# *An analytical study of lean management implementation on construction companies in Algeria*

## *دراسة تحليلية لتطبيق اللين مناجمنت في شركات البناء بالجزائر*

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***Abstract*****:** *Lean is a new management technique that has been successfully implemented in many countries to increase the probability of a project success. A questionnaire-based survey was used to elicit the attitude of stakeholders into 36 Algerian construction companies, towards factors affecting the performance of construction projects and investigating the perception and application of lean construction techniques and principles as an approach for improving performance of construction companies in Algeria.*

**keyword**: construction companies; performance; Lean management; ALGERIA.

**JEL classification code : XN1, XN2**

***ملخص:*** اللين هي تقنية إدارية جديدة تم تنفيذها بنجاح في العديد من البلدان لزيادة احتمالية نجاح المشروع هذا البحث هو أول دراسة في الجزائر تدرس فعالية تنفيذ اللين مناجمنت على **جودة** أداء شركات المقاولات الجزائرية. لغرض تحقيق الهدف من هذه المقالة ؛ تم استخدام استطلاع قائم على الاستبيان لاستنباط موقف أصحاب المصلحة في 36 شركة بناء بالجزائر ، تجاه العوامل التي تؤثر على أداء مشاريع البناء والتحقيق في تصور وتطبيق تقنيات ومبادئ اللين مناجمنت مقاربة لتحسين أداء شركات البناء في الجزائر

**الكلمات المفتاحية** : شركات البناء ؛جودة **الاداء** ؛ اللين مناجمنت ؛ الجزائر.

**تصنيف JEL : XN1، XN2**

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## 1. Introduction :

Despite the positive impact of the construction projects on achieving the objectives of social and economic development of countries, it is always followed by different challenges in which 70% of projects are exposed to time delay, 14% of projects risk to cost overruns, and 10% of projects' materil cost are wasted. According to world statistics in 2010, it was noticed that 45% of the world energy and 50% of the water have been consumed by the construction industry. Moreover, 23% of air pollution, 40% of water pollution and 40% of generating wastes are caused by construction projects. The main reasons of the previous problems are the unsustainable practice used in construction projects and the inappropriate approaches of handling the different types of wastes generated during construction projects. These challenges encouraged many countries to improve their construction practices by applying Lean construction.

Lean concepts are mostly evolved in Japanese industries, especially from Toyota. Lean Manufacturing is considered to be a waste reduction technique as suggested by many authors, but in practice Lean manufacturing maximizes the value of the product through minimization of waste. Lean principles define the value of the product/service as perceived by the Customer and then make the flow in-line with the customer pull and strive for perfection through continuous improvement to eliminate waste by sorting out Value-Added activity (VA) And Non-Value-Added activity (NVA). Hence, this paper aims at improving the performance and reducing waste of construction projects in Algeria by applying the appropriate Lean concepts.

## 2. Research methodology :

In order to achieve the aim of this paper, literature review was conducted and survey questionnaire, is developed to accomplish four objectives:

- Building a comprehensive background about the research topic through covering problems of the construction projects, waste in construction, and lean construction.
- Evaluating the impact of factors that affect project performance « cost, time and quality ».
- Investigating the perception and application of lean construction techniques and principles as an approach for reducing waste in construction; and
- Outlining research conclusions and recommendations for construction stakeholders and providing ideas for future research.

## 3. LEAN background :

In the hand , There are numerous problems facing the construction projects all over the world. They are famous for being over- widgets, late and burdened with scope creep. Many of the problems facing the construction, such as delays, over- budgeting and poor quality, have been extensively discussed in the literature,UK studies indicated that up to 30% of construction is rework, only 40–60% of potential labor efficiency, accidents can account for 3–6% of total costs, and at least 10% of materials are wasted. In fact, rework is one of the primary factors contributing to the Australian construction industry's poor performance and productivity (Love, Irani, & Edwards, 2003).

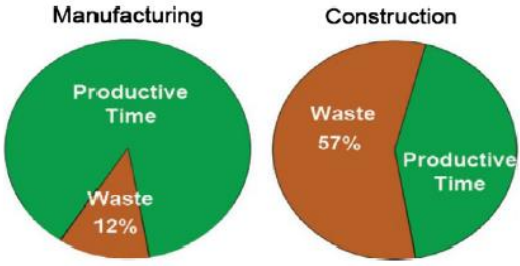
In general, a very high level of wastes/non-Value-Added activities are assumed to exist in construction and it is difficult to measure all waste in construction. (Love et al., 2003)

Similarly, a low priority is assigned to construction waste management and often fewer resources and incentives are made available to facilitate waste management (WM) Processes (Osmani, Glass, & Price, 2008), (Teo & Loosemore, 2001). As a result of waste generation, contractors have to bear the loss of profit due to the involvement of additional over Head costs and delays; loss of productivity due to additional time

involvement for cleaning (Skoyles & Skoyles, 1987); and considerable waste disposal costs (Lingard, Graham, & Smithers, 2000).

