Evaluation of the Project Management Information System in Saudi Arabia (Riyadh Municipality as a case study)

submitted by

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إعداد

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قسم إدارة الأعمال، المملكة العربية السعودية

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ABSTRACT

The process of evaluating information systems used in project management is a complex process and needs to show the real function of the Information System,

the aim of this research is to conduct a comprehensive evaluation of the most important programs used in Project Management in Riyadh Municipality , Kingdom of Saudi Arabia. The data was collected by technical experts located in Riyadh Municipality and the best option used in the management of technical projects was MS project (35.5%), the process of evaluating information systems used in project management is a complex process and needs to show the real function of the Information System, the aim of this research is to conduct a comprehensive evaluation of the most important programs used in Project Management in Riyadh Municipality , Kingdom of Saudi Arabia. The data was collected by technical experts located in Riyadh Municipality and the best option used in the management of technical projects is . Through the research, the most important criteria used in the selection of Information Systems in project management were identified, and after analyzing the data, this study showed that integrity and applicability is highly important feature based on other criteria. This research contributed to the discovery of the most important standards and alternatives that can be adopted in the management of Information Systems projects.

1. Introduction

The proactive integration of project management methods is shaping the way industries and construction projects are executed in the modern era (Saduakassova, 2023). The Project Management Institute (PMI) defines project management as the utilization of knowledge, skills, tools, and techniques to carry out project activities to fulfill the project's requirements (Ghorbani, 2023). The effectiveness of Project

Management depends on how well it aligns with the organization's context. The value of Project Management is determined by the implementation and the extent to which it fits with the strategic drivers of the organization (Cooke-Davies et al, 2009). It is widely acknowledged that project management practices vary widely depending on factors such as project type, application domain, and contextual factors. Therefore, the effectiveness of project management is tied to the specific organizational context, including factors such as structure, size, and company environment (Besner and Hobbs, 2008). To succeed in different fields or industries, it is crucial to explore the project management tools and methodologies used specifically in those areas.

Project management (PM) involves the use of techniques and tools to plan and execute a unique set of tasks, carried out by resources, to achieve specific goals (BSI, 2012), in recent years, technological advances and widespread adoption of artificial intelligence have led to a digital transformation in project management. This shift has led to the availability of various project management software designed to support tasks such as task management, status tracking, resource allocation, and online collaboration. These tools aim to streamline and automate project management processes (BSI, 2012). As a result, organizations now consider it essential to leverage information systems (IS) to effectively manage complex projects and increase overall success rates. An information system (IS) is utilized to gather, store, process, and distribute information for decision-making and managing information flow within an organization (Varajão et al, 2023). In project management, a Project Management Information System (PMIS) is specifically created to assist with different project processes. It serves as a platform for project managers and team members to collaborate, track and manage project tasks, monitor progress, allocate resources, and make well-informed decisions (Ottaviani, 2023).

Information Systems projects have a significant socio-technical aspect, meaning they involve both people and technology. They come in various shapes and sizes, including digital transformation initiatives, custom development of IT/IS solutions, consulting

for Information Systems, or implementing pre-built commercial applications (Meneses and Vara ao, 2022). When it comes to information systems projects, having a competent and cooperative team is one of the most vital elements for achieving success. Effective teams play a significant role in determining the outcomes and overall effectiveness of these projects (Rehman et al., 2020). One of the noteworthy instances of Information Systems in contemporary times involves the information management modeling system, facilitating seamless collaboration among project stakeholders, and permitting users to centrally store data for convenient accessibility (Kocakaya et al, 2019), So currently, information systems are not developed and deployed in isolation, instead off they are integrated with and expand upon pre-existing extensive and intricate information systems. The dynamic characteristics of the information infrastructure encompass features such as openness, shared resources, continuous evolution, standardization, diversity, and the utilization of existing installations, the concept of information infrastructure provides a fresh perspective for examining information systems and has been adopted by numerous researchers in the field of information systems (Hanseth, 2010).

