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Research Article

The Choice of Project Management Software by Project Managers; with the Moderating Impact of Top Management Support

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ABSTRACT

Nowadays, there are many projects management software available in the market to manage projects using computer-aided tools. The choice of the right project management software is very important for increased project performance. The study analyzed different project management software available in the market and being used by project managers of the IT industry. The analysis of popular project management software MS Project, JIRA, Trello, Asana, and Redmine is done against the importance of feature set according to the experts. The results inferred the fact that JIRA is the best project management software available currently in the market to manage IT projects. The study also aimed to investigate the impact of top management support in choosing JIRA as the most optimal project management software in increasing project performance. The moderating role of top management support is justified to be significantly positive in the findings hence, the support of top management increases the chances of adoption of JIRA as a project management tool within an IT organization. The last sections of the study focus on highlighting the implications of the research, the limitations of the study, and future suggestions for any interested researcher to implement the same analysis strategy in evaluating project management tools.

Keywords: *Project Management Tools; Top Management support; MARCOS; Project Performance.*

1. INTRODUCTION

1.1 Background

Technology evolves rapidly in the twenty-first century, and new inventions are constantly being developed and used. People have new requirements and demands from products when technology advances rapidly. Organizations and businesses that provide solutions to suit their customers' requests and needs must prepare ahead of time, work quickly, meet deadlines, produce high-quality products, and much more.

Project managers must adopt more trustworthy, flexible, dependable, and dynamic solutions to assist them in overcoming problems and delivering successful projects when new challenges in projects emerge as a result of dramatic socio-economic changes in the world. Project researchers and scientists have introduced approaches such as WBS, critical path analysis, analysing and reviewing programmes, Gantt charts, Earned Value Method, and others to assist managers in dealing with project management difficulties. However, because they are quantitative in nature, they require time to be updated to reflect contemporary technology and challenges (Bani Ali et al.,

2008). To overcome this stumbling block, project management software was developed to increase the productivity of existing methods while also reducing the effort, cost, and time required to apply these techniques in various phases of projects such as project planning, execution, monitoring, risk analysis, and so on.

Adaptability of current IT technologies and solution systems in an organisation has a wide range of consequences. By making information readily available to all peers, such solutions have been shown to increase an individual's as well as an organization's productivity, collaboration, ability to recognise and respond, and learning (Ozkan & Mishra, 2019). Projects that are managed with advanced project management software have been shown to be completed faster. It has been discovered that adopting project management software ensures a 28 percent higher project success rate than using traditional PMI methodologies (2017). It also helps to maintain schedule, cost, quality, customer satisfaction, and productivity restrictions (Sajad et al., 2016; Hassan et al., 2018). Organizations, on the other hand, are now investing in project management software to help them with their project management efforts and boost project productivity (Mishra & Mishra, 2013).

However, project management software may not always succeed in assisting with all project management activities, and errors may occur. Some projects continue to fall behind time, cost overruns are common, and customer unhappiness is common. Unfortunately, the rise in project performance resulting from the use of software may not be optimal, which could be the outcome of poor project performance despite the use of software (Pellerin et al., 2013). Project managers can choose from a variety of project management software programmes. As a result, selecting the appropriate project management software has an impact on a project's overall success. As a result, in order to improve project performance, project managers must be aware of the most appropriate instrument for project management.

The support of the organisation and top-level management has an impact on the project management software selected. Because top-level management is just as vital as project managers in a project, project managers who have excellent talents will not be able to succeed without their help. Top-level management is in charge of removing roadblocks to project development, assisting team members in enhancing their enthusiasm and dedication to work, and providing support to their team to deliver a prosperous project. As a result, top-level management's assistance in allocating funds and resources to adopt project management software and, if necessary, provide project managers with training is critical to completing successful projects (Frau, 2019).

However, when the organization's financial and human resources are restricted, top-level managers are unable to provide organisational assistance to their team members or project managers.

1.2 Purpose of study

The goal of this study is to use the most recently published Measurement of Alternatives and Ranking According to Compromise Solution (MARCOS) approach

to evaluate project management software used by project managers in software projects.

Initially, the research will determine which project management software is currently in use in the software sector. The MARCOS framework will then be used to assess each project against project performance criteria. This will assist software industry project managers in selecting the best project management software based on a set of criteria. Along with project managers' selection of appropriate project management software, it will assess the organization's and top-level management's assistance in selecting the most practical project management software.

1.3 Research Gap

Because there are so many new and innovative project management software options on the market today, selecting the right one for the project manager and top management when it comes to investing in the tool can be difficult. The literature contains a wealth of information on the various methods used by different researchers to assess project management software for its ability to improve project performance (Alencar and Almedia, 2010; Wang et al., 2014; Erdogan et al., 2019), but the new MARCOS method developed by Stev et al. (2020) has shown to be superior to those frameworks in project management software evaluation. However, in reviewing project management software, the literature is confined to only Smartsheet, Asana, MS Project, and Basecamp. It is missing an assessment of modern software used in software project management, such as JIRA, Trello, Redmine, and others. Furthermore, the present criteria are limited and should be combined with those acquired from the current programme that all respondents use. It will also contribute to the inclusion of new project management software features that project managers require, motivating software makers to improve their products.

1.4 Problem Statement

Any project's overall performance is influenced by its choice of project management software. As a result, in order to improve project performance, project managers must be aware of the most appropriate instrument for project management. To manage their projects, project managers in the software sector are now using various project management tools. Jira, Trello, Asana, MS Project, Base Camp, Smartsheet, Redmine, and other similar applications are examples. In the literature, it is not clear which tool is most useful for improving project performance. The support of the organisation and top-level management has an impact on the project management software decision (Puska et al., 2020). When it comes to spending finance and resources to improve project success, many firms are unable to assist their project teams (Frau, 2019). As a result, an empirical study is needed to offer an ideal analysis of project management software's impact on project performance.