Waste measures are more effective to support process management, since they enable some operational costs to be properly modeled and generate information that is usually meaningful for the employees, creating conditions to implement decentralized control. Fig. 1 shows the waste percentages of time in manufacturing and construction.

**Figure 1:Waste percentages of time in manufacturing and construction**(Marhani, Jaapar, Bari, & Zawawi, 2013)




Source : marhani, jappar, bari and zawawi , 2013

Waste has been defined by Alarcon (Alarcón, 1997) as ‘‘Anything different from the absolute minimum amount of resources of materials, equipment and manpower, necessary to add value to the product.’’(Alarcón, 1997)

Therefore, construction, being a complex industry, has motivated researchers to introduce new approaches and solutions to relieve the chronic problems in the industry. In this respect, Koskela and Howell (2000) highlighted the reasons behind introducing new methods in construction management. In their researches, they criticized the current management practice and argued that this approach is inadequate and should be reformed to keep pace with the complexity and uncertainty of the projects (Howell & Koskela, 2000). They argued that traditional thinking of construction management focuses on conversion activities and does not pay attention to flow and value.

(Senaratne & Wijesiri, 2008). According to findings by Koskela (Koskela, 1992),these wastes in flow processes of construction such as 'non-conformance quality costs' consume 12% of total project cost; 'poor materials management' causes 10 - 12% of total labor cost; 'time used for non-Value-Adding activities' amounts to 2/3 of total project time; and 'lack of safety' amounts to 6% of total project costs Thus, the value hindrance by wastes in flow processes of construction is quite evident which, then, triggers the necessity to implement a concept such as Lean Construction like strategic. This philosophy aims to avoid waste of time, money, equipment, effort and improving value through employing and combining existing approaches such as Just in Time (JIT), Total Quality Management (TQM), time-based competition and concurrent engineering (Melles, 1997)Adopting the "Lean Production" philosophy is expected to bring a revolutionary change in the way of work in every industry. Some researchers believed that although lean production theory was established for manufacturing industry, the similarities between the construction processes and craft manufacturing make lean production theory very applicable to construction(Farrar, AbouRizk, & Mao, 2004).

In construction, lean production has been relatively and quickly adopted by contracting companies which are keen to reduce waste in their construction projects.

A study was done in Nigeria to evaluate the effectiveness of implementing some Lean Construction Techniques in construction of 80 housing units. These techniques include Last Planner, Daily Huddle Meetings, and Increase Visualization. Results showed improvements in time management that lead to many savings in the project cost. The project was completed in 62 days using lean techniques instead of 90 days.Another study took place to show how VSM can improve the performance of civil engineering projects by allowing the site management to visualize the flows of materials, resources and information. This was examined through the fixing of reinforcement in two bridge construction projects. The results showed improvements in

lead time, inventory level and cost by approximately 80% (Sachs, Magnusson, & Simonsson, 2012).

In a study conducted by salem 2006 (Salem, Solomon, Genaidy, & Minkarah, 2006) Lean assessment tool was utilized to assess the implementation of several Lean Construction techniques. The assessment tool evaluates six lean construction elements: last planner, increased visualization, huddle meetings, first- run studies, five S's, and fail safe for quality,2006). In the test study, the selected General Contractor agreed to implement and test 6 lean construction techniques on a parking garage project. Results of the study were tangible in that the project was under budget and three weeks ahead of schedule.(Salem et al, 2006).

To ensure that the expected benefits of applying lean thinking to construction projects are actually being delivered, evidence should be provided to the concerned stakeholders to encourage them to apply this new approach in Algeria.

## 4. Results of Data Survey Collection :

To achieve the goal of this research, a questionnaire was used into 36 companies of construction to investigate the main factors that influence the construction project performance and the employees 'understanding regarding the lean thinking/techniques in the ALGERIAN construction project.

The questionnaire is structured into three main sections as follows:

Section (A): is structured to investigate general information and background about the respondents' experience.

