The benefits of applying project management methodology on project delay: A study in construction projects in Iraq

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Abstract. The purpose of the research is to look after establishing an appropriate solution for the problems in Iraqi construction projects which have been affected in the last years. It aims to evaluate the problems and then fix and/or at least mitigate them properly. It takes a construction project in the petroleum industry as a case study so that it can identify the realistic causes of project problems. In regard to research methodology, this research remarks on the root causes of project delay in the previous studies in Iraq, Oman and Qatar that is realised as a secondary data. Also, primary data is conducted to collect up to date information by using questionnaire. It exposes the main problems in Iraqi construction projects which are project delay, change in design, plan, scope and specifications and project cost overrun. The root cause of project delay is to accept the lowest bidding prices from the contractors and financial difficulty from the contractors. To improve the project management implementation that may require applying one of the project management methodologies in Iraqi construction projects. This research recommends applying PMBoK because it could deal with the project schedule which is the important thing recently and with cost, quality, communication and stakeholder.

1. Introduction
To lead any project successfully, three terms must be considered which are quality, cost and time. The three aspects realised as an Iran triangle in accordance with the project management consideration [1]. The parameter is to evaluate the project success factors against the actual the project outcomes in order to expose the deviation within the project performance assert that the construction project can be realized as successful, once it is finished on budget and time with the required quality [3]. The related parameter relies on the desire of project stakeholders thinking and requirements [2]. This research takes a construction project in the petroleum industry to specify and evaluate the realistic causes of project problems and as a case study. The petroleum industry is one of the most significant industry in Iraq. [4] claim that Iraqi Annual Federal Budget depends on petroleum revenue by 93% and 92% in 2013 and 2014 respectively. The percentage has increased to be 95% in 2015 as reported by Faucon, Kent and Said [5]. To fix the problems in Iraqi construction projects that needs at first to identify the root causes of the problems. So Badiru and Osisanya [6] state that “Projects in the oil and gas industry are characterized by huge investments, massive interfaces, and complex engineering endeavours”; then, applying an appropriate project management processes are required because of the complexity and size of the petroleum industry projects. In certain case, the lack of management and investment are the most problems in Iraqi projects as a general. Likewise, the market need for petroleum is predicted to increase up to fifty percent in 2030 that based on the petroleum demand since 2005 [6].
The cap of previous researches is captured because no improvement has been conducted yet in Iraqi construction projects and it is new idea to find a new mitigation. The idea has come out since International Oil Company(s) (IOC) invest the Iraqi petroleum fields. [7] states that IOCs have been invested the petroleum fields in Iraq since 2009 in order to increase the petroleum exportation to be ready for the execution stage in 2017 but, the plan has not been succeeded to be on time due to the limitation of infrastructure in Iraqi petroleum facilities. Furthermore, Table 1 demonstrates the proportion shares of IOCs with National Oil Company (NOC) in Iraq. In certain case, 85 percent of oil reverse are placed in the south of Iraq.

| The Field Name | Original Partners                  |
|---------------|-----------------------------------|
| Rumalia       | BP 38%, CNPC 37%                  |
| Zubair        | Eni 33%, OXY 23%, KOGAS 19%       |
| West Qurna I  | Exxon 60%, Shell 15%              |
| West Qurna II | Lukoil 85%, Statoil 15%           |
| Majnoon       | Shell 60%, Petronas 40%           |
| Halfaya       | CNPC 50%, Petronas 25%, Total 25% |
| Gharraf       | Petronas 60%, JAPEX 40%           |

The deficient infrastructure in Iraqi petroleum fields minimise the opportunity of increasing the petroleum exportation. The plan of increasing the petroleum exportation would be considered as a project that is based on the illustration of A Guide to the Project Management Body of Knowledge. It says that project is “a temporary endeavour undertaken to create a unique product or service” [9]. This paper will look after the project problems in regard to project schedule and then find a solution.

The research objectives are as follows:
- What are the causes of delays in construction projects in Iraq?
- What is the project management methodology?
- Which is an appropriate project management methodology for construction projects?
- Does the project manager using project management methodology in Iraq?

