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Construction Program Management- To Establish a Framework for Selection of Program Management Software

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Abstract

Program management plays a critical role in the successful management of projects that are interconnected and aimed at achieving specific goals. With the increasing complexity of projects, it has become necessary to use Project Portfolio Management (PPM) software for effective communication, coordination and control of multiple projects. However, selection of appropriate software can be a challenging task.

The aim of this thesis is to study different PPM software and establish a framework for software selection to be used for Program and Portfolio management.

To achieve this objective, various PPM software options have been evaluated, and a framework for software selection has been developed using WSM approach of multiple criteria method. A survey was conducted among Professionals and students of PM to support the approach. Based on the survey and Weighted Score Method (WSM), a software has been selected for program management of construction projects in Polito's expansion plan. The selected software will help in managing the construction projects effectively.

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1. Introduction

The management of construction projects is a complex and challenging task that requires a systematic approach. Program Management plays a crucial role in this process, providing a framework for managing multiple projects in an organized and efficient manner. Construction Program Management (CPM) is a subset of Program Management, specifically designed for the construction industry. It plays a vital role in ensuring the success of multiple construction projects. The objective of CPM is to manage construction projects in an organized manner, ensuring they are completed on time, within budget, and to the desired quality standards.

This thesis aims to highlight the importance of Program management in construction and to select a suitable PPM software for managing the construction program of PoliTO expansion plan.

PPM software provides a centralized solution for project planning, scheduling, budgeting, resource allocation, and performance tracking. The selection of a PPM software can significantly impact the success of the construction program.

This thesis will study different key factors which a PPM Software should have for effective portfolio management and will discuss different available software packages. These different alternatives will be compared and criteria for selection of most suitable tool will be advised in this thesis.

In short, the objective of this thesis is to highlight the significance of CPM and the role of PPM software in the management of construction programs. By carefully considering their specific needs and evaluating the various options available, organizations can ensure that their construction programs are managed effectively and efficiently, resulting in successful completion of projects on time, within budget, and to the desired quality standards.

2. Literature Review

2.1 Portfolio, Program and Project Management

A portfolio is a combination of projects, subsidiary portfolios, programs, and operations that are managed collectively to accomplish strategic goals.

Programs are made up of connected projects, subsidiary programs, and program activities that are managed in concert to achieve benefits not possible from managing them separately. Programs are typical portfolio components that are carried out to produce benefits crucial to an organization's strategic objectives. [1]

Projects are short-term initiatives that are done to produce distinctive products, services, or results, whether they are managed independently or as a part of a program.

The centralized management of one or more portfolios in order to accomplish strategic goals is known as **Portfolio Management**. When selecting programs or projects to sponsor, prioritizing their objectives and tasks, and making sure they have enough resources available are all key to portfolio management.

Program management is the process of applying information, skills, and concepts to a program in order to achieve program objectives and to gain advantages and control that are not possible when managing program components separately. [2]The main goal of program management is to deliver benefits resulting from a group of related projects and other programs in a coordinated and efficient manner. Program manager is the responsible for achieving program goals and objectives.

Application of knowledge, skills, tools, and procedures to project activities in order to achieve project requirements is known as **Project Management**. The goal of project management is to effectively deliver the outputs and results that businesses need while adhering to predetermined time, cost, and specification restrictions.

Through their interactions, Portfolio, Program, and Project management can be differentiated from one another. In order to achieve the required organizational value, portfolio managers make sure that programs and projects are chosen, ranked, and staffed in accordance with the

organization's strategic plan. Program managers concentrate on achieving organizational benefits in line with the organization's strategic strategy through the coordinated administration of projects, subsidiary programs, and other supporting tasks. The primary focus of project managers is on producing the precise outputs and outcomes needed by an organization as part of a project, program, or portfolio. [2]

2.2 Role Of Program Manager

The individual designated by the performing organization to oversee the team or teams in charge of attaining program objectives is known as a program manager. The program manager continues to oversee the direction, conduct, and performance of a program as well as the formation of a program team that is able to meet program goals and provide anticipated program benefits. As opposed to project managers, program managers have a different set of responsibilities. The difference between these two roles is based on the basic difference between the Project and Program management as discussed earlier in 2.1.