Section (B): is structured to identify the factors affecting the overall performance of the project in current practice.

Section (C): is structured to examine the respondents' awareness about lean techniques and their applications in the Algerian construction projects.

A questionnaire was conducted and sent to 36 respondents in different organizations. Only 20 out of 36 responded to the questionnaire. The

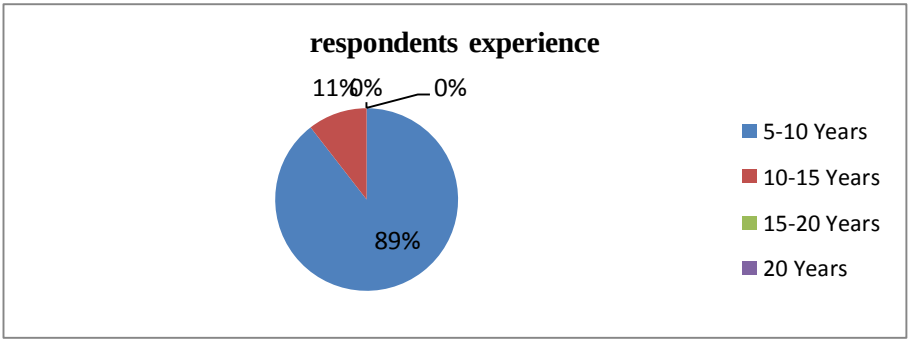
main purpose of this questionnaire is to measure the awareness of employees about Lean construction in Algeria.

## 5. Results discussion :

### 1.5. Section A: project information :

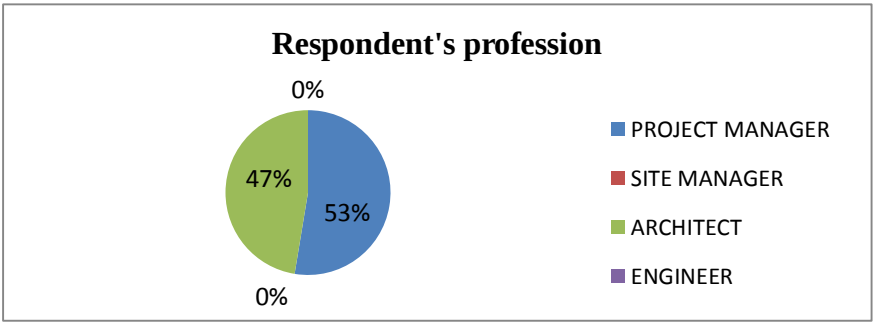
This section is structured to investigate general information about the project and background about the respondents' experience in construction companies. The experience of the respondents varied between 5 years' experience and above 20 as illustrated in figure 2 and 53 % of them have a position of project managers as shown in figure 3 All the projects were new buildings. Most projects values fall above than 10 Million DZD as illustrated Figure 4

**Figure2:respondentsexperience**



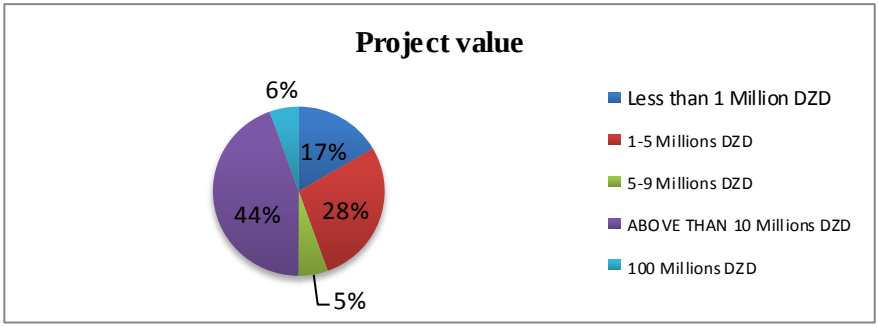

Source : author's traitment ,2019

**Figure3:Respondent'sprofession**




**Source: author's traitment ,2019**

*Figure 4:Project value*




**Source: author's traitment ,2019**

## 2.5. Section B: *Factors affecting project performance in construction projects in Algeria*

The purpose of section (B) is to identify the factors affecting the overall performance of the project in current practice. The impact of several factors on the project performance encountered the project manager in the operation phase. It shows the frequency of the factors impacting the overall project performance. These factors cause a lot of disruptions to the construction process.

Table 1 shows the frequency of the factors impacting the overall project performance.