1.5 Research Questions

The following questions are addressed by this study:

1. In the software sector, what project management software do project managers use? 2. Based on the parameters stated, which project management software among them gives the best project performance?

3. How important is top-level management support in selecting the best project management software for improving project performance?

1.6 Research Objectives

1. Determine which project management software is utilised by software project managers.

2. To determine which project management software is the most appropriate for your needs.

3. Determine whether senior management of the organisation supports the selection of the best project management software.

2. LITERATURE REVIEW

This section of the study summarises and analyses relevant literature and publications based on the use of project management software in improving project performance, as well as the role of organisational and top-level management in assisting in the selection of appropriate project management software to efficiently manage projects.

2.1 Project Management Software

In today's software development market, the Agile Methodology is very prevalent. Without the need of development papers, agile approach allows managers to be informed about project quality and progress. Various tools based on Agile Methodology are available on the market. Taiga, Axosoft, Agielan, Planbox, Jira, Trello, VersionOne, SpiraTeam by Inflectra, and Pivotal Tracker are just a few of the tools available. Managers can use these tools to keep an eye on the quality of a project and its progress. According to a comparison of these tools, Taiga, Axosoft, Agielan, and Planbox are excellent for startup projects, whereas Jira, Trello, and VersionOne are more popular among agile developer peers because of their versatility (Ozkan & Mishra, 2019). According to the findings, these technologies not only assist project managers in reporting project quality and progress, but they also improve team communication.

Organizations grow as a result of their investments, and project management strategies have proven to be essential in investment management. Investment management assists business executives in making informed decisions on project investments. Making the appropriate investment decisions leads to exponential growth of the business. There are a number of tools on the market that can assist managers and executives in making sound project investment decisions. This research looked at how project managers use various tools to make investment decisions. The MARCOS approach was used to assess the performance of several tools, with Smartsheet coming out on top(Puska et al., 2020).

In the project development life cycle, project management solutions have demonstrated a substantial improvement. Project managers can use a variety of technologies to help them make the best decisions at the right moment.

According to the findings, project managers commonly employ two project management software, JIRA and Microsoft Project 2013, to increase project timeliness and quality (Hoang et al., 2014). The importance of these tools in the industry was demonstrated through semi-structured interviews conducted to evaluate their performance and participant experience.

Information and communication technology are playing a vital role in smooth flow of the information and coordination of business activities. In today's world, it is not possible for any business to grow without using information and communication technology. This research demonstrated how investing in the correct project management tools may help firms develop by enhancing communication and information sharing processes. Many organisations, particularly large-scale IT businesses in Varazdin County and Croatia, have benefited from the investment in project management tools such as Microsoft Project (Brodar and Pihir, 2014). Many company processes have been improved due to the introduction of project management software. The benefits and drawbacks of employing project management software in large-scale projects have been examined in this research. Assignment, administration, roles, and responsibilities have all been more transparent thanks to Project Management Tools. Project Management tools make it easier to evaluate project, team, and individual performance. However, the expense of integrating project management tools and employee training has risen (Ha, 2020). Despite these drawbacks, project management technologies have helped firms develop tremendously.

The current study used MARCOS since the literature shows that several ways to evaluating the benefits of project management software have been used. The availability of numerous standards to choose from is a need for this strategy. The standard set, on the other hand, is subjective in nature and gathered through a subjective approach, and it is measured against these alternatives.

Different criteria's have been given by researchers in their study to evaluate a project management software in increasing the project performance and have ranked each software against these (Puska et al., 2020), summarizes these in his study. Along with the criteria's given, a set of additional criteria and sub criteria are established based on the distinctive research studies. The one is given by Puska et al. (2020) are:

Criteria 1: Tasks, Criteria to evaluate the creation, assignment, and management if tasks by the software, scheduling dates, setting project priority and determine the upcoming tasks within the project.

Criteria 2: Collaboration, Criteria to evaluate how well the software is in providing a collaborative platform where different team members can comment, discuss, and resolve comments.

Criteria 3: Project Essentials: Criteria to evaluate whether the software provides statistics for the projects being run as project road maps, Gantt charts, visually show planned tasks, budget breakout and how each activity/task can be monitored. Reports can be generated.

Criteria 4: Portfolio, this criterion evaluates how a project management software can be efficient in managing portfolio of project within an organization, cost for each one, filters, workflow for each activity, how

requests are being managed against a project, ROI calculations, different projections related to projects, risk assessment.

Criteria 5: Management of Resources, it evaluates the software capability to manage resources, keep a record for each resource, how well resources are given tasks, resource monitoring, project execution time.

Criteria 6: Platform, to evaluate how well the software is in cross functioning, readily available for different platforms, speed, and reliability of the software on mobile, desktop and web. Other than these criteria given, few more criteria can be added against the literary support of them to be important for a project manager. This importance of new criterion can be validated via Criterion weights questionnaire later. Pellerin et al. (2013), in his study gives importance to Procurement Management as an essential subsystem in a project management software. Therefore, a new criterion can be.

Criteria 7: Procurement, to evaluate how efficiently a software keeps track of purchasing, contract management, management of purchased materials, training, logistics, inspection and follow up. Ozkan and Mishra (2019) gives in their study modern features a software must have in IT industry which can be incorporated in the existing criteria's given by Puska et al. (2020), as;

Criteria 6: Platform, integrations with other SD ks for software developers as eclipse etc., Criteria *1: Tasks*, Issue generation and bug tracing, versions, iterations., *Criteria 2: Collaboration,* Email Integration.