2. Literature Review

It is usual to observe that the construction projects face slippage in schedule and cost. In contrary the project success is to finish the project on time, cost, with specifications [10]. The correlation between project success and management performance “Is hard to model involving complex constructs often with insufficient accuracy and detail leading to findings that are fragmented and incomplete” [11]. The definition of time-schedule is that “Are often used interchangeably, this is how long it will take for the contractor to complete a task” [12]. The delay is an act or event that extends the time to complete or perform an act under the contract [13]. The project success factors are to achieve the project [14]:
- On time;
- On cost;
- With desired execution and specification;
- With satisfying the stakeholders of the projects like the end-users;
- With approving the change of project scope by the end-users and the project manager;
- “Without disturbing the main workflow of organization”; and
- “Without changing the corporate culture”.

Table 1. The percentage shares between IOC and NOC in Iraq [8].
Understanding the reason behind the project slippage in the schedule (project delay) that might require to identifying the root causes of project delay. To do so, it should look at the previous researches. [15] claim that 70% of construction projects in Saudi Arabia are finished with slippage in the schedule. Khaleel and Hadi [16] conduct a study in Iraq on the project delay. They conclude the top five root causes of delay in Iraqi construction projects: (1) financial difficulty with the contractors, (2) shortage of skilled manpower, (3) change in economic conditions, (4) consultant slack of judgment and experience, (5) unavailability of equipment. Alnuaimi and Mohsin [17] conduct a research in Omani construction projects. They highlight the most frequent root causes of project delay as follows (1) lack of experience in project construction; (2) shortage in materials; (3) change in design; (4) poor planning construction work; and (5) poor site management. Finally Mohamed, Hassan and Farrell [18] report the causes of project delay in Qatar: (1) long response from utility agencies; (2) major change in design during construction; (3) ineffective planning and scheduling; (4) ineffective control of progress; and (5) changes in the scope of the project are the most serious root causes of project delay.

3. The justification of applying Project Management Methodology

These root causes of delay above would have a high impact on the construction projects unless applying project management methodology (PMM) within the project lifecycle. The PMM may look after to prevent and/or at least mitigate problems in project lifecycle. They could assist to decrease the risk of project slippage in the schedule essentially. PMM is “An application of knowledge, skills, tools and techniques to meet or exceed the project requirements” [19]. It is “A set of processes, methods and tools for achieving a specific goal in project management” [20].

This section aims to justify the success of using PMM within project lifecycle through demonstrating the benefits of applying PMM. [19] conclude the benefits are (1) the project objectives can be agreed; (2) PMM can be handled and distributed of project reports easily; (3) easy to review the project, according to its objectives; (4) the transparency in project management practices; (5) success in project risk management; (6) handling the problems and the complexities of the project; (7) easy to measure completion percentage and to improve control and command of the project; (8) regulating the inventories of stakeholders in various phases of the project; (9) measurement of accomplishment against plans; (10) improved estimating probability for future planning; and (11) giving an indication when objectives are not going to be met.

There are various PMMs that could be useful to be applied in construction projects. It is intended to illustrate the description, advantages and disadvantages of 20 PMMs (see Appendix A). Subsequently, based on that three PMM are justified and could be applied in the construction projects which are PMBoK, PRINCE2 and Scrum. Then, the concept is to choose just one PMM to be applied in accordance with the most appropriate PMM to the construction projects in Iraqi petroleum industry. Although they are demonstrated in depth in Appendix A, herein are more justification for just the three ones as follows:

3.1. PMBoK (Project Management Body of Knowledge)

The main aim of PMBoK is to provide a guide for the project managers to implement projects successfully (Project Management Institute 2013). [6] say that the benefits of using PMBoK in Brutus Project, that has executed by Shell Company, are (1) providing a better communication between project teams; (2) providing a work breakdown structure; (3) providing a new system of financial software; (4) the implementation approach has given the project team new perception and vision to implement the project objectives and reinforced the fundamental principles of project management; (5) improving expectations of the customers; (6) improving the organisation financially; help to identify the project risk; (7) help to estimate the project time; and (8) help to estimate the project cost.

3.2. Scrum

Scrum is useful to be used to enhance the end user’s satisfaction [21]. It enhances continual planning which has a higher priority than plan and also the planning, that is not being stopped till obtaining the customer satisfaction, works to reduce the risk of the project [21]. [22] suggest that “Scrum has great
potential in the design and planning departments of construction firms.” Scrum and agile software development look after to present better communication, increase productivity and minimize risk [9].