**Table1 :The frequency of factors impacting the project performance in Algeria.**

| | Factors Impacting the project Performance | Cost | Time | Quality |
|---|---|---|---|---|
| 1 | Change orders by owner during construction (Variations) | **84,2%** | **68,4%** | **57,9%** |
| 2 | Rework due to errors during construction | **36,8%** | **78,9%** | **57,9%** |
| 3 | Poor site management and supervision by contractor | **68,4%** | **63,2%** | **57,9%** |
| 4 | Difficulties in financing project by contractor | **73.7%** | **78.9%** | **42.1%** |
| 5 | Poor communication and coordination by contractor with other stakeholders | **31.6%** | **84.2%** | **68.4%** |
| 6 | Ineffective planning and scheduling of | **52.6%** | **31.6%** | **100%** |

| | | | | |
|---|---|---|---|---|
| | project by contractor | | | |
| 7 | Poor qualification of the contractor's technical staff | **57.9%** | **47.4%** | **89.5%** |
| 8 | Mistakes and discrepancies in design documents | **78.9%** | **89.5%** | **78.9%** |
| 9 | late delivery of materials and equipment | **42.1%** | **84.2%** | **47.4%** |
| 10 | Inadequate details in drawings | **42.1%** | **73.7%** | **63.2%** |
| 11 | Complexity of project design | **57.9%** | **63.2%** | **57.9%** |
| 12 | Insufficient data collection and survey | **57.9%** | **73.7%** | **57.9%** |
| 13 | Unqualified workforce | **31.6%** | **78.9%** | **89.5%** |

**Source: author's traitment ,2019**

Respondents were asked to rank the factors, using a Likert scale (1-5), as either 'Very High (5)','High (4)', 'Average (3)', 'Low (2)', or 'Very Low (1)'. The following describes the major factors impacted the Cost, Time, and quality, as per the rankings made by the respondents. The major factors impacting the project performance are identified based on the following factors that its frequency of occurrence more than 50 %. Factors with total impacts of average level, high level and very high levels greater than or equal 50% of the total respondents of each factor.

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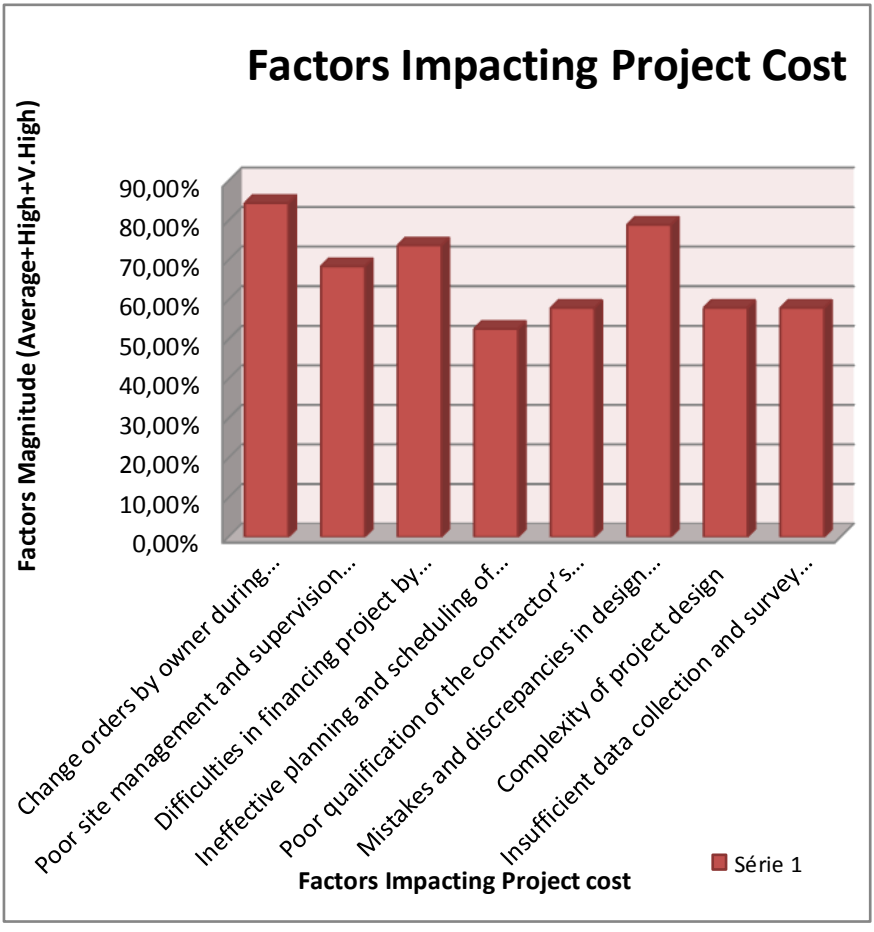
- **Main Factors Impacting project cost**

