

## Development of Project Methodology Implementation: Engineering Perspective

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### Abstract

The study aimed to develop a methodology for the implementation of construction projects according to the world standards during the life cycle of the project from the beginning to the closure. Since the construction projects in Jordan suffers many problems, a specified questionnaire was designed as a method of data collection and distributed among simple random sample of 191 respondents from total population.

The relative importance index was used to sort the practices according to their importance to the proposed methodology. The results showed that the most important factors according to the overall ranking based on the value of the relative importance index (0.844) is in the project planning stage. This is related to the duration of the task, which should not exceed more than (4-6) weeks; as the determination of the duration of the project activities is an important point in developing the methodology. In addition, the study revealed that the project monitoring and closing phase is the most important during the project life cycle (relative importance index was about 0.655). The lowest value of the relative importance index was (0.399) in the implementation phase of the project, which related to the impact of cash flow on the implementation of the project, because this factor particularly affects the implementation phase more than the implementation of the project as a whole. Finally, the results showed that if present methodology is applied the improvement would be between 75% to 79% in comparison to the conventional projects methodologies.

### Scope of the Study

Deciding to choose the most suitable methodology in each project is essential step during project planning and whether to have one or more methodology for a project. Project methodologies are different in composition and the parts of a methodology all play a role in supporting the project team during the project life cycle to achieve the projects' objectives.

The study give insight of the best practices of project management that will lead to better performance for construction projects in Jordan, recommended key practices during implementation that could be adopted to achieve project success, and identify key problems facing project implementation processes.

### Objectives of the Study

The main objectives of the study are as follows:

- 1-Developing a project methodology implementation from engineering perspective depending on world standards.
- 2-To analyze and find out and what are critical factors that play an importance role in influencing the project success (i.e. implementing the world standards).
- 3- Improve the quality of project planning and implementation, project implementation within time, cost, budget from engineering perspective.
- 4- Understand and manage employers needs in a positive way from engineering perspective.
- 5- Increase productivity and reduce costs and thus increase profits from engineering perspective.
- 6- Minimizing errors and defects in the product or service provided, reduced human error and waiting service time from engineering perspective.

**Keywords:** Project Methodology, Project Life Cycle, Cash Flow, Relative Importance Index, Jordan.

## 1. Introduction

People needs are increased , they need products ,service for their life like needs to food ,medicine ,machines ,hospitals ,roads and so on ; in order to achieve this needs the projects is carried out ( Project Management Methodology Guide , 2016).Projects are defined as temporary endeavor(s) conducted to create a unique product, service, or result (Project Management Institute PMI, 2013), A project does not last indefinitely, but instead has time constraints and is focused on generating a product, service, system or result that is distinctive to the organization. The time of project implementation is a competitive indicator among developed countries to demonstrate their ability, and engineering development, every project has a beginning and an end: their lifecycle has identifiable start and end points, which can be associated with a time scale. The project lifecycle includes all project activities from

the point of inception through to the completion of the project.A process Groups interact in a phase of project, As shown in Figure.1 These phases are:

- 1- Initiation phase.
- 2- Planning phase.
- 3- Executing phase.
- 4- Closing phase.

Throughout the project's duration there is a project phase called monitor and control. Monitor and control all project work and management activities, monitor project variables, measure progress, manage changes,address risks and issues and identify corrective actions as per the project's needs , it's a procedure that must take part in all the life cycle of the project and not in a particular stage .

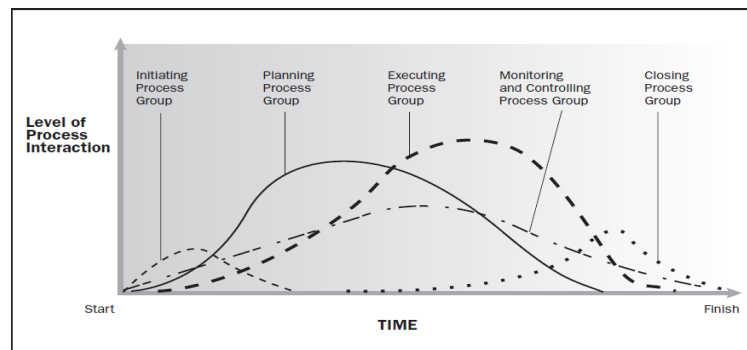


Figure 1: Project life cycle (Pmbok,2008).