3.3. PRINCE2 (PRoject In Controlled Environment)
PRINCE2 is “Method of project management structured based on experience gained in thousands of projects and contributions of numerous sponsors, managers, project teams, academics, trainers and consultants. It becomes a practical reference, possible to apply to any type of project, scale, organization, geography or culture. it has become widely recognized as one of the methods of project management more accepted” [23]. The last version of PRINCE2 is intended to have more flexibility; to ensure meeting the customers’ expectations and providing the easiest way to make the change in the product [24]. The main approach of PRINCE2 is to focus on the business case, organizational structure and guide the project team [3]. It could provide a good management practice by adopting six aspects which are cost, quality, scope, benefit, timescale and risk [25].

4. The disadvantages of Project Management Methodology
[26] exposes the disadvantages of applying PMMs as follows:
- They are required many documentations for instance using policies and checklists; and
- more constraints.

5. The Project Management Methodology Choice
It is optional for an organisation or project manager to pick up an appropriate PMM or what is fit with their business and culture. However, this paper is suggested to choose PMBoK, according to the Cons and Pros in Appendix-A and the above benefits. Importantly PMBoK focuses on ten knowledge area (see Figure 1) [27], [28] and [29]:
Figure 1. The ten knowledge areas of PMBoK [29]

The most interesting knowledge area for this paper is project time management (PTM). If it has been used properly, PMT would be fixed the delay in the Iraqi construction projects.

6. Methodology
This paper is examined the root causes of project delay in three countries which are Iraq, Oman and Qatar because they have numerous similarities for instance culture and project environments. The identification of root causes in the three countries is considered secondary data. Thus, this gives a good insight to evaluate the root causes of project delay in the Iraqi construction projects by conducting primary data.

The primary data are conducted by using a questionnaire (Survey) with the excellence department managers, project managers and engineers. The questionnaire consists of four questions; the outcomes of first and second questions that have been discussed in the previous paper which was titled “The causes of project delay in Iraqi petroleum industry: A case study in Basra Oil Company”. However, the other two questions are new that will be revealed in detail. The questions of the questionnaire are as follows:
1. What are the main problems in construction projects in Iraqi?
2. What are the root causes of delays in Iraqi construction projects?
3. Do you know what a Project Management Methodology is?
4. Which Project Management Methodology you have heard or used?

The data are collected from 33 respondents who work as an engineer as client, contractor and consultant. Partial of these data were discussed widely in previous research to the same authors of this paper. As mentioned, the related data are placed in the main body of this paper. The data are analysed by using Statistical Package for Social Science computer software version 25 (SPSS 25) as a tool to analyse the questionnaires sufficiently. SPSS 25 assist to display the ranking of the evaluated questions that are asked to the respondents. The analysed data have relied on the Mean of each response. [30] states that the mean is a point that is located in between of distribution responses. The data were collected by using the Bristol Online Survey (BOS).

7. Results and Data Collection
This section will look after to answer four questions. These four questions are asked to be evaluated by the respondents in the questionnaire. The most significant problems in construction projects in Iraq are project delay (project time over run) and followed by Change in Design, Plan, Scope and Specifications. The answer is prioritised in order from 1 to 7 for the first question (see Table 2).

| Ranking | The Main Problems                                      | Mean  |
|---------|--------------------------------------------------------|-------|
| 1.      | Project time overrun                                   | 3.85  |
| 2.      | Change in design, plan, scope and specifications       | 3.48  |
| 3.      | Projects cost overrun                                  | 3.45  |
| 4.      | Poor communications between the client/owner, contractor and consultant | 3.42  |
| 5.      | Conflict between the contract, the scope of work, drawings and specifications | 3.39  |
| 6.      | Poor Project management                                | 3.22  |
| 7.      | Quality defects                                        | 2.94  |

The respondents of questionnaire evaluate 20 root causes of project delay. The ranking of 20 root causes of project delay as demonstrated in Table 3 below. Table 3 expresses the priority of the root causes of project delay from 1 to 20. The most serious ones are from 1 to 5.