As shown in figure5 , the major factors that impact the project cost as per the fore mentioned criteria are (8 factors out of 13 factors):

- Change orders by owner during construction (Variations)
- Poor site management and supervision by contractor
- Difficulties in financing project by contractor

- Ineffective planning and scheduling of project by contractor
- Poor qualification of the contractor's technical staff
- Mistakes and discrepancies in design documents
- Complexity of project design
- Insufficient data collection and survey

**Figure 5: Factors impacting the project cost**




**Source: author's traitment ,2019**

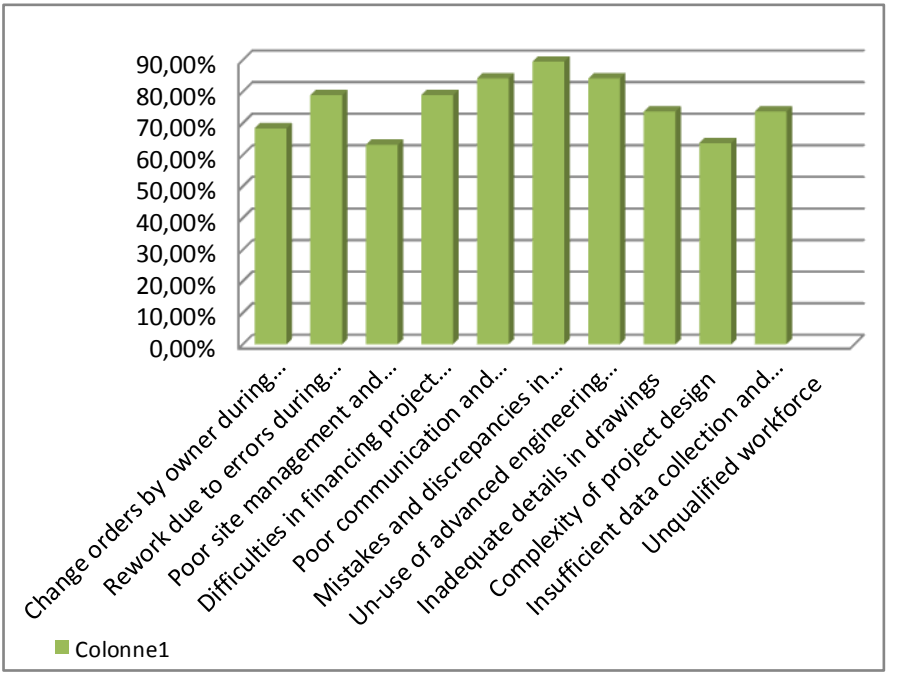
- **Main Factors Impacting project time**

For the purpose of this article, the main focus will be on the causes of project delay or the factors impacting the project schedule. The ranking

of the causes of time overrun from the Contractor's perspective. It can be concluded that more than 80% of the respondents believe that inadequate drawings, poor communication by contractor, change orders by owner, discrepancies in design documents, ineffective scheduling, and changes in material specifications during construction are the most factors causing delays and time overrun for a construction project. In the proposed framework, the focus will be in the aforementioned factors to show how using the lean concept can avoid such delays.

As shown in figure 6, the major factors impacting the project time as per the aforementioned criteria are (10 factors out of 13 factors):