The study of Moses Eledan (2018), entitled" An Appraisal of the Project Management Approach for Property Refurbishment in The Real Estate Sector in Ireland ", the result found that sustainable property refurbishment follows the standard processes and procedures of project initiation, planning, implementation, monitoring and control [1]. The study of ArtiJ.Jari, Pankaj, P.Bhangale,(2013) entitled : " To Study Critical Factors Necessary for a Successful Construction Project", the results of this study emphasizes that critical success factors that help in avoiding delays and lead to better performance in construction projects ; include the following : clarity/ definition of project objectives, scope of project, project manager, project team commitment, capability and cooperation, planning, control, suitable size of work package and environment, communication and management of information [2]. This study is distinguished from previous studies by the following. It focused on construction projects in Jordan only , It measured the level of different project management practices during implementing construction projects construction, It was developing a new methodology for implementing a construction projects depending on world standards, also, this study try to find the best way for PM practices during project life cycle that leads to improve the implementing ,and managing the project well , in order to find out the most significance factors that causes projects failure .

### 1.1 Statement of the Problem (challenges faced by Construction in Projects Jordan)

Many projects failed because of a lack of specific methodology in terms of study, planning and implementation. One of the reasons for the failure of these projects or their implementation at a lower level or delayed delivery of the deadline is not to follow a proper methodology for the implementation of the project. Therefore, in this work the researcher clarified the importance of developing a correct methodology to implement the project within specified duration to ensure its success and achieve its objectives.

Construction projects in Jordan faced many challenges so this study is focus on this prpblem,also there are many studies discussed the reasons and the solution to avoid these challenges in aconstruction projects .

The study of, Faten Al-Btosh, (2017): entitled "Success Factors of Construction Projects Performed in Al-Karak Governorate in The Period Between Year 2000-2015 "[3].

This research explores the factors that influence success of construction projects performed in Al-Karak Governorate through the period between the years 2000 to 2015.

The results of this research indicate that the most important seven success factors of construction project in Al-Karak Governorate as: Project contract mechanism, No disputes in projects, The value of bid bond, Location of company, Conformance to codes and standards, No defects in project, Accurate bill of quantities.

The findings of this research show that construction project in Al-Karak Governorate are suffering in the first point from three major problems before inviting the contractor to price tender.

These problems are as follows: Inaccuracies in studying drawings and items of tender, Failure to examine the project site, Incompatibility between contract duration and contract value. These problems cause more other problems during projects implementation, the most important of which are: delays in the completion and change orders.

The study of Al- Momani, (2000): entitled "Construction Delays" The objective of this paper is to identify the causes and range of delay in public projects in Jordan between the year of 1990 and 1997 using a quantitative analysis [4]. The study found that the significant causes of delay were as following:

- 1- Bad design
- 2- Variation orders
- 3- Weather
- 4- Site conditions
- 5- Late delivery
- 6- Economic situations
- 7-Increase in quantities

The main four causes of delay according to study are; Poor design, Change orders, Site conditions, and Economic conditions.

## 2. Methodology and Data Collection

Study objectives were achieved by implementing the following steps:

- Reviewed the past works and construction projects methodologies.
- Designed a special questionnaire as a method of data collection.
- Analyzed the data statistically by computer Software (SPSS package version.22 and excel).

To meet study objectives, a questionnaire was set as a method of data collection,each questionnaire consisted of two parts part one focuses on demographic and general information such as : type of organization , respondents experience , job title, and type of project & company classification.