Table 2. The main problems in Iraqi construction projects

| Ranking | The Root Causes of Project Delay                        | Mean |
|---------|--------------------------------------------------------|------|
| 1.      | Accept the lowest bidding prices from the contractors  | 4.3  |
| 2.      | Financial difficulty from the contractors              | 3.94 |
| 3.      | Using traditional paperwork more than software programmes | 3.94 |
| 4.      | Official and unofficial Holidays                       | 3.91 |
| 5.      | Poor project management                                | 3.79 |
| 6.      | Delay in Importing materials                           | 3.64 |
| 7.      | Inadequate number of staffs working with contractors   | 3.61 |
| 8.      | Mistakes in estimating project duration                | 3.58 |
|   |   |
|---|---|
| 9. | Delay in decision-making from the client | 3.48 |
| 10. | Inadequate the number of Contractors, sub-contractors and vendors that have a good experience | 3.48 |
| 11. | Change time-schedule | 3.44 |
| 12. | Change in design, specifications and scope of work | 3.24 |
| 13. | Inadequate number of staffs working with client | 3.19 |
| 14. | Shortage in materials | 3.06 |
| 15. | Change the project management strategy and methodology by the clients | 3.03 |
| 16. | Poor communication between project parties | 2.97 |
| 17. | Complexity in Design | 2.91 |
| 18. | Mistakes in designs, specifications and drawings | 2.88 |
| 19. | Delay in Payment by the client | 2.82 |
| 20. | Weather conditions | 2.61 |

The third question is demonstrated that 57.6% of the respondents have idea of what a PMM is. While, 42.4% of the respondents have no idea about PMM (see Figure 2).

![Figure 2. The percentage of the respondents who know project management methodology](image)

The answer of four question shows that the respondents, who know of what PMM is, are asked this question. They pick up PMBoK (42.9%), PRINCE2 (14.3%), Waterfall (7.1%) and Six-Sigma (see Figure 3).
8. Discussion
This section strives to discuss the research objectives in results and data collection against the information in the literature review. In order to produce a vital research with valuable information that really help to revoke the delay in the construction project in Iraq.

8.1. What are the main problems in construction projects in Iraqi?
The highest risk in construction projects in Iraq is project delay (project time overrun) as stated in the data collection and results. Change in design, plan, scope and specifications and project cost overrun are evaluated to be problems in Iraqi construction projects. In term of project delay, Assaf and Al-Hejji 2006 agree that 70% of projects in Saudi Arabia have been delayed as indicated in literature review section. So, the concept of this paper is to focus on the significant problem that is realised as a severe problem in construction projects in Iraq.

8.2. What are the root causes of delay in Iraqi construction projects?
Twenty root causes of project delay are piloted to the respondents in order to be evaluated based on the respondents’ experience and knowledge. They acknowledge that by answering the questions logically. The most significant root causes of project delay is to accept the lowest bidding prices from the contractors. It is not revealed by literature review section however the author has used a brainstorm to highlight the current root causes in Iraqi construction projects therefore, it is considered a new issue. The most significant causes of project delay partially differentiate with the previous studies which are review in the literature review section. Table 4 shows the status of 20 root causes of project delay in Iraqi construction projects.
### Table 4. The status of root causes of project delay

| No. | The Root Causes of Project Delay                                      | Status     |
|-----|-----------------------------------------------------------------------|------------|
| 1.  | Accept the lowest bidding prices from the contractors                 | New issue  |
| 2.  | Financial difficulty from the contractors                             | New issue  |
| 3.  | Using traditional paperwork more than software programmes             | New issue  |
| 4.  | Official and unofficial Holidays                                      | New issue  |
| 5.  | Poor project management planning                                      | New issue  |
| 6.  | Delay in Importing materials                                          | New issue  |
| 7.  | Inadequate number of staffs working with contractors                  | New issue  |
| 8.  | Mistakes in estimating project duration                               | New issue  |
| 9.  | Delay in decision-making from the client                              | New issue  |
| 10  | Inadequate the number of Contractors, sub-contractors and venders that have a good experience | New issue  |
| 11  | Change time-schedule                                                  | New issue  |
| 12  | Change in design, specifications and scope of work                    | New issue  |
| 13  | Inadequate number of staffs working with client                       | New issue  |
| 14  | Shortage in materials                                                 | New issue  |
| 15  | Change the project management strategy and methodology by the clients | New issue  |
| 16  | Poor communication between project parties                            | New issue  |
| 17  | Complexity in Design                                                  | New issue  |
| 18  | Mistakes in designs, specifications and drawings                       | New issue  |
| 19  | Delay in Payment by the client                                       | New issue  |
| 20  | Weather conditions                                                    | New issue  |

8.3 Do you know what a Project Management Methodology is? Which Project Management Methodology you have heard or used?

One the first hand, according to data collection and analysed data, 57% of total respondents (19 out of 33) have heard about PMM. However, these people have never used PMM in the construction projects in real life. It might not be reasonable for the respondents to evaluate the PMM because no idea has been notified about PMM. This is considered a research limitation.