**Figure 6:Factors Impacting Project Time**

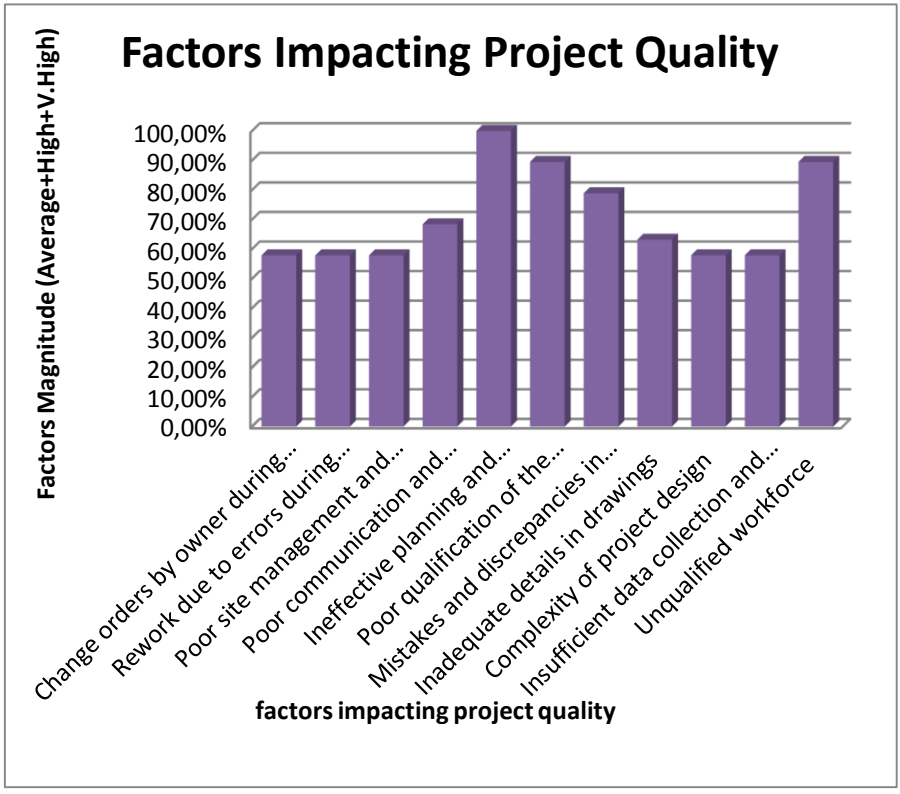



**Source: author's traitment ,2019**

- **Main Factors Impacting project quality**

As shown in factors):, the major factors impacting the project quality as per the aforementioned criteria are (11 factors out of 13 factors):

**Figure 7:Factors impacting project quality**




**source: author's traitment,2019**

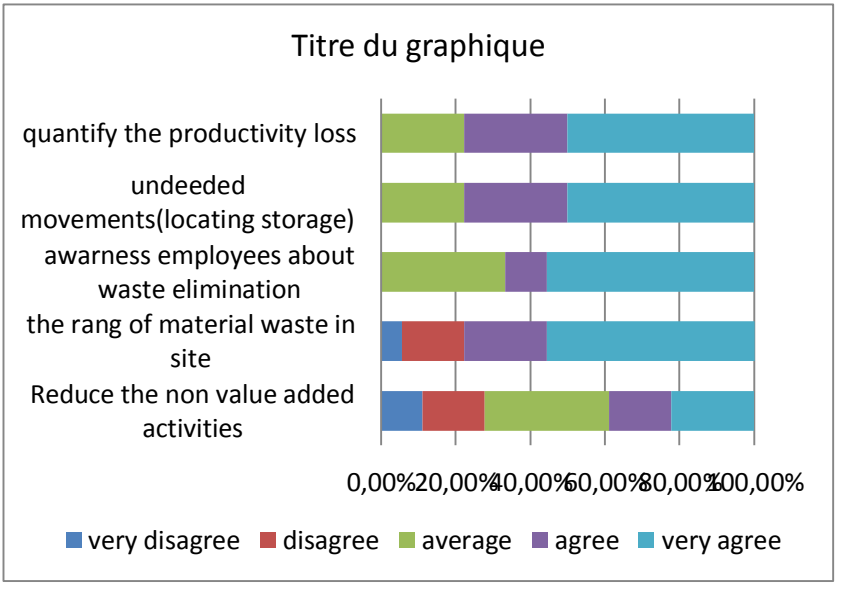
### 3.5. *Section C: Respondents' awareness about lean techniques and their applications in the Algerian construction project*

Section (C) Is structured to examine the respondents' awareness about lean techniques and their applications in the Algerian construction projects. The questions examined the different principles of lean to see the possibility of applying lean approach to construction projects in Algeria. The following principles were evaluated using a Likert - type scale from 1 (very disagree) To 5 (very agree).

### 3.5.1. Waste reduction*:*

Fig.8 shows the rating of each principle related to waste reduction in Algerian construction companies. It can be concluded that more effort should be done to increase the awareness of employees on site about waste reduction as 55% of the respondents believe that the people awareness about waste reduction is either low or very low. Also, more focus should be given to decrease the material waste on site as 75 % of the respondents believe it is either agree or very agree. The concern to reduce the non--- added value activities and undeeded movements (locating storage) should be improved. Also, the quantification of the material loss and productivity loss should be highly considered.