2.3 Role of Program Management Office

A program management office is a type of management structure that promotes the exchange of resources, methodologies, tools, and approaches while standardizing the governance procedures for programs. This office frequently provides support for organizational change management initiatives such as training. Program management offices may be set up within a specific program to provide support for that program or outside of a specific program to give assistance for one or more programs within an organization. [2]

A program management office, when created as a part of a program, is a crucial aspect of the infrastructure of the program and an aid for the program manager. It could help the program manager handle numerous projects and program activities by following;

- Defining standard program management practices.
- Providing trainings.
- Support Communications.
- Support Change management.

- Conduct performance analysis.
- Supporting budget and timeline management.
- Define Quality standards.
- Reporting Management
- Resource management
- Centralized support for risks and decision making.

And other tasks…

Its to be noted that some program runs for many years that many activities overlaps with organizational operations. The PMO of such programs may take some of the operational activities under their responsibilities.

Some businesses decide against having explicitly program management offices. In those circumstances, the designated program manager often takes on the managerial role of the program management office.

2.4 Program Management Performance Domains

During all phases of Program Management, the Program Managers ensures the goal achievement of programs by working simultaneously in multiple performance domains which are; [1]

- Program Strategy Alignment
- Program Benefit Management
- Program Stakeholder Engagement
- Program Governance
- Program Life Cycle Management

2.4.1 Program Strategy Alignment

This performance domain defines program outputs and outcomes to deliver benefits in line with the goals and objectives of the organization.

Programs are created to be in line with organizational strategy and to make it easier for the organization to realize its goals. Program managers must possess the abilities to synchronize the program with the organization's long-term objectives as well as a clear awareness of how the program will meet the portfolio and organization's strategy, goals, and objectives.

The Program Strategy alignment performance domain includes following activities/components.

Program Business Case

A program business case is a document that details the motivations behind starting a program, the advantages it will provide, the resources needed to do it, and the anticipated return on investment (ROI). It is a method for making decisions that aids organizations in assessing the viability of suggested projects and deciding whether to devote resources to them. The problem or opportunity that the program is meant to address, together with the program's aims and objectives, anticipated benefits and outcomes, and associated risks and limits, should all be covered in the business case. It should also include information about the program's budget, schedule, and techniques for gauging and monitoring progress. A program business case's objective is to offer a thorough and convincing justification for why a program should be approved and put into action.

Program Charter

A program charter is a document that outlines the goals, parameters, stakeholders, and purpose of a program. It serves as a high-level summary of the program that clarifies its objectives and limitations. In order to give the program a clear direction and to coordinate the efforts of all stakeholders in attaining the program's goals, a program charter is employed. Throughout the course of the program's lifecycle, decisions and priorities are made using it as a guide and blueprint.

Program Roadmap

A program roadmap is a high-level visual representation of a program's objectives, activities, and results, as well as the schedule for achieving them. It gives a succinct and unambiguous description of the program's goals, the steps needed to get there, and any interdependencies therein. The program's overall direction and the relative importance of various activities ar

both made clear to stakeholders by the roadmap. It serves as a communication tool that makes it possible for all program participants to be aware of the status, top priorities, and any changes to the original plan. Project portfolios, business programs, and technology programs are just a few of the many sorts of programs for which roadmaps can be constructed. [1]