2.2 Organizational and Top Management Support

Project success is the goal of a project management. Various practitioners and academicians are trying to identify the important factors that has maximum positive effect on project success. This study shows the importance of presence of project managers in top management support in the success of a project and discusses the relation between the role of project managers as a transformational leader and the project success (Iqbal at el., 2015). By using PLS-SEM technique to make an analysis on the role of top management support and the success rate of project. The study concludes that project success can be enhanced by unfolding the relationships between top management support and project managers' transformational leadership.

Organizational and top management support brings positivity in terms of success of project. This study discusses how organizational and top management brings innovation in processes of project. Structural Equation Modelling (SEM) used for the analysis of synergy between organizational structure and information technology which revealed that the synergy between organizational structure and information technology (IT) does not mediate the effect of Organizational top management support in innovation (Al Shaar at el., 2015).

To achieve organizational goals, it is very important for organization to set some goals for the growth of its employees. The concern of organization for its employees can greatly affect the growth of organization. This study discusses Perceived Organizational Support (POS) which shows the organizational values on employees' contribution and concern for the growth of employees. Perceived Organizational Support includes working ethics of

organization, working environment for employees, practices of HR and employees job satisfaction (Sun, 2019). For an organization to achieve long term goals it is necessary for an organization to improve perceived organization support. This can be done by supportive or high commitment HR practices, fairness, superior and co-worker supports and employee empowerment.

2.3 Research Model

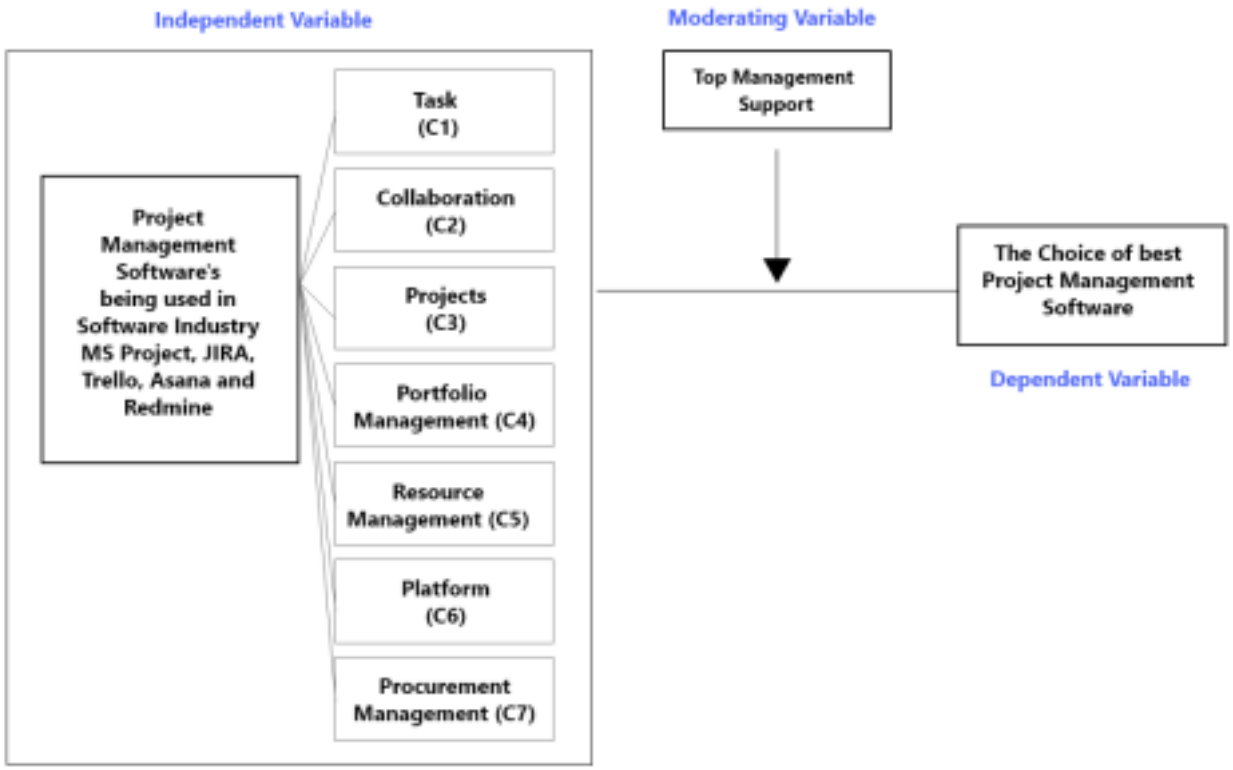

Fig: 2.1 The model for choosing a project management software

2.4 Research Hypothesis

The hypothesis set for the research model is:

H1: *The project managers use different project management software's.*

H2: *Each project management software has a distinct impact on project performance.*

H3: *The choice of a project management software is positively impacted by the top management support of an organization.*

3. RESEARCH METHODOLGY

This section uses research technique to identify project management software in use and compare it to project performance, as well as look at the role of organizational or top management support in selecting the best project management software. This part focuses on the research design, research sample, and instrumentation, data collection and selection processes, and

dependable and appropriate data analysis approaches. Finally, a few ethical considerations and limits are presented in this section.

3.1 Research Design

This section uses research technique to identify project management software in use and compare it to project performance, as well as investigate the role of organisational or top management support in selecting the best project management software. This part focuses on the research design, research sample and instrumentation, data collection and selection processes, and trustworthy and appropriate data analysis approaches. A few ethical considerations and limits round out this section.

3.1.1 Criteria and Alternatives Setup

The research methodology being undertaken involves the MARCOS method for defining multicriteria analysis. Initially a criterion is set up on basis of literature for evaluating a project management software in increasing project performance, after defining criteria's, the alternatives are determined, which in our case which would be different project management software used in software industry. Later then, the weight of criteria is received via questionnaire and another questionnaire to evaluate the project management software was rolled where project managers would evaluate each software.