**Figure 8:Respondent's awaerness about waste reduction techniques and their applications in the algerian construction companies**

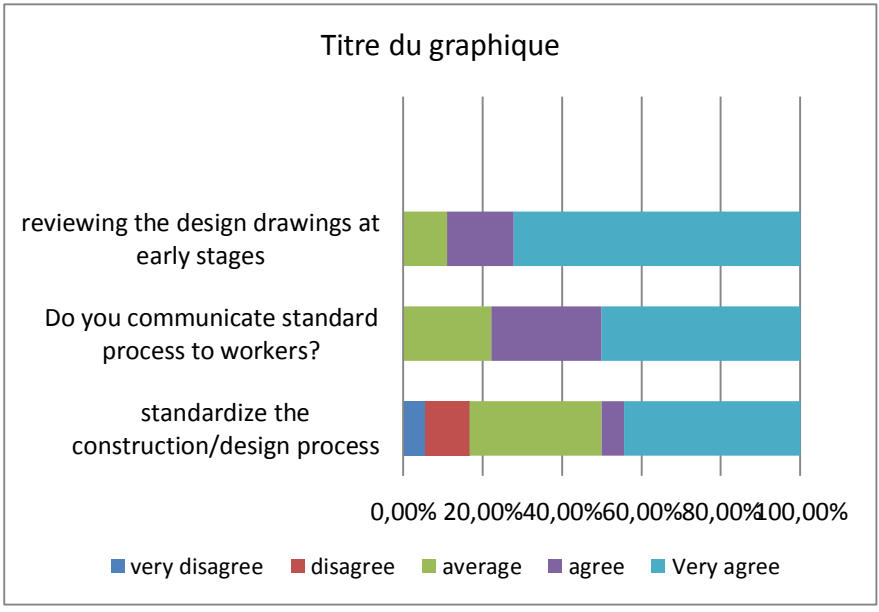



**source: author's traitment,2019**

### 3.5.2. Reduce Variability:

Fig.9 shows the rating of each principle related to reduction of variability. It was concluded that much concern was given to process standardization in organizations which reflects their potential for adopting some of the lean construction techniques.

**Figure 9:Respondent's awaerness about reduce variability techniques and their applications in the algerian construction companies**

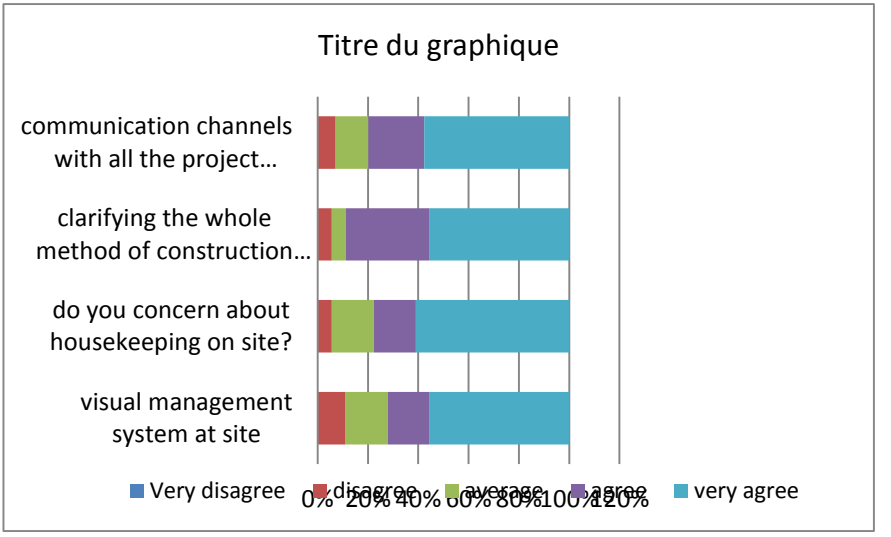



**source: author's traitment,2019**

### 3.5.3. Increase transparency :

Fig.10 shows the rating of each principle related to increase transparency ,so questions measured the awareness of the respondents about increase transparency . It can be concluded from the responses that the awareness of 57,6% of the respondents is very agree while more than 80% is agree for using increase transparency techniques as shown in figure 10.