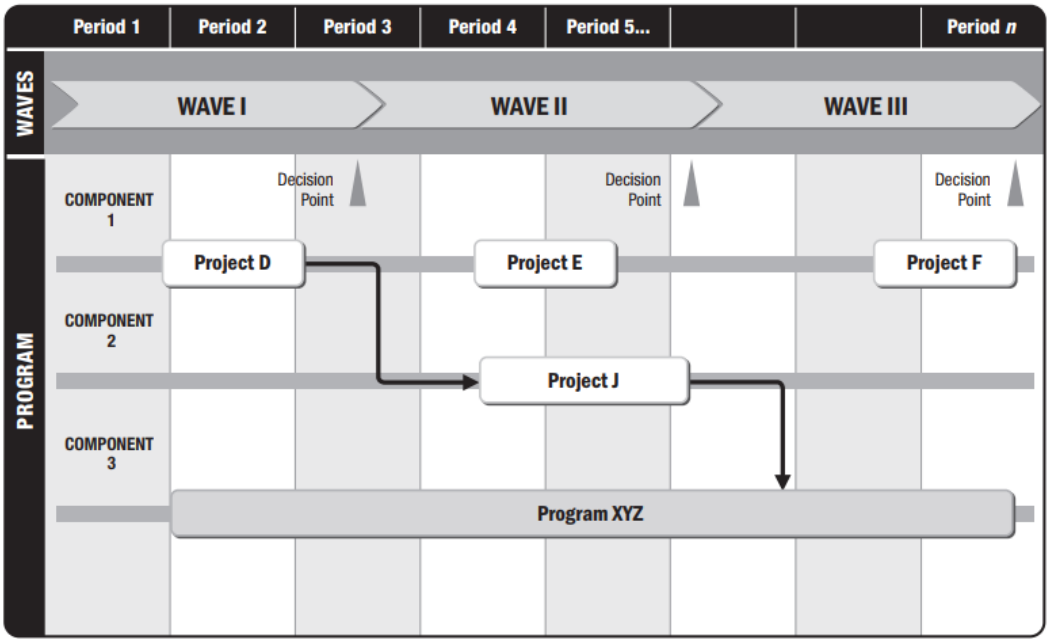

Figure 1: Example of Program Roadmap

Environmental Assessment

Programs often have environmental factors which may have influence the program and have significant impact on program’s overall success. These factors are may be internal to the organization or may be from external sources. These factors may include but not limited to, Business environment, Funding, Resources, Market , Industry , Economy, Political Stability, Supply base, Technology ,etc..

Its responsibility of Program Manager to assess these factors while managing program to ensure Program overall success and its alignment with organization strategic objectives and goals. Feasibility study, SWOT analysis, comparative advantage may be used to analyze these environmental factors.

Program Risk Management Strategy

The process of detecting, evaluating, and prioritizing risks that could affect the effective execution of a program, as well as putting precautionary measures in place to reduce those risks, is known as program risk management. A clearly defined program risk strategy is necessary for the successful delivery of the program roadmap, which must be in line with organizational strategy and take into account environmental factors revealed in environmental assessments.

Identifying Risk, Assessing, prioritizing them based on their impact and likelihood, Developing mitigation measures and implementation and review of these measures are the part of Risk management strategy.

2.4.2 Program Benefit Management

A variety of components that are essential to the success of the program are included in program benefits management. Program Benefits Management involves procedures for defining the program's anticipated advantages and desired results as well as procedures for assessing the program's effectiveness in achieving these benefits and objectives. Fig.2 illustrates the main activities involved in the performance domain of Benefit management.