3.1.2 Quantitative Approach

This section uses research technique to identify project management software in use and compare it to project performance, as well as look at the role of organisational or top management support in selecting the best project management software. This part focuses on the research design, research sample, and instrumentation, data collection and selection processes, and dependable and appropriate data analysis approaches. Finally, a few ethical considerations and limits are presented in this section.

3.1.3 Type of Study

This study's quantitative approach is an experiment to examine the research study's hypothesis. Except for the inclusion of each variable, this experimental approach allowed the researchers to maintain control over all other circumstances that could effect the experiment's outcome. The participants took part in the experiment over the internet. The experiment's sample consisted of project managers from various projectized organisations in Pakistan.

3.1.4 Unit of Analysis

The unit of analysis defines a level where the basic analysis of the study has been done. The kinds of unit of analysis in research are individuals, groups, organizations, or even a complete culture. As the target level of the study is project performance in using a project management software as well as the presence of top management support in choosing project management tool, so the unit of analysis in an individual project.

3.2 Population

It is a huge group of people with whom you plan to generalize the result of the study (Canva, 2001) said that "population is a set of people, events, things connected with interest that the researchers want to examine". In this study, our targeted population is the IT industry of Pakistan. The PSEB (Pakistan Software Export Board) board was referred to reach only registered software companies in Pakistan. Total of 200 companies were contacted over LinkedIn, personally, via email and other online platforms out of 4641 companies registered and the questionnaire was distributed then using a probability sampling technique.

3.3 Sampling

Sampling is the process of picking the population of interest so that you may generalise the results back to the entire population while analysing the sample. Because the population is so large, it is impossible to collect data from the complete population due to resource and time constraints; therefore, sampling approaches are required. It is extremely difficult to collect data in Covid-19 because of the current scenario. As a result, data is gathered via online questionnaires using the easy probability sampling method.

3.4 Sample Size

Sampling is the process of picking the population of interest so that you may generalise the results back to the entire population while analysing the sample. Because the population is so large, it is impossible to collect data from the complete population due to resource and time constraints; therefore, sampling approaches are required. It is extremely difficult to collect data in Covid-19 because of the current scenario. As a result, data is gathered via online questionnaires using the easy probability sampling method.

3.5 Questionnaire and Instrumentation

Data was gathered utilising a questionnaire technique, according to the details. English was the language utilised in the survey. The questions and technical words were easily understood by the participants, who held bachelor's and master's degrees and had more than 3-4 years of experience in the sector. Demographics, Criteria Weights, Alternative Weights, and Top Management Support were the four sub-questions included in the survey form. For each, a Likert scale with a 1-5 scale was used to measure them: 1 represents the most strongly disagreed, while 5 represents the most strongly agreed. The demographics questionnaire was designed using demographics adapted from Ahmed et aldemographics. .'s (2014). The Puska et al., (2020) and Ozkan and Mishra (2019) methodologies were used to develop the second and third questionnaires, which were used to collect the weights of the criteria and alternatives. The fourth questionnaire was created in the same way as Ahmed et al. (2014) used to assess senior management support.

3.5.1 Category Scale

The category scale is commonly used in businesses, industries, etc., to divide the respondents into different ways. For instance, when it is required for different employees based on their designations, income, qualification, this type of scale is used.

Gender, Qualification, Experience, Position in the Organization

These three items were used to get information about respondent gender, qualification, and experience. Mostly these elements were used as control variables but in this study, these are used as an independent variable.

3.5.2 Data Collection Procedure

To collect data an appropriate method is used to gather information. Questionnaire surveys are recently the most frequently used in collecting data for research (Barling., 2014). Data is collected from the IT industry. The criteria weights questionnaire was distributed among project managers collected the weights of each criterion for project management software in increasing project performance. The project managers would be rating the importance of each criterion on a scale of 1-5, 5 being the highest importance. For the evaluation of different project management software another questionnaire was rolled out to collect data, each software was rated on a scale of 1-5, 5 being the highest.

3.5.3 Data Analysis Techniques

Based on the data collected via criterion and alternative weights, a mean value for each criterion was formed for each alternative. After, collecting the data is then analyzed using MARCOS methodology of multicriteria analysis. The multivariate technique: PLS SEM was used for analyzing the impact of Top-Level Management Support in choosing Project Management Software being the most feasible alternative available. It is feasible for smaller sample sizes and analyzes the data upon regressions.

3.6 Researcher Strength

The researchers have a scientific mind and can think critically and logically. They are always willing to take risks and always ready to face failures and rejection but never put it off, because they can accept failures as a challenge.

4. DATA ANALYSIS

The purpose of this section is to test the hypothetical relationships formulated in the study. It will provide empirical analysis using the SPSS tool. The empirical analysis will provide a statistical evidence for project managers to choose the best alternative software available in market to manage projects in software industry as well as it will analyze how much the choice of a project management software is affected due to the organizational or top management support.

4.1 Descriptive Analysis

This section analyses the sample demographics in terms of gender, qualification, experience of the project managers, criteria set for an ideal project management software for project managers along with the current project management tool being used by them. Table 4.1 demonstrates that the majority most of the sample profile constitutes Male (mean = 1.7129) with a minimum qualification of bachelor’s degree (mean=2.5545) and the expertise of respondents in their industries lies between 5-10 years (mean=2.6238),

holding a position of Project Manager (mean=3.6436) are currently using MS Project (mean = 2.4554) in managing IT projects.

Table 4.1: Descriptive Statistics

		Gender	Qualification	Experience	Position	PM Tool
N	**Valid**	101	101	101	101	101
	Missing	0	0	0	0	0
Mean		1.7129	2.5545	2.6238	3.6436	2.4554
Median		2.0000	2.0000	3.0000	4.0000	2.0000
Std. Deviation		.45468	.74129	1.04739	.81956	1.52003

4.1.1 Gender Analysis

Below shown Table 4.2 shows the frequency of gender participation in the sample size. The total size of the sample was 101 out of which the male participation was 71.3% and female participation was 28.7%. Therefore, the females were lesser in the number of respondents having a frequency of 29 while male respondents were 72.