2. Literature review and background

Project Management, Information Technology (IT), and Software Engineering are indispensable fields in the contemporary world. They are firmly established, acknowledged by professionals, and supported by well-defined standards, methodologies, tools, certifications, and industry associations (Morcov et al,2020). Nevertheless, even in this well-established landscape, intricate projects continue to pose significant challenges and risks, often remaining inadequately comprehended, the following studies confirm emphasized the advantages of information systems across a variety of industries, including healthcare, banking, and manufacturing. However, there is still more research that needs to be done on the use of new tools related to information system specifically in project management for example (Rusanova, 2023) focused on enhancing the efficiency of management decision-

making in transportation logistics projects through the utilization of automated planning and analysis systems. It employs a systematic approach and various scientific methods, including logical analysis, synthesis, and modeling. The study examines resource and budget planning using a logistics center as an example, monitored through MS Project. It highlights the importance of resource utilization and analyzes project progress against planned indicators. The article suggests optimizing staffing, budget, and time parameters by employing additional labor resources, leading to improved project dynamics. Finally, it underscores the need for further research in project risk management. By discovering another technique used in project management (Besner and Hobbs, 2012) presented the findings of an empirical study on project management practices. The research examines the utilization of various project management practices, tools, and techniques by surveying 2,339 practitioners from diverse backgrounds. The analysis reveals patterns of practice, showing that practitioners tend to use project management tools and techniques in specific groups or "toolsets." The article briefly compares these findings with the Project Management Body of Knowledge (PMBOK® Guide) and explores how practice differs across various project types, including engineering and construction, business and financial services, IT and telecommunications, and software development. These variations have significant implications for both project management practice and its study. (Raharjo, 2023) focuses on identifying Critical Success Factors (CSFs) for the successful implementation of Agile project management in Indonesia. The identified CSFs include management support, competent project teams, organizational processes and guidelines, organizational culture alignment with Agile, Agile training for team members, and having a clear product roadmap. The study employs the Analytic Hierarchy Process (AHP) to rank and explain these CSFs through pairwise comparisons, offering valuable insights for organizations aiming to enhance their Agile project management practices and improve project outcomes. The study's contributions are twofold: academically, it

enriches the existing knowledge base by providing a comprehensive review of CSFs specifically related to Agile project implementation. Practically, it helps organizations prioritize these CSFs, enabling them to make informed decisions and allocate resources effectively, ultimately enhancing the success of their Agile projects. However, it's important to note that the study's limitations include relying solely on literature and expert judgment for defining CSFs, potentially overlooking context-specific factors. Future research should consider incorporating diverse data collection methods and delve deeper into exploring the relationship between CSFs, organizational strategy, and the adoption of scaled Agile projects in various organizational contexts. Additionally, alternative modeling methods such as ANP, TOPSIS, and fuzzy logic based AHP could provide a more nuanced understanding of decision-making processes in prioritization. (Niederman, 2021) investigate from the stresses the significance of AI technology in project management based on their experience and the absence of an objective perspective. (Moosavi and Bardsiri, 2017) investigated the difficulty of accurately predicting the amount of effort needed for software development projects. They proposed a new approach that combines an Adaptive Neuro-Fuzzy Inference System (ANFIS) with a recently developed optimization algorithm called Satin Bowerbird Optimizer (SBO) to improve the reliability of these estimates. The authors' hybrid model aims to address the issue of unreliable estimates by utilizing ANFIS's adaptability and SBO's optimization capabilities. The effectiveness of the model was evaluated by comparing it with other optimization algorithms and using real data sets, which showed promising improvements in estimation accuracy. To utilize algorithms and data effectively, it is necessary to transform certain qualitative indicators (such as programming language) into quantitative indicators, a process that can potentially introduce biases and this is considered a limitation. (Abreu et al, 2018) uses triangular fuzzy numbers to evaluate traditional economic criteria for software development projects, which introduces flexibility and certainty in the prediction process. The method considers three possible

scenarios and allows for variations that may occur during the project's life cycle. The proposal was experimentally applied to 30 software projects, and the results were compared with those obtained by traditional economic criteria. The study found significant differences in favor of the fuzzy economic criteria for Net Present Value and Internal Rate of Return, and better results were achieved for fuzzy Period of Recovery of Investment, although the difference was not statistically significant, the limitation of this study was the calculations involved in the model are intricate, and it may be challenging to apply them to the industry.