**Figure 10::Respondent's awaerness about increase transparency techniques and their applications in the algerian construction companies**

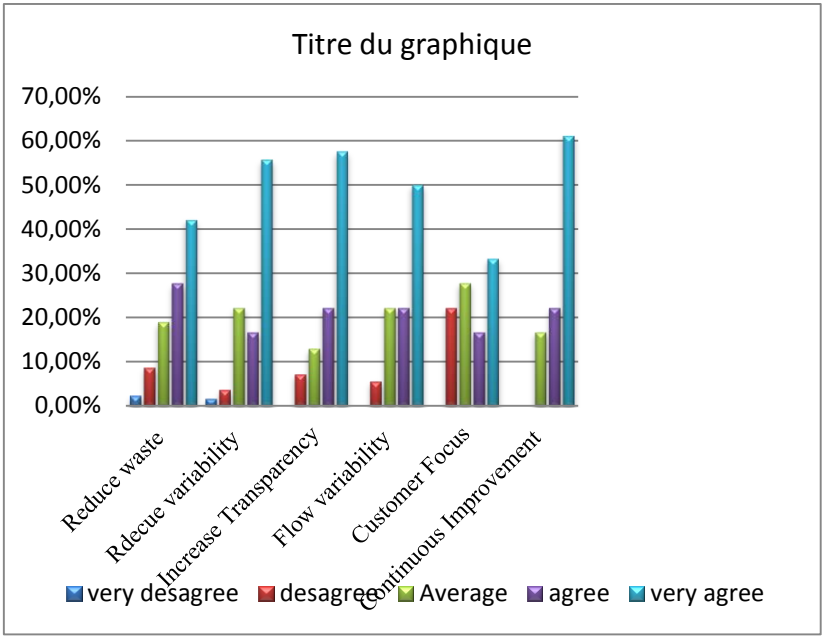



**source: author's traitment,2019**

### 3.5.4. Respondents' awareness about Lean techniques and their Applications in the Algerian construction companies :

Figure 11 shows the rating of each principle related to Respondents' awareness about Lean techniques and their Applications in the Algerian construction companies.

**Figure 11:Respondents' awareness about Lean techniques and their Applications in the Algerian construction companies**




**source: author's traitment,2019**

Figure 11 shows the rating of each principle related to Respondents' awareness about Lean techniques and their Applications in the Algerian construction companies. It can be concluded that more efforts should be done to increase the awareness of employees on site about waste reduction as 69,85% of the respondents believe that the people awareness about waste reduction is either low or very low. Also, it was deduced that much concern was given to process standardization within the projects in the same organization which reflects their potential for adopting some of the lean construction techniques as 72,4% of the respondents believe it is high or very high. The concern to increase the process visualization on the site should be improved using visual management tools, signs only as more than 79% of the respondents are not deploying visual management in their projects. Also, the quantification of the material loss and productivity loss should be

highly considered. Moreover, the concept of flow variability needs improvement to be more efficient because the just-in-time method is barely used on a construction project in Algeria as well as the concept of work flexibility. On the contrary, there is decent potential for using the schedule look-ahead to improve the process work flow as more than 52% of respondents are almost using this technique. Furthermore, it can be concluded that there are huge attention and consideration for the customer focus approach in most of the projects, from the responses that the awareness of 50% of the respondents is high or very high while 22,7 % is low .Finally , there is noticeable potential for adopting most of the techniques related to the continuous improvement .more than 83% answer with agree or very agree. Thus result gives indication that these techniques are either not efficiently implemented or not totally implemented in the Algerian construction projects and with some more effort their efficiency will be increased. Therefore, these techniques should be examined in Algeria to see its impact on the project performance,

## 6. Conclusion :

The construction sector is considered one of the sectors worldwide. It plays a major role towards achieving the objectives of sustainable development nationally and internationally. However, the construction sector is blamed for its negative impact on the environment. One of the pressing issues is the waste generated in construction projects.

this paper aimed to investigate the role of Lean Construction concept towards reducing construction waste in the Algerian construction projects. A questionnaire-based survey was used to elicit the attitude of project managers, architect, site supervisor and engineers towards factors affecting the performance of construction projects and investigating the perception and application of lean construction techniques and principles as an approach for reducing waste in construction projects in Algeria. 36 questionnaires were distributed 20 questionnaires (56%) were returned.

Results indicated that the most important factors agreed with respondents as the main factors affecting the performance of construction

projects in Algeria were: Change orders by the owner during construction (Variations), mistakes and discrepancies in design documents and unqualified workforce.

On the other hand, the lean principles and techniques are either not efficiently implemented or totally implemented in the Algerian construction projects and with some more effort their efficiency will be increased. Therefore, these techniques should be examined in Algeria to see its impact on the project performance.

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