Table 4.2: Gender Statistics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Female**	29	28.7	28.7	28.7
	Male	72	71.3	71.3	100.0
	Total	101	100.0	100.0	

4.1.2 Qualification Analysis

The purposive sampling strategy was adopted, targeted to get the responses from the project managers having an adequate educational background of project management studies. Table 4.3 shows that among 60 respondents out of 101 i.e., 59.4% of the participants had chosen their highest qualification to be of bachelor's degree. Whereas 26 were the ones holding a master's degree and 15 respondents were holding PhD degree. None of the participants was thereby holding solely an intermediate degree.

Table 4.3: Qualification Statistics

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Bachelors**	60	59.4	59.4	59.4
	Masters	26	25.7	25.7	85.1
	Doctorate	15	14.9	14.9	100.0

	Total	101	100.0	100.0	

4.1.3 Experience Analysis

This purposive sampling strategy was further extended to target the project managers having experience in their industries. The respondents were given a set of professional years' experience to choose from. Table 4.4 shows that 18.8 % of respondents were having Less than 3 years of experience, 23.8% were having an experience of 3-5 years, 33.7% were having an experience as a project manager for 5-10 years and the rest 24% of respondents were having a professional experience of 10-15 years. None have an experience of greater than 15 years in our sample.

Table 4.4: Experience Statistics

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Less than 3**	19	18.8	18.8	18.8
	3-5 Years	24	23.8	23.8	42.6
	5-10 Years	34	33.7	33.7	76.2
	10-15 Years	24	23.8	23.8	100.0
	Total	101	100.0	100.0	

4.1.4 Organizational Position Analysis

Below shown Table 4.5 shows the frequency of organizational position of a respondent in the sample size. The total size of the sample was 101. Most of the respondents hold a position of project manager in their organization with a percentage of 79.2%, then the statistics depict 8.9% of respondents were middle managers in their organizations, 6.9% were the lower managers, 4.0% were the top managers and just 1% were the ones holding a consultant position in his organization.

Table 4.5: Position Statistics

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Top Management**	4	4.0	4.0	4.0
	Middle Management	9	8.9	8.9	12.9

	Lower Management	7	6.9	6.9	19.8
	Project Manager	80	79.2	79.2	99.0
	Consultant	1	1.0	1.0	100.0
	Total	101	100.0	100.0	

4.1.5 Alternative Analysis

H1: *The project managers use different project management software's.*

The study aimed to provide a statistical evidence that different project managers use different software to manage projects in the IT industry. The choice of a project management software in questionnaire was given as per the top 6 software used in Pakistan by project managers in Software and IT industry (Jahan at el., 2019. The data collected from sample provided a justification for presence of different software being used currently. The Table 4.6 below shows the frequency of different alternative software project managers are currently using in their organizations against a total sample size of 101 responses. Majority of the project managers are using MS project with a frequency of 39 out of 101 and the second most used software is JIRA, being used by 23 of the respondents, 18 of the respondents are using Redmine, the Trello software is being used by 11 of the respondents and Asana is being used by 10 of the respondents out of a total of 101.

Table 4.6: Alternative

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**MS Project**	39	38.6	38.6	38.6
	JIRA	23	22.8	22.8	61.4
	Trello	11	10.9	10.9	72.3
	Asana	10	9.9	9.9	82.2
	Redmine	18	17.8	17.8	100.0
	Total	101	100.0	100.0	

4.1.6 Criterion Analysis

Initially, the study examined the importance of each of the criteria set for an ideal project management software in their firm. The respondents were provided a set of criteria based on literature discussed above and were asked to rate the importance of each in a project management software. A total of 7 criterions were given to rate on a Likert scale to choose the level of importance from 1 to 5. The mean value closet to 5 indicate the highest importance and value closet to 1 indicate the least importance of a criteria for project managers. The rating of respondents was totally based on their

subjectivity of experience. The table 4.7 shows the mean of each criterion analyzed from the sample response data. It can be inferred from the table that the criteria 1 and criteria 5 hold the highest rating of importance with a mean = 4.801 and mean = 4.673, and criteria C4 and C6 hold the least importance for the project managers with a mean = 4.405. The table below shows values for each of the criterion which shows that C1 and C5 hold the most importance for evaluation of a project management software whereas the criteria C2 and C7 hold middle importance and rest C4 and C6 are of lowest importance.

Table 4.7: Criterion Analysis

		C1	C2	C3	C4	C5	C6	C7
		Task	**Colab.**	**Projects**	**Portfolio**	**Resource Management**	**Platform**	**Procurement**
N	**Valid**	101	101	101	101	101	101	101
	Missing	0	0	0	0	0	0	0
Mean		4.801	4.554	4.445	4.405	4.673	4.405	4.584
Median		5.000	5.000	4.000	4.000	5.000	4.000	5.000
Std. Deviation		4915	.502	.4995	.4935	.4713	.4935	.4953
Weights		**0.047**	**0.045**	**0.044**	**0.043**	**0.046**	**0.043**	**0.045**

4.2 MARCOS Analysis

H2: *Each project management software has a distinct impact on project performance.*

After determining the mean of each criterion, the importance of each criterion had been established. Next step was to determine the rankings of each alternative software tools for managing projects. For this purpose, the first step of MARCOS data analysis technique was implemented to initially form a decision matrix. The decision matrix was formed from the data collected via survey questionnaire. Table 4.8 shows the decision matrix, along with a maximum value for each of the criteria because the maximum value for all the alternatives was desirable for determining the ranking of each alternative.