(Wanner et al, 2020) explain a model for making investment decisions in AI is outlined, which combines the use of AHP, an economic model, and sensitivity analysis, the authors suggest three primary assessment criteria for AI projects: effort, performance, and interpretability. These criteria are further categorized into aspects like human resources, time, cost, and other relevant factors. The weakness point is that the author exhibits a prevalent bias in favor of AI systems. Nevertheless, it should be noted that this concept lacks a strong academic basis. (Vidgen and Wang , 2009) present three principles for the co-evolving system: aligning with the pace of co-evolutionary change, enhancing self-organization, and coordinating the balance between exploitation and exploration. This academic theory is valuable for organizations as it assists in evaluating their resources (agile capabilities) and development systems during the implementation of agile software development. (Edeson, 2012) promoted the use of an integrated systems approach to understand project team resilience in various organizational systems, including businesses, non-profits, and governmental entities. This approach highlights the importance of developing adaptive capacity through organizational learning. (McEvoy et al, 2016) focused on discussion and theory rather than relying on empirical data. The authors arrived at a framework called results-based management, which has the potential to analyze project management activities. The study establishes a link between capacity development and the concept of 'complexity,' incorporating Complex Adaptive Systems (CAS) into

the process of designing and overseeing capacity development. (Khanfar at al, 2018) identify critical failure factors (CFFs) for IT projects, classify them based on their source, and prioritize them using fuzzy analytic hierarchy process (FAHP). The study found that project team and planning are the highest impact factors on IT project performance, and critical failure factors of unstable organization environment and poor communication and reporting between project stakeholders are the most significant CFFs that lead to project failure. The paper provides a framework for IT project managers and practitioners to diagnose and solve CFFs with high impacts on project performance to avoid project failure from the early stages of the project. The study recommends that organizations focus on improving and developing internal operations and business processes to avoid failure. Future studies should focus on the interrelations between CFFs and their impact on IT project performance. (Lamba et al, 2020) determined and propose a model for ranking the factors that hinder or act as barriers to implementing reverse logistics (RL) in E-commerce supply chains. The study identifies a total of 16 barriers and employs the analytic hierarchy process to prioritize them. Among these barriers, the top three hindrances for RL in E-commerce companies are the insufficient investment in RL, a lack of comprehension of best practices, and uncertainties regarding demand. The research findings have the potential to assist companies in effectively implementing RL processes, offer insights for government policymakers, and shed light on the challenges associated with RL adoption in developing nations. The study recommends substantial investments in infrastructure and advanced technology to integrate RL seamlessly into E-commerce supply chains. The limitations of this study pertain to its methodology, and it suggests that future research should explore and compare RL implementation across different companies using methods like Data Envelop Analysis (DEA) as well as other techniques such as ANP, ELECTRE, and PROMETHEE.

This study aims to identify the most important tools used for information systems in project management and assess them using the hierarchy and their application within the Riyadh Municipality within the kingdom of Saudi Arabia.

3. Research Methodology

The phase of data collection and methodology is crucial in an AHP project as it ensures that the rankings are founded on reliable data and expert opinions. This phase offers a systematic method for assessing and prioritizing information system technology tools, which promotes informed decision-making in the selection of IS tools. Table 1 explain the research methodology phases:

Table 1: Research Methodology phases for IT tools and assessment.

#	Research Methodology Item	Description
1	Identify Stakeholders	Identify the key stakeholders or experts who will participate in the AHP process. These individuals should have knowledge and expertise related to the information technology tools being ranked.
2	Define Criteria and Sub-Criteria	Clearly define the criteria that will be used to evaluate the IT tools. These criteria should be relevant to the goals and objectives of the project. Each criterion may have sub-criteria that provide more detailed aspects for evaluation.
3	Collect Data	Gather data on each of the IT tools being considered for ranking. This data may include information on features, performance, cost, user feedback, and any other relevant attributes.
4	Pairwise Comparisons	Conduct pairwise comparisons for each criterion and sub-criterion. Stakeholders or experts will compare the importance or performance of each criterion relative to the others using a scale, typically ranging from 1 to 9 in AHP.
5	Consistency Checks	Perform consistency checks to ensure that the pairwise comparison judgments are consistent. Inconsistent

#	Research Methodology Item	Description
		judgments can lead to unreliable results, so adjustments may be needed.
6	Data Analysis	Use the collected data and pairwise comparison results to calculate the weighted scores for each criterion and sub-criterion. AHP uses mathematical calculations to determine the weights that reflect the relative importance of each criterion.
7	Ranking	After obtaining the weights, rank the IT tools based on their overall performance against the criteria. The tool with the highest overall score is considered the best choice.
8	Sensitivity Analysis	Perform sensitivity analysis to assess the robustness of the rankings. This involves making small adjustments to the judgments or data to see if the rankings change significantly.

