khalifa bin Zayed} \end{cases}$$

involves the initial construction of the main infrastructure facilities, and the initiation of a modern country which will **attract investors and businesses in the future**: this is the first innovation introduction at the country level.

One can easily estimate , and from available statistics. However, **the calculation of is an ongoing process**:

- In mathematical terms, we say the **Objective** approaches infinity.
- In historical/social/economical terms, we say his highness **Sheikh Zayed investment milestones' benefits will cover many generations**

α_{Sheikh} involves the modern investments in Ultra-Advanced Innovations in the U.A.E. That means that the **novel Emirati Project Management Era** includes a myriad of innovations whose outcome exceeds the mere combination of their production units. That includes (not an exhaustive listing) [2,3,4,5,6]:

- **Smart Grid Integration** in Roads and Transport Authority, Dubai Electricity and Water Authority, Dubai Health Experience, and many other Ministries, agencies, and authorities.

That will lead to significant cost reduction and operation management improvement

- **U.A.E. Hyperloop**

That will create a unique competitive advantage for the U.A.E. by reducing travel time within the country, and will also help bringing the development level of all regions to a similar state and advancement speed

- **U.A.E. Artificial Intelligence Strategy**

U.A.E. is a global pioneer in adopting artificial intelligence within private and public sector. The **Ultra-Advanced Innovation Grade α for this field is high and keeps on increasing** as technology and Project Management techniques are advancing

- **Emirates Mars Mission**

We can see the **Ultra-Advanced Innovation Grade $\alpha_{\text{Sheikh Khalifa bin Zayed}}$** in the statement of his highness Sheikh Khalifa bin Zayed: "*We aim for the U.A.E. to be among the top countries in the field of aerospace by 2021*". The **Objective** of this project exceeds, and will exceed even more, the only field of aerospace. The results of Aerospace Projects will generate strikingly unexpected outstanding results in Project Management doctrine in other fields of application. For instance, GPS is a result of an aerospace project.

Projects' management in the U.A.E. will have much to expect from its unique involvement in aerospace activities where conditions are extremely tough. Coping with these will provide many innovative ways to manage regular projects on earth in a significantly better manner

- **Different Expos:**

Gathering people from different backgrounds in a common ground allow to get advantage of all the benefits of collective intelligence at a global level. U.A.E. invests heavily in expos, e.g. Dubai expo 2020. That will generate an unlimited number of benefits: **Objective approaches infinity**. For instance, expos increase startup incubation and establishment and revive the real estate sector

- **U.A.E. Happiness**

Certainly, machines and artificial intelligence gain more importance in modern life. However, **human innovation** is at the heart of all possible improvements. The care the U.A.E. provides to happiness is a major contribution to $\alpha_{\text{Sheikh Khalifa bin Zayed}}$ which will enable Emirati citizens throughout generation to give the best of themselves to innovate and propose best uses and practices according to their context and lifestyles

IV.APPLICATION: INNOVATION ASSESSMENT, BURJ KHALIFA

To show the practical and the applicable aspect of our research, we will use the -grading tool to assess the Project Management of a Burj Khalifa-like project, evaluating the introduction of **smart technologies based on artificial intelligence reducing the number of active employees to one by floor**. This is an example to get inspiration about the method and apply it in other contexts.

To apply our **novel approach in innovative technology introduction in Project Management**, we will make use of the following pieces of information/assumptions:

- Burj Khalifa construction cost is 1.5 Billion USD
- Burj Khalifa number of floors: 163
- Burj Khalifa floor total area: 3.3 Million square foot
- Burj Khalifa property sell price: 5000 AED per square foot
- Burj Khalifa construction time: 1325 days, which is equal to 3.63 years
- We assume the minimal lifetime of Burj Khalifa is equal to 100 years (according to benchmarks)

Using these smart technologies based on artificial intelligence which reduce the number of active employees to one by floor, we get the following:

$$N_{inov} = 163$$

The preliminary objective is to breakeven with regards to the construction cost:

$$\text{Objective} = 1.5 \text{ Billion USD} = 5.5 \text{ Billion AED}$$

Besides, from our work, we have the following:

$$\text{Objective} = N_{inov} \times a \cdot e^{\alpha N_{inov}}$$

is assumed to be equal to the normalized currency ():

$$a = 1 \text{ USD}$$

Therefore:

$$1.5 \text{ Billion USD} = 1 \text{ USD} \times e^{163 \alpha}$$

Then:

$$\alpha_{Burj\ Khalifa} = \ln\left(\frac{1500000000}{1}\right) \times \frac{1}{163} = \frac{21.12}{163}$$

$$\alpha_{Burj\ Khalifa} = 0.12$$

Hence, using the smart technologies based on artificial intelligence, **Burj Khalifa -grade is equal to 0.12**.

The value of 0.12 is **extremely high**. Actually,

Assuming the utilization of ordinary techniques and procedures, for instance, requiring 1 employee for 10 potential visitors to Burj Khalifa. Knowing that Burj Khalifa can accommodate 10000 people at once, then:

$$N = \frac{10000}{10} = 1000$$

Therefore, the new α will be equal to the following:

$$\alpha = \ln\left(\frac{1500000000}{1}\right) \times \frac{1}{1000} = 0.021$$

The new grade is **6 times lower than the one corresponding to the innovative technology introduction.**

Otherwise, to estimate the profit value thanks to α , which is a component of α_{Sheikh} , we can estimate **the impact on subsequent generations as follows:**

$$Price \times time_{operating\ a\ property} = Cost \times time_{construction}$$

$$Price = 3.3\ Million\ sq^2 \times 5000\ AED$$

$$Cost = 1.5\ Billion\ USD = 5.5\ Billion\ AED$$

Therefore:

$$time_{operating\ a\ property} = \frac{5.5\ Billion\ AED \times 3.63\ year}{3.3\ Million \times 5000\ AED} = 1.21\ year$$

Consequently, Burj Khalifa will be an innovation that bring income for:

$$lifetime - time_{operating\ a\ property} = 100 - 1.2 = 98.8\ year$$

For almost 100 years to come, Burj Khalifa will be a source of income free of cost for the upcoming generations thanks to the forward-looking investment corresponding to the second generation of founders of the U.A.E. (α_{Sheikh}).

V.CONCLUSION

Project Managers and Decision Makers find themselves in front of many questions to answer regarding the investment to engage and the gain to expect. Furthermore, not many countries, cities, and mega-projects' holders go for, what is seemingly, the most difficult choice to make: **invest heavily in innovation now to get**

excellent results in the future. We have proved using an easy-to-understand model that in the long term, innovation is the insurance to optimally reduce costs, and reach outstanding objectives depending on the chosen innovation. Finally, we provide a prominent real-world example: the U.A.E. Actually, thanks to **Ultra-Advanced Innovations**, which are inspired of forward-looking founders and leaders, the country made, and will continue to make, a significant progress in the most productive and strategic fields on a global level. Additionally, we ran numbers and applied our method to **Burj Khalifa, and to the potential application of smart technologies based on artificial intelligence in this edifice.** We demonstrated a Burj Khalifa-like project will have a high grade , and will be a source of income for almost the following 100 years.

REFERENCES

- [1.] S., H. “Problem-Solving and Operational Research Tools to optimize resource allocation”
- [2.] S., H., “OPEX reduction framework based on resource allocation optimization”
- [3.] www.rta.ae
- [4.] www.dhx.ae
- [5.] www.dewa.gov
- [6.] www.mrsc.ae
- [7.] www.dm.gov