Table 4.8: Decision Matrix

	C1	C2	C3	C4	C5	C6	C7
	Task	**Colab.**	**Projects**	**Portfolio**	**Resource Management**	**Platform**	**Procurement**
MS Project	0.191	1.103	0.173	0.169	0.193	0.095	0.183

JIRA	0.218	0.205	0.193	0.179	0.193	0.190	0.187
Trello	0.188	0.208	0.176	0.175	0.184	0.179	0.18
Asana	0.188	0.198	0.184	0.094	0.105	0.189	0.072
Redmine	0.193	0.177	0.187	0.083	0.194	0.069	0.072
Max	**0.218**	**0.208**	**0.193**	**0.179**	**0.194**	**0.190**	**0.187**

The third step of MARCOS analysis was to normalize the decision matrix above. The table 4.9 below shows a normalized matrix. The values which were greater than 0 depicted that the alternative is greater than the criterion mean value and vice versa. The smaller a value is the closer was it to the mean. The table below shows that the alternatives along with their weights. The alternatives software tools of MS Project and JIRA have two maximum values for criteria. Similarly, the alternatives Trello and Asana have two maximum values and Redmine has 3 maximum values. For this purpose, MARCOS multi criteria analysis is needed to rank the alternatives for project managers to choose easily.

Table 4.9: Normalized Matrix

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
	Task	**Colab.**	**Projects**	**Portfolio**	**Resource Management**	**Platform**	**Procurement**
MS Project	-0.333	-1.717	-1.152	0.614	0.497	0.847	0.724
JIRA	1.760	0.615	1.235	0.818	0.511	0.789	0.795
Trello	-0.610	0.688	-0.872	0.743	0.252	0.601	0.668
Asana	-0.610	0.444	0.205	-0.970	-1.777	0.764	-1.098
Redmine	-0.206	-0.030	0.583	-1.206	0.515	-1.308	-1.090
Weight	**0.054**	**0.019**	**0.019**	**0.043**	**0.065**	**0**	**0.21**

The fourth step of the MARCOS method was to aggravate the normalized matrix by multiplying the weights of the coefficients with respective criterion The aggravated normalized matrix is shown below in table 4.10.

Table 4.10: Aggravated Matrix

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
	Task	**Colab.**	**Projects**	**Portfolio**	**Resource Management**	**Platform**	**Procurement**
MS Project	-0.017	-0.032	-0.021	0.026	0.032	0	0.152

JIRA	0.095	0.011	0.023	0.035	0.033	0	0.166
Trello	-0.032	0.013	-0.016	0.031	0.016	0	0.140
Asana	-0.032	0.008	0.003	-0.041	-0.115	0	0.230
Redmine	-0.011	-0.000	0.011	-0.051	0.033	0	0.228

The second step of identifying ideal and anti-ideal solutions was then implemented after establishing the aggravated normalized table. To determine both, the maximum value of each criterion was considered as to be ideal and the minimum one represents the anti-ideal solution for a certain criterion. The below table shows the corresponding values of ideal and anti-ideal solutions.

Table 4.10: Aggravated Matrix

	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**SUM**
	Task	**Colab.**	**Projects**	**Portfolio**	**Resource Management**	**Platform**	**Procurement**	
MS Project	-0.017	-0.032	-0.021	0.026	0.032	0	0.152	0.138
JIRA	0.095	0.011	0.023	0.035	0.033	0	0.166	0.365
Trello	-0.032	0.013	-0.016	0.031	0.016	0	0.140	0.152
Asana	-0.032	0.008	0.003	-0.041	-0.115	0	0.230	-0.408
Redmine	-0.011	-0.000	0.011	-0.051	0.033	0	0.228	-0.247
IDEAL	**0.095**	**0.013**	**0.023**	**0.035**	**0.033**	**0**	**0.166**	**0.367**
Anti-Ideal	**-0.032**	**-0.032**	**-0.021**	**-0.051**	**-0.115**	**0**	**-0.230**	**0.040**

The fifth step of the methodology was to determine the utility degree of each alternative. To determine the utility degree, the sum of all the criterion of an individual alternative is divided by the overall average of ideal and anti-ideal solution. The K+ and K- values were established each for MS project, JIRA, Trello, Asana and Redmine. The table 4.11 shows these utility values against each alternative. The last step of the method involved forming a utility function. This function was established against the following equation:

F (Ki) = (Ki + + Ki -)/ (1+((1-f (Ki +)/f (Ki +)) +f (Ki +)/f (Ki -))),

Whereas,

F (Ki -) = ((Ki +)/ (Ki ++ Ki -) and

F (Ki +) = ((Ki -)/ (Ki ++Ki -) and

The table 4.11 also shows the utility function value against each alternative. The values of f (Ki (-)) = 0.098 and f (Ki+) = 0.901 This

remains same throughout the analysis of each alternative. Based on this equation, the utility functions were calculated, and the ranks were assigned accordingly. The highest utility value held the highest rank.

Table 4.11: Ranking Matrix

	Ki-	Ki+	F(Ki)	Rank
MS Project	3.450	0.376	0.401	2
JIRA	9.125	0.994	0.981	1
Trello	3.8	0.414	0.40	3
Asana	-1.02	-1.111	-1.09	4
Redmine	-6.17	-0.67	-1.268	5

The results show that JIRA has the highest ranking whereas Redmine and Asana are ranked lowest among these alternatives. The results also showed that Trello and MS Project have a slight difference of 0.001 in their ranking value whereas JIRA and Trello have a difference of approximately 0.581 which is significant enough approximately 5%. The difference between the highest ranked JIRA and lowest ranked Redmine is 0.287. This amount of difference among the ranking values provides an information that almost all the software is alike as well as the normality stats also confirm the presence of specific criteria to be most in a particular alternative.

4.3 Top Management Support Analysis

To study the moderating role of Top management support in choosing an ideal solution for the typical PSEM technique of research statistics analysis was implemented using the SPSS tool.