In some cases, decision-making requires more than just a simple idea to implement and necessitates a deeper understanding of the problem. (Saaty,2004) proposed the Analytic Hierarchy Process (AHP), which is a mathematically based tool for multi-criteria decision-making. It is designed to handle complex, unstructured, and multi-attribute problems. The AHP generates weights for each evaluation criterion by assigning scores based on pairwise comparisons made by the decision-maker. The higher the weight assigned to a criterion, the more important it is considered to be. The results are then synthesized. Although the AHP was initially developed for general use, it has been applied in various fields. For instance, (Karaman and Akman, 2018) used AHP in the Turkish airline industry to assess the criteria for corporate social responsibility (CSR) programs among many alternatives. They discovered that the CSR model in the airline industry is limited to an economic domain and is hindered by social and environmental dimensions. (Kokangül et al, 2017) conducted a risk assessment study in a manufacturing company and discovered that the AHP method

can determine the importance levels and risk classes of hazards simultaneously. (Zhang et al, 2018) evaluated the performance of various rural house space heating systems and identified the best system among the options using the AHP method. (Ho and Ma, 2018) conducted a literature review on integrated AHP approaches and applications published between 2007 and 2016. They found that AHP has been applied to a wide range of topics, including manufacturing, logistics, supplier evaluation and selection, distribution network replacement, and many others.

Table 2: Main information system tools used in project management and organizations.

#	Information System tools	Description
1	Project Management Software	Comprehensive tools such as Microsoft Project, Primavera P6, and Smartsheet help in creating project plans, tracking progress, managing resources, and generating reports.
2	Task Management Software	Tools such as Trello, Asana, and Jira enable teams to manage tasks, set priorities, and collaborate on project activities.
3	Gantt Chart Software	Gantt chart tools such as Gantt Project or Insta gnat assist in visualizing project timelines and dependencies.
4	Project Portfolio Management (PPM) Software	PPM solutions such as Planview and CA PPM help organizations manage multiple projects and allocate resources efficiently.
5	Resource Management Software	Tools such as Resource Guru and Team deck assist in resource allocation, ensuring that the right people are assigned to the right tasks.
6	Document Management Systems	Platforms such as SharePoint, Google Drive, and Dropbox enable secure storage, sharing, and version control of project documents.
7	Time Tracking Software	Tools such as Toggl and Harvest help team members track the time spent on various project tasks for accurate billing and resource allocation.
8	Agile Project Management Software	Tools such as Jira (for Agile development), Scrum wise, and Target process are specialized for Agile project management methodologies.

#	Information System tools	Description
9	Knowledge Management Systems	Platforms such as Confluence and SharePoint are used for storing and sharing project-related knowledge and documentation.

A preliminary question form (face-to-face interview) was distributed to determine the basic criteria for selecting information systems related to project management, then these systems were identified to be evaluated using the hierarchical analysis method, and a model was created to explain this.

The main criteria to select the information system tools which used in the project management at Riyadh Municipality presented in the following table:

Table 3: The main criteria selected at Riyadh Municipality for choosing the information systems.

#	Main Criteria	Definition	Sub Criteria
1	Accessibility	Accessibility, in this context, refers to the capability of the system to accommodate various user roles and the convenience of accessing it remotely. The system ensures accessibility by providing access to multiple categories of users, such as consultants, contractors, and project managers. This involves the availability of a portable version, enabling teams to access the system from the field.	Access on different portal.
2	Integrity and applicability	Integrity and applicability involve the system's relevance and suitability to meet the diverse needs of different projects across various departments within the business. It ensures that the integrated management system is versatile enough to accommodate the unique requirements of different projects. The integrated management of project data, documents, and stages goes beyond maintaining integrity and applicability. It also includes providing	Applicable to all departments software.

#	Main Criteria	Definition	Sub Criteria
		additional and complementary features through the linkage with other systems. For example, the system can facilitate processes such as submitting material inspection requests by integrating with sample inspection systems. This comprehensive approach aims to meet the varied business and project requirements across all departments.	
3	Analyzing and Visualization Data	Analyzing features involve the capability to examine and interpret data, drawing meaningful insights and conclusions. Visualization features, on the other hand, pertain to presenting data in a graphical or visual format, enhancing the understanding of complex information through charts, graphs, or other visual representations. When integrated into a business intelligence context, these features become crucial. Business intelligence dashboards leverage analyzing and visualization features to track key indicators, monitor progress, and manage budgets for various projects. This not only allows users to view the current status of projects but also facilitates the issuance of comprehensive reports. These dashboards provide more than just a snapshot of project statuses; they enable in-depth analysis of information needs for project beneficiaries. By leveraging analyzing features, the system can identify and understand the specific requirements and preferences of stakeholders, ensuring that the information	Analyzing and Data reporting