On the other hand, the section of justification for applying the PMM shows the ability of these PMM in order to solve project problems and the benefits of PMMs. Some of these benefits are

1. Providing better communication between project teams;
2. Providing a work breakdown structure;
3. Providing a new system of financial software;
4. The implementation approach has given the project team new perception and vision to implement the project objectives and reinforced the fundamental principles of project management;
5. Improving the expectations of the customers;
6. Improving the organisation financially; help to identify the project risk;
7. Help to estimate the project time; and
(8) help to estimate the project cost.

However, the disadvantages of PMM are
1. They are required many documentations for instance using policies and checklists; and
2. more constraints.

Therefore, if making a comparison between the benefits of PMMs versus the disadvantages, the logic absolutely could stand beside the benefits of PMM. The reason being is that it is wise to conduct when the project manager uses the documentations. Consequently, the project will be completed with no or less slippage in the schedule, cost and quality. In term of constraint, it may be a reason for why the constraints make the project performance in accordance with a plan and appropriate steps.

9. Conclusions

In summary, the concept of research has come out with the delay on building the infrastructure of fields in the Iraqi petroleum industry. This paper has taken Iraqi petroleum industry due to its significant impact on the Annual Federal Budget. Iraqi Annual Federal Budget relies on the petroleum revenue by 95% in 2015.

The first question in the questionnaire was that what are the main problems in construction projects in Iraqi. The respondents have evaluated seven project problems. The highest problems in the Iraqi construction projects is project delay and then followed by change in design, plan, scope and specifications and cost overrun.

The second question is what the root causes of delay in Iraqi construction projects are. The top five root causes of delay in construction projects in Iraq are:
1. Accept the lowest bidding prices from the contractors;
2. Financial difficulty from the contractors;
3. Using traditional paperwork more than software programmes;
4. Official and unofficial Holidays; and
5. Poor project management planning.

While, the third question is that do you know what a Project Management Methodology is. The answer to this question is that 57% of respondents who know the PMM. While the last question is that which PMM you have heard or used. They answered that the respondents just heard about PMBoK, PRINCE2, Waterfall and Six-Sigma however they have never used any PMM in real project.

To handle the root causes of delay in the construction projects in Iraq that would need to apply one of the PMMs as mentioned in Appendix-A which has been justified to select three PMMs only (PMBoK, Scrum and PRINCE2). The final choice is made on PMBoK because it could deal with a project schedule, cost, quality, stakeholder, communication, risk, scope and human resource. This paper has taken a great chance in order to correlate between project slippage in schedule and the PMM. The brief advantages of PMBoK are:
1. providing better communication between project teams;
2. providing a work breakdown structure;
3. providing a new system of financial software;
4. the implementation approach has given the project team new perception and vision to implement the project objectives and reinforced the fundamental principles of project management; and
5. improving the expectations of the customers.

Furthermore, PMBoK and/or PRINCE2 could establish a roadmap for the project(s). This would assist the project manager to go through multi-steps and processes in the roadmap to achieve the project goal successfully with no or less project slippage in the schedule, cost and quality.

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### Appendix A. The Descriptions, Advantages and disadvantages of 20 project management methodologies