H3: *The choice of a project management software is positively impacted by the top management support of an organization.*

4.3.1 Normality Analysis

Initially the normality test of univariate significance for investigating the significance of the independent, dependent, and moderating variables was used. For analyzing the distribution to be normal the skewness values of variables and the kurtosis values were tested. The table 4.12 below, shows that the test justifies the distribution to be normal as the value of skewness is between -1 and 1, and the kurtosis is between -3 and 3.

Table 4.12: Normality Analysis

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error

Top Management	101	-.126	.240	-.817	.476
Choice of PMS	101	-1.170	.240	.503	.476
Alternative	101	.618	.240	-1.126	.476
Valid,N (Listwise)	101				

4.3.2 Reliability Analysis

The Cronbach alpha test was implied to validate the survey consistency and reliability. The acceptable value of this test as given by Nunally (1994), is 0.6 and any value above this range. The table 4.13 shown below justifies the reliability and consistency of research questionnaire with a value of 0.6 that is in the acceptable range.

Reliability Statistics

Cronbach's Alpha	N of Items
0.603	13

Table 4.12: Item-Total Statistics

Scale	Mean if item Deleted	Variance if Item Deleted	Corrected item Total correlation	Cronbach's Alpha if Item Deleted
C1-Task	49.5842	19.665	0.591	0.551
C2-Collaboration	49.6436	20.432	0.399	0.571
C3-Projects	49.6634	21.146	0.258	0.588
C4-Portfolio	50.1287	17.593	0.396	0.548
C5-Resource Management	49.5050	20.592	0.372	0.575
C6-Platform	50.1782	16.848	0.452	0.532
C7-Procurement	50.0297	16.369	0.459	0.528
TM-2	49.9901	20.250	0.170	0.599
TM-3	50.0000	20.540	0.124	0.609
TM-4	49.8119	21.314	0.052	0.620
TM-5	49.8515	21.708	0.030	0.620
TM-6	49.9208	20.674	0.142	0.603
TM-7	50.1683	20.781	0.100	0.613

4.3.3 Correlation Analysis

The relationship of independent, dependent, and moderating variable was validated by performing correlation analysis. The range of coefficient should be from -1.0 till 1.0, the more the value was closer to 0 it meant the relationship was weak and more it was closer to 1 it inferred a strong relationship. The table 4.13 below shows that the top management impacted positively on the decision of project management software being currently used by project managers in their organization, the value 0.478 justifies the relationship to be significantly positive. However, the table 4.13 below also shows that the top management impacts negatively on the choice of an ideal project management software to be chosen of by an individual in a company.

Table 4.13: Correlations

		1	2	3
Alternative	**Pearson Correlation**	1		
Top Management Choice of an ideal PMS	**Pearson Correlation**	0.485**	1	
	Pearson Correlation	-.611**	0.154	1
	**. Correlation is significant at the 0.01 level (2-tailed)			

4.3.4 Regression Analysis

To identify the unit of impact of top management in supporting the decision for an ideal project management software to manage team projects, regression analysis was done. The regression analysis authenticated the moderating impact of choice of an ideal solution.

A linear regression technique was implemented in SPSS. The table 4.14 shows summary of the regression model. The correlation coefficient R shows a strong relationship between predictor variables as it is closer to 1. The value of R square depicts 46% change in dependent variable due predicting variables. The significance values for the model are less than 0.05 which means the regression model is fit.

Table 4.14: Model Summary

					Change Statistics				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**R Square Change**	**F Change**	**Df1**	**Df2**	**Sig. F Change**

1	0.632a	.400	.388	.46220	.400	32.634	2	98	0.000
2	0.685b	.469	.453	.43695	.069	12.655	1	97	0.001

a. Predictors: (Constant), Top Management, Alternative

b. Predictors: (Constant), Top Management, Alternative, Interaction term

The table 4.15 below, show that the alternatives software being used currently in the organizations have an indirect significant relation with the choice of an ideal project management software (b= -.272 and p= 0.000 which is less than 0.05). The table below also shows that the top management has a direct significant impact on the choice of an ideal project management software (b=215 and p = 0.041 which is less than 0.05). However, the top management has a mitigating significant moderating impact over the choice for an ideal project management software (b=-.235, p=0.001) as due to the induction of top management support in choosing an ideal project management software the negative impact of alternatives is mitigated and has now a positive value of beta coefficient of b= 0.72 where p =0.012.

Table 4.15: Coefficients[a]

Table 4.15: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.013	.392		10.244	.000
	Alternative	-.272	.035	-.701	-7.834	.000
	Top_ Management	.215	.104	.185	2.070	.041
2	(Constant)	2.092	.655		3.194	.002
	Alternative	.726	.283	1.868	2.569	.012
	Top_ Management	.684	.164	.590	4.161	.000
	Interaction_ term	-.235	.066	-2.800	-3.557	.001

a. Dependent Variable: Choice_of_PMS

4.4 Accepted / Rejected Hypothesis

Hypothesis	Statement	Result
H1	The project managers use different project management software's.	**Accepted**

H2	Each project management software has a distinct impact on project performance.	**Accepted**
H3	The choice of a project management software is positively impacted by the top management support of an organization.	**Accepted**

5. RESULTS DISCUSSION, LIMITATIONS, IMPLICATIONS AND RECOMMENDATIONS

The purpose of this section is to discuss the results in section 4 and deliberate the objectives of the research study. This section discusses the macros and statistical operations done in previous section to rank different project management software according to their part in increasing project performance, and later analyzing the impact of top management support in choosing the tool with highest ranking i.e., JIRA for managing project in IT industry.

After discussing the results, this section presents the importance of the study in academic and organizational level implication. As well as the section highlights the limitations of the study and opens the lens for future studies to be done by researchers.