Part two measure the degree of applying a methodology practices with world standards during the project life cycle, it consists of five sections, as follows:

Section one: project initiation phase

Section two: project planning phase

Section three: project implementation phase

Section four: project monitoring and control phase

Section five: project closing phase

The questionnaire consisted of 55 questions; these questions were closed – ended type that limit the respondent to specified answers multiple according to the degree of influencing the proposed methodology with four point scale (strongly agree, agree,disagree,strongly disagree), and open ended question at the end of each part related to the respondents opinions .

### 2.1 Population and Sample Selection

The term "population " refers to all elements, individuals, items, or object which characteristics are under study in a particular research, the population that is being studied is also called the " target population ", while the term "sample " refers to subgroup or a proportion of the population that is selected for study [5]. Table 1 shows the target population distributing on three department according to the type of organization, simple random sample was taken to represent the construction project in Jordan as a case study, the sample size of the study was 191participants only 157 responses were obtained which equals to 82% response rate, it considered as acceptable ratio.

Type of organization			Total	Sample of the study		Percentage of returned (%)
Contractors	Supervisors	Owners		Distributed	Recieved	
61	49	47	157	191	157	82%

Table 1: Details of the study sample

Before data analyzed reliability testing was done to check if the instrument of questionnaire was reliable and consistent, reliability defined as the degree of consistency and stability with which it measures the attribute it is supposed to be measuring.

Reliability is tested using Cronbach's alpha, the data showed the reliability testing with AlphaCronbach's from the table its value 0.877 which is larger than 0.7 which indicates "Good " internal consistency and high reliability of the sample.

## 3. Data Analysis and Discussion

The data collected for this work is quantitative, therefore quantitative analysis shall be used, so Statistical Package for the Social Sciences (SPSS package version .22) used to analysis the data.

Statistical Package for Social Science (SPSS) was used, in order to analysis the collected data by the following tests.Descriptive statistics analysis(frequencies and percentages), to describe the demographic data , the numerical presentation of data summary is the frequencies and percentages , which are related to the responses to individual questions in personal and public information Part . Statistical methods (arithmetic mean, standard deviation and relative importance index) to describe respondent's attitude toward the factors, and to ranking them by importance. Relative importance index analysis has been acknowledged as an excellent way to cumulate the scores in an ordinal scale of different variables as rated by the respondents [6]. The RII was computed by the formula:

$$RII = \frac{\sum W_i}{n} (1)$$

[AN]

Where:

RII – Relative importance index; ( $0 \leq RII \leq 1$ )

W – Score allocated to a variable by respondents on a scale of 1 to 4;

A – Highest weight

N – Total number of respondents.

ANOVA test was used to test the hypothesis: the researcher used one-way ANNOVA- test for testing hypothesis, since there's one independent variable effect on dependent variables (one variable is quantitative and the others are numeric). Post hoc test (Tukey's method): Tukey's multiple comparison test is one of several tests that can be used to determine which means amongst a set of means differ from the rest (comparison of Means test to reveal which means in the data differed significantly from the others) [7].

### 3.1 Questionnaire Analysis:

Questionnaire analysis include the analysis of the two parts of the questionnaire.

### Part One: Personal and Public Information

This section includes the analysis of the respondent's demographic information, which include gender, years of experience, job title, type of organization, projects types, classification type for contracting company/ supervisor office.

### Part Two-Apply Methodology to Implement Projects During the Project Stages from Start to Closure Depending on World Standards:

In this part respondents were asked to give rate answers about the application of the world standard practices during project life cycle with four-point scale, in this part relative importance index used to evaluate participants responses by priorities. Index intervals Importance Level used in this part: (0-0.25) Low, (0.26-0.50) Medium-Low, (0.51-0.75) High-Medium, (0.76-1) High. This step is summarized the results, since the researcher ranked the factor for each project phase by category according to average value of RII for three organization type respondents (owner, contractor & supervisor), these factors are sorted by category for the related phase, then ranked by overall phases, this summary is listed in appendix(I).