#	Main Criteria	Definition	Sub Criteria
		presented aligns with the needs and expectations of the intended audience. This approach enhances the overall effectiveness of project management and decision-making processes.	
4	Flexibility	Flexibility refers to the system's adaptability and versatility in accommodating diverse needs and preferences. In the context of project management, flexibility manifests in various aspects, including partner evaluation, communication, user interfaces, and continuous training. The flexibility extends to user interfaces (UI) and the overall user experience (UX). The system is designed with user-friendly interfaces, ensuring ease of use for individuals who may not have extensive knowledge or experience in management systems. This approach enhances accessibility and usability for a diverse user base.	Easy to use for user.
5	Privacy	Privacy refers to the protection of sensitive information and the control individuals have over their personal or confidential data. In the context of project management, privacy involves safeguarding project-related information and ensuring controlled access to data.	Protection data. Allow to share data with specific role.

After initial data collected from experts which involve the information systems used in project management the following table presents each information system with its main role.

Table 4: Alternative information systems at Riyadh Municipality.

#	Information System Name	Definition of the system	Major role of system
1	EPM	Enterprise Performance Management (EPM) involves the continuous monitoring of performance throughout an organization with the aim of enhancing overall business effectiveness. By integrating and analyzing data from diverse sources such as e-commerce platforms, front and back-office applications, data warehouses, and external datasets, an EPM system provides comprehensive insights. Sophisticated EPM systems are capable of accommodating various performance methodologies, including but not limited to, the balanced scorecard approach. (Fabac,2010)	To add information, scope, and project card.
2	P+	P+ is an end-to-end project management system that gives you a complete overview of your organization's portfolios, programs and projects with the ability to keep them on track.(Sadeghi-Bazargani,2010)	Project dashboard, follow-up of projects by all agencies affiliated with the Secretariat, establish a clear timeline for the project, issuing reports on projects.
3	PMIS	A Project Management Information System (PMIS) serves as the structured organization of a project's information. It gathers and utilizes project data via one or multiple software applications. These tools aid project managers in strategizing, executing, and concluding their projects, while effectively	It is a software-based system that assists project managers and teams in planning, executing, monitoring, and closing projects. PMIS provides a centralized platform for storing and managing project-related information, facilitating

#	Information System Name	Definition of the system	Major role of system
		managing the influx of information to prevent overwhelm. (Lee,2012)	collaboration, and supporting decision-making throughout the project life cycle.
4	Basecamp	basecamp is a flexible project management solution crafted to enhance team collaboration and organization. It boasts an array of functionalities including task management, file sharing, messaging, scheduling, and more, all accessible through a unified platform. With Basecamp, teams can optimize communication, monitor project progress, and maintain efficiency, making it an ideal tool for managing projects of any scale.(Hermawan,2021)	The ability to add all documents related to the project. Providing the opportunity for all those added to the system to exchange opinions. Add any suggestions to the system's space. Ease of following up on projects, Ease of adding projects, setting milestones, and developing a plan And the project schedule allows Easy access to any comment from anyone added to the system. Privacy is high as the system is restricted to individuals. Only those authorized within the agency.
5	MS Project	Developed by Microsoft, this software aims to provide project managers with the ability to create project plans and requirements, assign tasks to team members, and monitor project statuses. Users are grouped according to their assigned tasks or roles, with access levels granted to various project documents.(Cicibas,2010)	It is designed to assist project managers in planning, scheduling, executing, and tracking the progress of projects. Microsoft Project provides a range of tools and features that help project managers and teams effectively manage their projects from initiation to completion.

The model was created by using Expert Choice software which is used in decision making process and make pairwise comparisons between criteria and other comparison between alternatives based on each criterion.

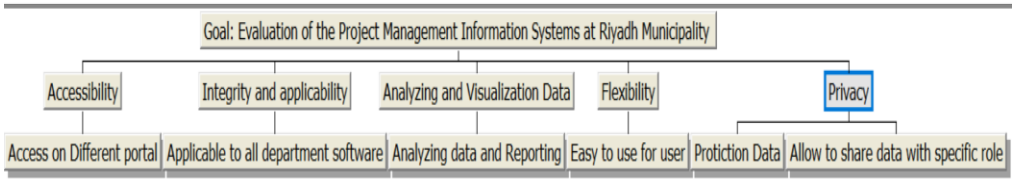

Figure 1: The main goal with criteria and sub criteria model.[Expert Choice Software].