| S/No | PM Methodology            | Description                                                                 | Advantages                                                                 | Disadvantages                                                                 |
|------|---------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| 1.   | Agile                     | “An iterative and incremental-evolutionary approach to software development which is performed in a highly collaborative manner by self-organizing teams within an effective governance framework with ‘just enough’ ceremony that produces high-quality solutions in a cost effective and timely manner which meets the changing needs of its stakeholders” [31]. | 1) Have a flexibility to be used; 2) Focus on engaging the project stakeholders; 3) An Agile approach provides a unique opportunity for clients to be involved throughout the project; and 4) Look after to satisfy the project stakeholders [31] and [32]. | 1) It could have the massive hands-on project approach; 2) It has no control on defining the project cost and time; and 3) It can’t provide a potential for the new users or customers who need to track the project documentations [31] and [32]. |
| 2.   | Waterfall                 | A development method that is linear and sequential. Waterfall development has distinct goals for each phase of development. Imagine a waterfall on the cliff of a steep mountain [33]. | 1) The end outcome and goal could be determined early; 2) Provides well communication and transferring; and 3) Provides clear understanding structure [31] and [33]. | 1) It can’t deal with the project deviation and variation; 2) It becomes complicated when the change is raised in the project; and 3) Takes time in order to test the project even after its completion [31] and [33]. |
| 3.   | PRINCE2                   | “This methodology is also known as ‘PRojects IN Controlled Environment that is the planning, delegating, monitoring and control of all aspects of the project and the motivation of those involved to achieve the project objective within the expected performance targets” [24]. It is currently used in various organisations as part of analyzing project risks management [35]. | 1) It is suitable for any business and project; 2) Provides a good control on project; and 3) Meets the project end users [24] and [34]. | 1) Takes time to adjust the project once the change is raised; 2) It is not deal with time schedule; and 3) It is not suitable to the small activities [24] and [34]. |
| 4.   | Critical Chain Project Management (CCPM) | “The critical path method is an essential tool for project planning, control, and scheduling”. It is named path because sequence of tasks. It is the longest path in project time-schedule must be finished on time, otherwise the entire project will be slippage in schedule [35] and [36]. | 1) Provides a well allocation works to the project team; 2) Makes and provides clear dependencies between the project tasks; and 3) Good organizer for complex and large project [35]. | 1) It is complicated for small projects; and 2) Thousands of tasks and dependencies links together in complex and large project. They should be divided into small tasks [35]. |
| 5.   | Critical Path Method (CPM) | The critical path method is an essential tool for project planning, control, and scheduling. It is named path because sequence of tasks. It is the longest path in project time-schedule must be finished on time, otherwise the entire project will be slippage in schedule [35] and [36]. | 1) Provides a well allocation works to the project team; 2) Makes and provides clear dependencies between the project tasks; and 3) Good organizer for complex and large project [35]. | 1) It becomes bigger and incomprehensible in term of chart when the project is big than comprehensive. 2) It can’t provide comprehensive information about project recourses. 3) When it is printed out on paper, it is no possible to carry it in site once the project size is big. Likewise, it is hard to be tracked on computer [35] and [36]. |
| 6.   | Event Chain Methodology (ECM) | “A practical schedule network analysis technique as well as a method of modeling and visualizing of uncertainties. Event chain methodology comes from the notion that regardless of how well project schedules are developed, some events may occur that will alter it. Identifying and managing these events or event chains (when one event causes another event) is the focus of event chain methodology” [37] and [38]. | 1) It enables managers to examine the relationship between tasks and risks. This creates more realistic projects; and 2) a stochastic modeling technique for schedule risk analysis [37] and [38]. | 1) Project managers sometimes might not remember to identify the external events such as external risks; and 2) Defining distributions is not a trivial process [37] and [38]. |
| 7.   | Extreme Programming (XP)  | “Extreme programming (XP) is a software development method originally created by Kent Beck and defined in his book Extreme Programming Explained, published in 1999. XP focuses on programming techniques, communication and teamwork. The methodology contains a body of practices, many of which have been incorporated into what is today considered agile software development practices” [39]. | 1) It has simplicity; 2) It is well used for communication and feedback; and 3) Suitable for small projects with significant motivated workers [32], [39] and [40]. | 1) When people focus too much on the processes, other might not find these processes structured and focused; 2) Rather than on design XP focuses on the task-code; and 3) Lack of defect in documentation causes bugs in the future that might be always happened [32], [39] and [40]. |
8. Kanban

“Kanban is a lean approach developed in the automotive industry as a mechanism to pull materials and parts throughout the value stream on a just-in-time basis. In Japanese, the word Kanban means ‘card’ or ‘sign’ and is the name given to the inventory control card used in a pull system.” Kanban system is just one of the tools and techniques used in lean manufacturing besides other techniques like Quality Circle, 5S Housekeeping, and continuous improvement and many others” [41] and [42].

1) It is used as a strategic operational decision to be used in the production lines;
2) It assists to improve the productivity of company and reduce waste in production too;
3) It is an event-driven rather than time-boxed [41] and [42].

1) Sometime its team makes the board over-complicate; and
2) Lack of time-scheduling because there is no timeframe [41] and [42].

9. Adaptive Project Framework (APF)

“The adaptive framework is embedded in strategic management documents to scale suitable agile methodologies on a long-term basis” [43].