## Appendix (I)

Summary of relative importance index and rank for factors during project life cycle

Factor	RII	Ranking by category	Overall Ranking	Importance level to methodology
<b>Project Initiation Phase</b>				
F1: Identification the need for project	0.503	7	43	Medium-Low
F2: Project Manager selection	0.462	9	53	Medium-Low
F3: Project Stakeholders identification	0.619	4	30.5	High-Medium
F4: Clearness of Project objectives	0.688	2	19	High-Medium
F5: Project stakeholders participation in project mission	0.584	5	32.5	High-Medium
F6: Determination the final vision of project	0.736	1	14	High-Medium
F7: understanding of project objective	0.682	3	20	High-Medium
F8: Preperation of project design	0.475	8	51	Medium-Low
F9: implementation phase prior to the planning phase	0.548	6	37	High-Medium
<b>Project planning Phase</b>				
F10: Timetable preparation	0.719	8	17	High-Medium
F11: Appropriate project plan	0.802	3	4	High
F12: Dividing project plan	0.504	17	42	Medium-Low
F13: Project plan for control	0.753	6	12	High-Medium
F14: Determination the time of each task in the project plan	0.676	9.5	21.5	High-Medium
F15: Determination the resources of each task in the project plan	0.546	13	38	High-Medium
F16: Determination the cost of each task in the project plan	0.730	7	15	High-Medium

F17:Determination the staff of each task in the project plan	0.536	15	<b>40</b>	High-Medium
F18:Distribution the work among staff	0.537	14	<b>39</b>	High-Medium
F19:Involve the team in preparation project plan	0.498	18	<b>44</b>	Medium-Low
F20:Analyzing risk in a scientific and systematic manner	0.812	2	<b>2</b>	High
F21:Analyzing the forces that affect the project environment	0.511	16	<b>41</b>	High-Medium
F22:Mission duration should not last more than (4-6) weeks	0.844	1	<b>1</b>	High
F23:project duration appropriate to the size of the project	0.483	21	<b>49</b>	Medium-Low
F24:Eliminate unnecessary costs	0.676	9.5	<b>21.5</b>	High-Medium
F25:Determination the critical path	0.791	4	<b>6</b>	High
F26:Include risk in the project plan	0.497	19	<b>45</b>	Medium-Low
F27: Effective communication for decision	0.488	20	<b>47</b>	Medium-Low
F28:Developing project schedule in planning stage	0.774	5	<b>8</b>	High
F29:identify opportunities and challenges by project manager	0.560	12	<b>36</b>	High-Medium
F30:Identification of strengths and weaknesses during the planning	0.629	11	<b>29</b>	High-Medium
<b>Follow the previous page</b>				
<b>Project implementation Phase</b>				
F31:Implementation on the basis of project plan	0.710	5	<b>18</b>	High-Medium
F32:Project implementation as a whole is differ from implementation phase	0.452	11	<b>54</b>	Medium-Low
F33:Award/bonuses to team members	0.754	4	<b>11</b>	High-Medium
F34:Documenting the observations and incidents	0.641	6.5	<b>26.5</b>	High-Medium
F35:The affect of cash flow on project implementation	0.399	12	<b>55</b>	Medium-Low
F36: company practice for management ensure the acceptance of project outcomes	0.580	8	<b>34</b>	High-Medium
F37: company practice for management ensure the project quality	0.641	6.5	<b>26.5</b>	High-Medium
F38:Provide training programs for team members	0.762	3	<b>10</b>	High
F39:Updating the risk system	0.803	1	<b>3</b>	High
F40:Disregard for risk management during implementation reflects negatively on the project outcome	0.465	10	<b>52</b>	Medium-Low
F41:Project manager skills	0.483	9	<b>49</b>	Medium-Low
F42:Reviewing risk register during project implementation	0.801	2	<b>5</b>	High
<b>Project Monitoring and Control Phase</b>				
F43:Reviewing the project implementation to the project plan	0.743	2	<b>13</b>	High-Medium
F44:Corrective actions	0.722	3	<b>16</b>	High-Medium
F45:Developingan alternative implementation plan	0.766	1	<b>9</b>	High