4. Results and Discussion

At this stage, the results were obtained after collecting data through experts in the Riyadh region of the kingdom of Saudi Arabia, the results indicate that the highest important criterion for experts was Integrity and applicability (45.3%) and the best alternative of the available options is MS project (35.5%). The following graph represents the result.

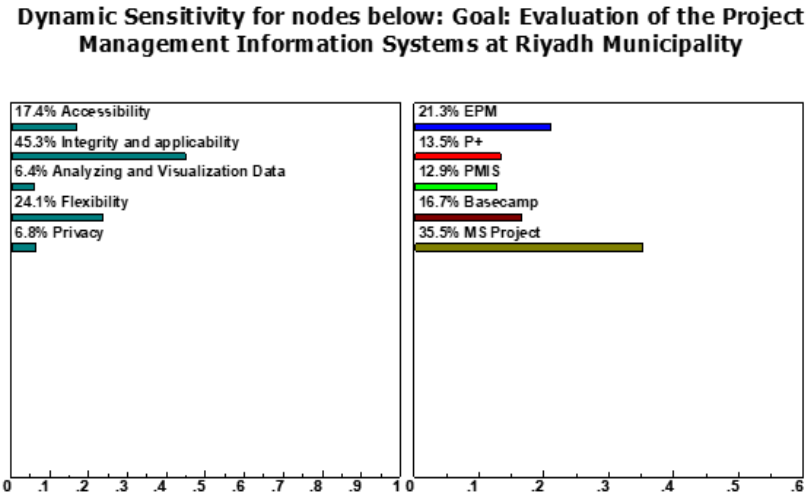

Figure 2: The dynamic sensitivity for Evaluation of the project management information systems at Riyadh Municipality.

The sensitivity analysis for this result shown in fig 3 which includes the vertical line implies to current state of the data and if the score change a little toward right side the alternative score will impacted based on option weight.

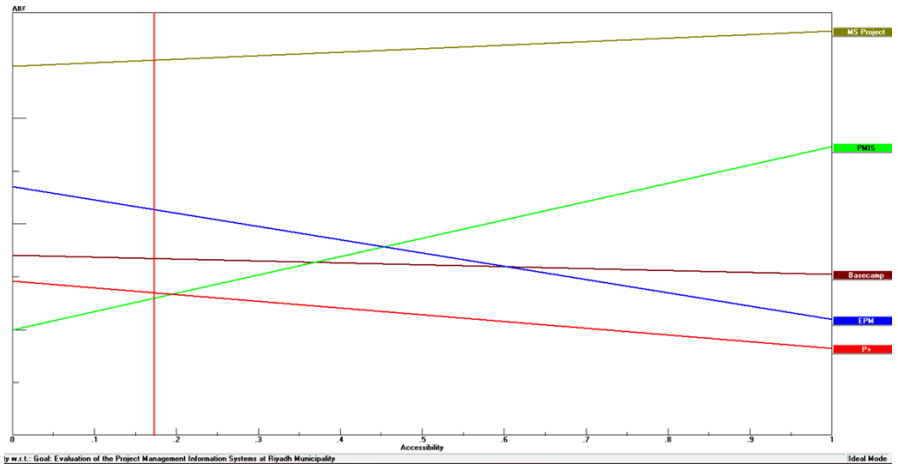

Figure 3: The gradient sensitivity for Evaluation of the project management information systems at Riyadh Municipality.

5. Conclusion

Evaluation process to select the best tool used in information systems for project management is highly complicated, by collecting data using questioner and using Expert Choice software support to discover the whole software used in Riyadh municipality. The integrity and applicability criteria is selected as high important feature for information systems based on experts judgment. The best option used at Riyadh municipality is MS project and the most technical experts in IT system prefer to use it more than other software's.

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The Riyadh Municipality contributed to facilitating accurate information and data to the researcher in this project and provided the necessary support to obtain accurate results.

Biography

Dr. Abdullah Alkharmany has experienced and highly qualified leader in project management and business development with a proven record of accomplishment across various sectors. A dedicated and diligent engineer with over 24 years of experience in project management, engineering, and business administration. Possessing high efficiency and managerial competence, coupled with strong communication skills. Forward thinking and ready to contribute valuable expertise and skills to overcome challenges faced by organizations. Eager to leverage rich and robust practical experience and skills in a challenging work environment, aiming to become an asset to the organization he work for. Qualified to work in a senior managerial position or as a leader or part of a team and has the ability to work successfully to meet schedules and deadlines.

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