5.1 Results Summary

5.1.1 Study Question (1)

To investigate the answer to this question, the very first hypothetical formulation **H1**: *The project managers use different project management software's,* was established. The descriptive analysis of different alternative project management software justifies that the project managers in IT industry are using different tools to manage projects. The results showed MS project to be the most used tool with a percentage of 38.6%, then comes JIRA with a percentage of 22.8%, then Redmine with a percentage of 17.8% whereas Trello and Asana hold the most minimum percentage of 10.9% and 9.9% each.

5.1.2 Study Question (2)

To investigate the answer to this question, the second hypothetical formulation **H2**: *Each project management software has a distinct impact on project performance.*

The MARCOS analysis performed in section 4, provides a detailed implementation of each step to identify the highest ranked project management software in terms of impacting the project performance. The results infer that each project management software has its distinct utility function in increasing project performance based on which the tools were ranked. JIRA holds the highest rank of 1, due to its highest utility function value of 0.981, then MS Project is ranked at number 2 with a utility function value of 0.401, the utility function value of Trello is found to be near to MS Project i.e., 0.40 yet it was ranked at number 3 due to a difference of 0.001. The software Asana and Redmine are ranked the lowest at 4 and 5

positions. This is since they are not much optimal in the criteria of project performance the experts have set.

5.1.3 Study Question (3)

To investigate the answer to this question, the third hypothetical formulation **H3**: *The choice of a project management software is positively impacted by the top management support of an organization.* The results in previous section confirm the positive impact of organizational support in choosing the most optimal project management software to manage the organizational projects. The result is deduced from regression analysis of the moderating role of top management support. The top management support has a positive significant impact of almost 23% (b = 2.35) in increasing the choice of an ideal solution and minimizing the current solution the project managers are implying to manage their projects.

5.2 Research Discussion

The research results and findings justify the research hypothesis by providing a statistical justification of each. The data gathered from the survey questionnaire was coded in SPSS tool. The descriptive analysis initially performed inferred to the evidence of different project management software being used in different IT companies of Pakistan. The analysis resulted that MS Project is being used by 39 companies, JIRA is used by 23 companies, Redmine is used by 18 companies, Trello is used by 11 companies an Asana is being used by 10 companies out of a total sample size of 101 companies. The study later implemented the MARCOS method in ranking this software for project managers to opt for the most optimal one. To perform the MARCOS analysis initially a criterion analysis was done. For this purpose, a set of criteria was developed from the data collected via survey questionnaire of an ideal project management software in increasing the project performance. The questionnaire included 7 sets of criteria

(Tasks, *Collaboration, Projects, Portfolio, Resource Management, Platform and Procurement Management)* which were formed based on the literature review of project performance critical factors. The project managers were then inquired in the questionnaire to rate the importance of each criterion to be present in an ideal project management software. Once the data was gathered for each, the weights were assigned to each criterion. After setting the weights a decision matrix for each alternative (MS Project, JIRA, Trello, Asana and Redmine) based on the weights of the importance of a certain criterion was established and normalized and aggravated with the weights. To establish the rank of each alternative software the mathematical calculations of MARCOS methodology were implied, and tools were ranked. The results showed that JIRA is ranked the highest in increasing the project performance, MS Project is ranked secondly, Trello is ranked at third position in increasing project performance, then comes the Asana and lastly Redmine. The difference in ranking of each software tool is due to the difference in availability of each criteria level in each. After giving ranks, the study analyzed the top management support in choosing the most optimal project management software that can be used in an organization for an increased project performance. The results justify an increased moderating impact of top management support while choosing a project management software to manage organizational projects. The co-efficient of moderating term shows that

approximately 23% of the organizational support is needed in choosing the right project management software in an IT company.

5.3 Research Limitations

The present research analyzed the right choice of a project management software in increasing the project performance in just IT industries of Pakistan. The responses of the study were gathered based on convenient sampling technique and collected from just 20-25 firms out of a total of 4641 IT industries registered in Pakistan by PSEB.

5.4 Research Implications

The present research has both academic as well as professional impact for project managers. The research has implemented the latest multi criterion analysis method of MARCOS to rank the project management software and contributes to the literature where the availability of project management software is multiple, and one must choose the most optimal one. The research provides a clear guide for professionals and top management to opt for a right project management software for managing the IT projects.

5.5 Future Suggestions

The researchers can investigate the same objectives of study in different industries as construction, services, medical etc., The researchers can implement the latest MARCOS method to rank different project management software being used in these industries to provide a statistical evidence for project managers to opt the best one. The researchers can also explore different moderating and mediating variables in also increasing the chances of choosing the best one and minimize to minimize any hindrance in the way of managing the projects with the most advanced project management software in their industry for an increased project performance and hence project success.

5.6 Conclusion

The importance of project management is inevitable. The project managers are using different project management tools in managing their organizational projects. As the market has multiple options available for project managers to opt a project management software therefore, they must choose the most optimized tool. This research provides a statistical evidence for choosing the best project management software available in market for managing any IT project. The study asked different project managers to provide which project management software they are currently using and its impact on project performance. This gave a data about what project management software are being used in the market. The most used ones were MS Project, JIRA, and Trello while least used were Redmine and Asana. The study then inquired about the feature importance of tasks, collaboration, projects, portfolio, resource management, platform, and procurement in a project management software from the experts. These established criteria set for a best alternative among MS Project, JIRA, Trello, Redmine and Asana. Later the study ranked these alternatives against the criteria sets following the MARCOS methodology, and the results ranked JIRA the best solution to manage IT projects considering

the highest level of project performance be provided and Redmine was ranked the least. Once the project managers get to know the best alternative the study also aimed to induce their choice with the support of Top management in choosing JIRA as a project management tool in their firm. The results provide a statistical evidence that if top management supports then the decision to choose JIRA as the best alternative to manage IT projects will increase by 23%.

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