F46 : Measuring the percentage of completion of the project with the baseline plan	0.668	4	<b>24</b>	High-Medium
F47:Follow up the work carried out to ensure it's acceptable to specifications	0.493	7	<b>46</b>	Medium-Low
F48: It is necessary to make a review of the timetable	0.569	6	<b>35</b>	High-Medium
F49:Reviewing the project plan to ensure the closure of project work	0.619	5	<b>30.5</b>	High-Medium
<b>Project Closing phase</b>				
F50:Closing the project administratively after performing all the required work	0.483	6	<b>49</b>	Medium-Low
F51:It is essential that all the work to be performed is acceptable	0.584	5	<b>32.5</b>	High-Medium
F52 :Final review of the project by the stakeholders	0.660	3	<b>25</b>	High-Medium
F53:Recording of lessons learned from the project	0.789	1	<b>7</b>	High
F54:Measure the project satisfaction at closure	0.674	2	<b>23</b>	High-Medium
F55:Archived all project documents	0.631	4	<b>28</b>	High-Medium

The determination of the final project vision is the factor that has most significant in project initiation phase with 0.736 index value , because the clearness of the final project vision to all project stakeholders in the beginning of project , that will guide them to suitable project plan that include the distribution of responsibilities to all project member ,in the following project phases.In project planning phase they agreed that the mission duration should not last more than (4-6)weeks with 0.844 index value ,determining duration for project mission is important point in this phase ,that will insure closing the project within schedule without delayed (i.e. project success without planning it's a matter of chance ). The most significant factor in project implementation phase is updating the risk system with 0.803 index value , studying risks that may face the project implementation and managing is important point that should considered by all project stakeholders, they emphasis that the risk system should updating by tacking in consideration new risks that will face the project, the problems/risks that facing implementing a project now differs from that faced implementing a project before 20 years old ,so this point is important in order to determine the project duration from the beginning .

Developing alternative implementation plan the most significant factor that owner, contractor and supervisor agreed that it has the most important in project monitoring and control phase with 0.766 index value ,because if the alternative plan is developed it will help the project members to face the project problems , risks without delays.In project closing phase all respondent agreed that recording of lessoned learned with 0.789 index value from the project is the most important practices in this phase, since it will include a summary of project experience that help the company in the future projects to solve and avoid similar problems. The most significant factor for all project phases by (Overall Ranking) .Mission duration should not last more than (4-6) weeks in project planning phase , is the factor that considered as the most significant factor

by overall ranking ( i.e. for all project phases ), since it has the highest value of relative importance index ( RII=0.844), according to respondents views towards project life cycle phases; because determining the duration of the project task is an important point for developing the methodology, which will ensure that the project is closed on time without delay and without the need to extend. The least significance factor for developing the methodology is in project implementation phase with RII value equals to 0.399 which related to the an effect of cash flow on project implementation, because this factor affects particularly on the execution phase more than the effect on the as whole project implementation .

The Most Significant Phase During Project Life Cycle By (Owner, Contractor, Supervisor) Answers:

This part reveled the most significant phase affecting during project life cycle, Fig 2 represent the relative importance index (RII) during project life cycle by (Owner, Contractor &Supervisor) answers which detailed as followed.

**Owner Answers:**

From Fig 2 the phase that has strongly significance through owner answers is ( Project Monitoring and control phase) with RII value 0.655, because reviewing the project tasks and comparing them with the plan is necessary , in order to make a corrective actions (crashing ,resource leveling )to avoid project delayed and to be accomplish with project constraints ( time, cost ,quality, satisfaction) ,to properly address issues and risks; owners especially want to achieve project objectives without problems so project monitoring is considered to be significant to them .