1) It is a good approach when the project scope and goal are defined;
2) It is flexible and too easy to the users; and
3) If the resources have been stated clearly, it could be considered straightforward to know the roles and responsibilities of project team [43] and [44].

1) It might cause slippage in project schedule and cost Due to its flexibility;
2) Higher participations and expectations; and
3) Poor control on project [43] and [44].

10. Lean

“It is a set of tools that assist in the identification and elimination of waste that might improve quality as well as production time and cost” and “Lean means manufacturing no waste. Waste, that means “muda” in Japanese language, has seven types: waste from overproduction, waste of waiting time, transportation waste, inventory waste, processing waste, waste of motion, and waste from product defects” [43].

1) Increase in quality; and
2) Easier to control and monitor [43].
3) It depends on decision-making quickly; and
2) The project is reliant completely on team [43].

11. PRiSM

It is a practical and experimental process-oriented supporting, environment, methodical and execution of software process models [45].

1) Displaying a serious execution about eco-ideals and reap the benefits of reduced energy, waste management and distribution costs
2) One source of data entry.
3) Efficient transfer of data between companies and organizational sections and units [45].

1) It can’t work independence. The level of the organisation requires to be on board with sustainable principles.
2) High price to be purchased and implemented.
3) needs customization [45].

12. Rational Unified Process (RUP)

“It is a process framework developed by Rational Software. RUP is an iterative development methodology based upon six industry-proven best practices” [46].

1) “It is considered a risk mitigation;
2) RUP has been refined by using thousands of projects with thousands of Rational customers and partners”; and
3) It can be customized with any project [45] and [46].

1) Like Waterfall, RUP is also process-heavy, and can rely too heavily on stakeholder feedback. Even as an iterative process, it can be too slow for certain types of projects.
2) The development time required is less due to reuse of components [45] and [46].
3) The development time required is less due to reuse of components.

13. Scrum

It’s “Approach is used in the top companies in the field of software development and has a significant success rate. Analysis of the field consider that SCRUM can be appropriate also for other types of software development companies, in order to benefit from using object-oriented tools and techniques” [47].

1) It works within fast-moving development projects;
2) Scrum meetings provide clear visibility for the project team; and
3) It is an agile methodology that provides from the end-users well feedback [47].

1) Scope-creep is a huge issue in Scrum projects - they can easily blow out of control if not reigned in.
2) Project quality is difficult to be implemented, unless the they go through aggressive testing process; and
3) Using the Scrum framework in large project teams is a challenge [47].

14. Six Sigma

“It is an effective application of statistical techniques, delivered in an innovative manner that has achieved acceptance, use and results by the management and

1) It suggests improvements before defects even notice.
2) Six Sigma demonstrates and identify the whole processes behind the production of a component or
3) Six Sigma can be extremely rigid, which some teams find limit their creativity. Being a data-driven quality-assurance system; and
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| 15.  | PMBoK | “It is the best representative of this approach [10]. PMBoK formally defines a total of 44 project processes that describe activities throughout a project’s life cycle. These 44 project processes are organized into two axes: into five process groups and into nine knowledge areas. Its process is described in terms of inputs (documents, plans, design, other data, etc.), outputs (documents, products) and tools and techniques (mechanisms that are applied to inputs for producing outputs) and without being too specific, it provides guidance to someone that wishes to apply the processes” [49]. |
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| 16.  | Traditional | “It is gaining very wide public attention recently, and it is considered as “the” project management approach for today’s projects, compared to what is called traditional project management [50]. |
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| 17.  | Feature Driven Development (FDD) | It “Is a process that provides businesses with feature-rich systems that should help them control their ever-evolving nature” [51]. |
|   |   |   |
|   |   |   |
| 18.  | Dynamic Systems Development Model (DSDM) | “It provides a methodology and framework of controls and best practice for the rapid application of high-quality business system solution” [52]. |
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|   |   |   |
| 19.  | Information Technology Infrastructure Library (ITIL) | “Is derived from the definition of Technology Management. Information Technology Management is concerned with exploring and understanding Information Technology as a corporate resource that determines both the strategic and operational capabilities of the firm in designing and developing products and services for maximum customer satisfaction, corporate productivity, profitability and competitiveness” [54]. |
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|   |   |   |
| 20.  | Joint Application Development (JAD) | “Is a generic term which describes a variety of proprietary and custom-developed methods for conducting workshops in which users and technical developers work together on information system project planning, requirements definition, user interface design, or other activities” [57]. |
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