**Contractor Answers:**

From Fig 2 the phase that has strongly significance through contractor answers is ( Project Monitoring and control phase) with RII value 0.652 , because reviewing the project tasks and

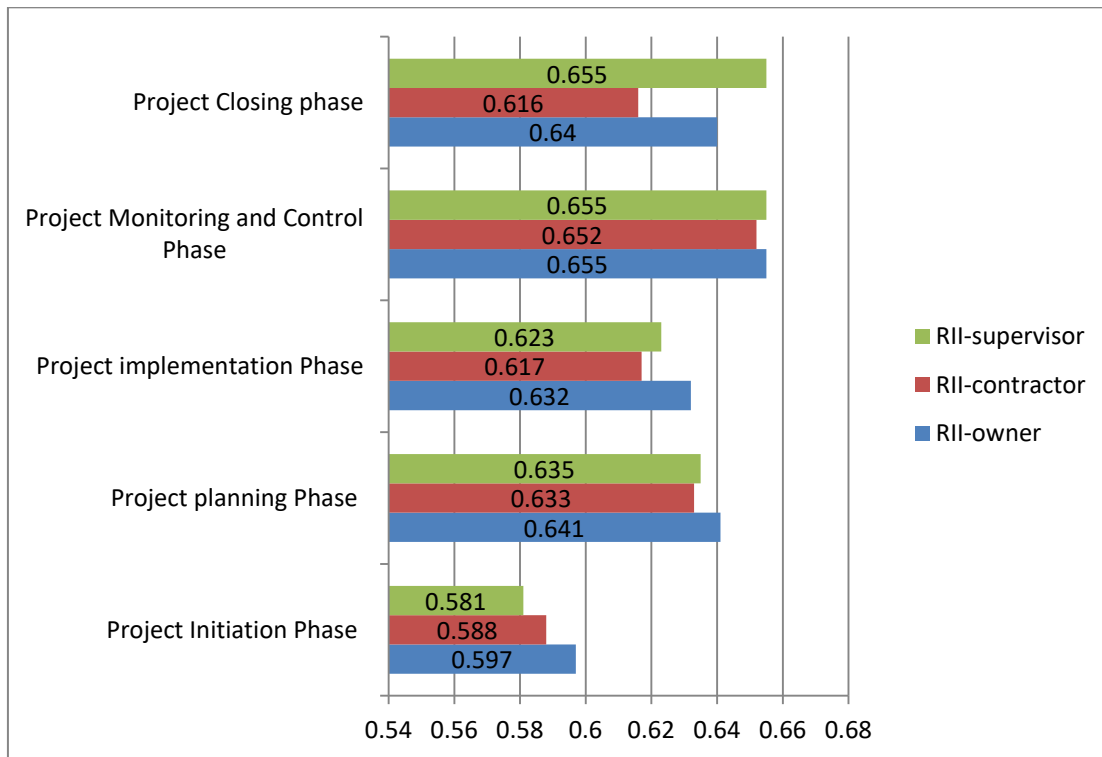
comparing them with the plan is necessary , in order to make a corrective actions ( crashing ,resource leveling ) to avoid project delayed and to be accomplish with project constraints ( time, cost ,quality, satisfaction),to properly address issues and risks; contractors especially want to close the project without defects or any financial problems so project monitoring is considered to be significant to them .

**Supervisor Answers:**

From Fig 2 the phases that has strongly significance through supervisor answers are( Project Monitoring and Project Closing) with RII value 0.655 , because reviewing the project tasks and

comparing them with the plan is necessary , in order to make a corrective actions ( crashing ,resource leveling ) to avoid project delayed and to be accomplish with project constraints ( time, cost ,quality, satisfaction) ,to properly address issues and risks; supervisors especially want to achieve project objectives without problems so project controlling is considered to be significant to them .

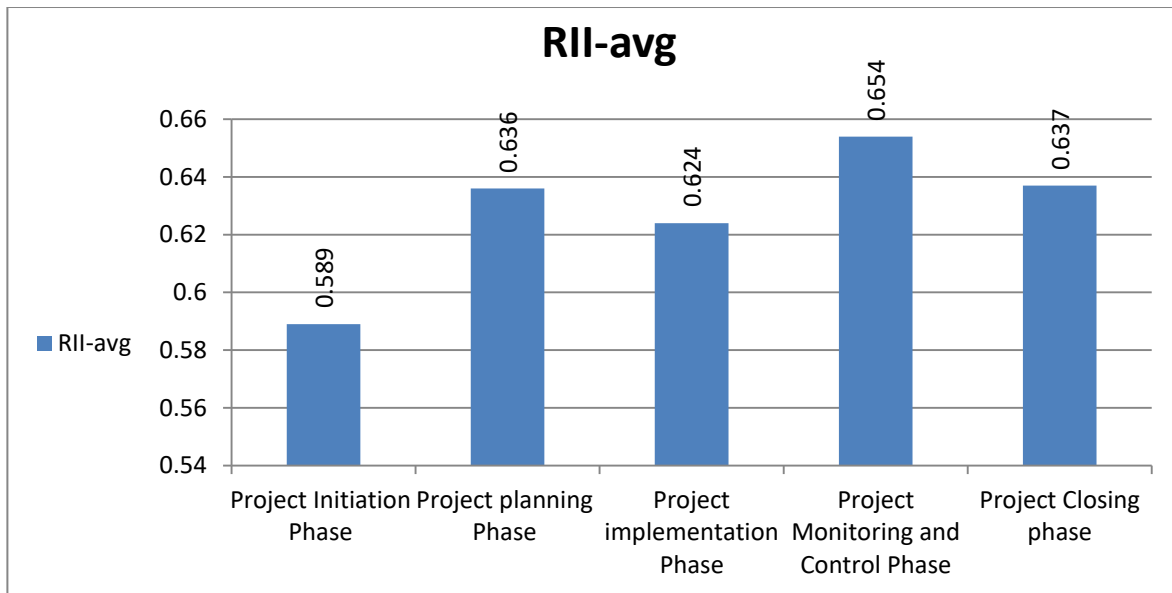
Also, project closing is considered to be significant to supervisors because they want to administratively close the project without problems, and delivering the project to the owner without defects.



**Figure 2:** RII for project life cycle phases by (owner, contractor, supervisor) answers

By calculating the average value of RII for each phase according to organization type and sorted them in descending order, then ranked them by importance in Fig. 3, to determine the most significant phase during project life cycle. Fig 3 represent the relative importance index values for project life cycles according to overall answers , the most significant phase during project life cycle by overall answers is project monitoring and control with RII value 0.654, because reviewing the project tasks and comparing them with the plan is necessary , in order to make a

corrective actions to avoid project delayed and to be accomplish with project constraints ( time, cost ,quality, satisfaction) and to properly address issues and risks .The lowest value for the RII is for project initiation phase with RII value 0.589 , in this phase the project vision, tasks and responsibilities are unclear to all project stakeholders and there are many missing information about project detailed so initiation phase considered to be least significant phase according to respondents views .



**Figure 3:** RII for project life cycle phases by overall answers

### Open –Ended Question Result

The respondent was asked to answer open-ended question, at the end of each phase; to give a percentage of improving and managing the project well if the practices on each phase applied (i.e. increase project profit, quality, satisfaction of outcomes and closed the project within specified duration without delayed) rather than using conventional methods.

The question is as follows:

)In your opinion, what percentage in managed and implemented of the project well if the steps in the above steps are applied?). The respondents given different percentages according to their point of views, table.2 illustrates the average percentage given by respondents during project life cycle by (owner, contractor

&supervisor ) answers, the highest overall percentage given by respondents was 79% to project planning phase and to project implementation phase, this is an indication that these phases will significantly affected by applying the suggested practices in improving the project implementation. The lowest percentage was given to project closing phase with value of 75%, this is an indication that the respondents agreed that applying the world standard practices during project life cycle affect significantly in previous phases than project closing phase. In general, the results showed that if present methodology is applied the improvement will be between 75% to 79% in comparison to the conventional projects methodologies.

Phase	Percentage of improving and managing the project well ( average % of respondent answers)			
	Owner	Contractor	Supervisor	Avg. overall
<b>Project Initiation phase</b>	<b>74%</b>	<b>78%</b>	<b>75%</b>	<b>76%</b>
<b>Project planning phase</b>	<b>76%</b>	<b>80%</b>	<b>80%</b>	<b>79%</b>
<b>Project implementation phase</b>	<b>76%</b>	<b>79%</b>	<b>82%</b>	<b>79%</b>
<b>Project Monitoring and control phase</b>	<b>76%</b>	<b>76%</b>	<b>81%</b>	<b>78%</b>
<b>Project Closing phase</b>	<b>73%</b>	<b>74%</b>	<b>79%</b>	<b>75%</b>

**Table 2:** Average percentage of improving and managing the project well according to respondents answers rather than using conventional methods



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#### 4. Conclusions

In this work, the analysis of the results have shown that determination of final project Vision is the most important practice during Project initiation phase, in Project planning phase the rule that the mission duration should not exceeded more than (4-6) weeks is the factor that has the strongly influence during this phase, updating the risk system is factor that has strongly effect in project implementation phase , developing an alternative implementation plan , is the most important practice in project monitoring and control phase, recording of lessons learned from the project , is the most important practice in project closing phase. The most significant phase during project life cycle by (owner, contractor and supervisor) is project monitoring and control and project closing phase. Project implementation it's not a science only, it's also an art, which is a responsibility related to all project team Project success indicators differ from people to another according to the point of view, the indicators of success in client view not the same indicator in the community view and the team view, the key idea for project success that there are is no ideal project, the project that satisfy all point of views [8-16].

#### 5. Recommendation (Practical Implications of The Findings and How They Can Be Applied in Areal -World Construction Project)

The researcher recommends some recommendations based on the previous results:

- 1-Effective management is impossible without an adequate methodology that will improve management and implementation of project to avoid implementation problems and to ensure closing it within specified duration and within reasonable cost and quality.
- 2-The use of suitable project management methodology related to many objectives: the overall company strategy, organization objectives project the size of project team and /or scope to be managed, the priority and importance of the project.
- 3-Project life cycle include many sequences steps that related to each other's these practices should be taken in consideration; to ensure success the final outcomes of the projects.
- 4-Project implementation it's not a science only, it's also an art, which is a responsibility related to all project team.
- 5-Project success indicators differ from people to another according to the point of view, the indicators of success in client view not the same indicator in the community view and the team view, the key idea for project success that there are is no ideal project, the project that satisfy all point of views.

By applying these methodology in a construction projects, the results showed that if present methodology is applied the improvement will be between 75% to 79% in comparison to the conventional projects methodologies.

#### 6. Limitations

- 1-This study is involved only the construction projects and will not take the consideration for other projects like other construction projects like (sewage and water supply) and industrial projects.
- 2- Time limitations.

#### Future work 7.

From the study results, there are some future works can be presented:

- 1-Projects success is a hope for all people all over the world, so there are many researches related to this field to achieve this wish and avoid failure.
- 2- This study is indicated the most significance factors that lead to improve project outcomes, which may consider as a solution for projects implementing problems; so, this study encourages other researchers to study the solution of project implementation problems.
- 3- Further researches can be done by adopting this study result on a real project and another project used traditional method to compare the benefit of using the developed methodology for projects implementation.

#### 8. Acknowledgment

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