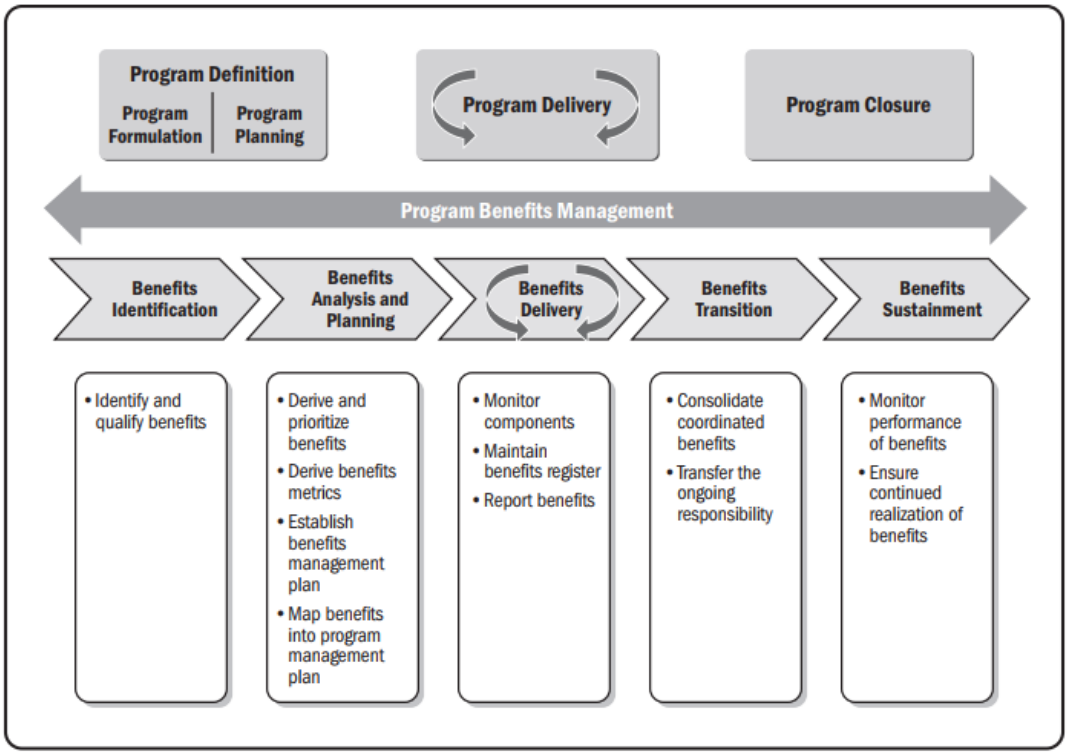

Figure 2: Program Benefit Management

Benefits Identification

Benefits identification is a crucial step in the performance domain of Benefits Management. It involves identifying and defining the potential benefits that can be derived from a particular project, program or initiative. During this step, stakeholders are engaged to identify the benefits that are most important to them and the organization. The benefits are then prioritized based on their potential impact and feasibility. Benefits identification helps to align the project with the organization's overall goals and objectives, ensures that the project is

contributing to the overall success of the organization, and provides a clear understanding of what benefits are expected to be delivered and how they will be measured.

Benefit register is the document which is developed in this phase. This document includes the list of benefits along with the description how each benefit will be measured and key performance indicator to measure to evaluate the performance. This document is reviewed timely to access the program success. [1]

Benefits Analysis and Planning

Establishing the program's benefits management strategy as well as creating the metrics and framework for tracking and managing the program's components and measuring its benefits are the goals of the benefits analysis and planning phase. Activities that are included in this phase are;

- Create a Benefit management Plan: The methods and tasks necessary to realize the benefits specified in the project or program are outlined in this plan, together with any risks that may affect the benefits' delivery and the measures taken to reduce those risks.
- Establish Benefit Realization : This plan outlines the procedures necessary to realize the benefits specified in the benefits management plan, as well as the key stakeholders' roles and duties, the delivery schedule, and the success criteria.
- Benefits monitoring and review: It is crucial to regularly monitor and analyze the benefits outlined in the benefits management plan to make sure they are being delivered as planned and that any required adjustments can be made to keep the project or program on track.

Benefits analysis and planning result in updates to the benefits register, which was initially created during benefit identification. Now, using the program roadmap as a guide, program benefits are mapped to the program components. The benefits register is then discussed with the relevant parties in order to determine and approve the key performance indicators and other metrics that will be used to assess the success of the program. [3]

Benefits Delivery

The benefits delivery phase's goal is to guarantee that the program provides the anticipated benefits, as outlined in the benefits management strategy. As the program is implemented, risks that affect benefits may be realized, may need to be updated, or may become outdated; in addition, new risks and updated ones should be entered in the benefits register with the corresponding benefits.

Benefits Transition

The goal of the benefits transition phase is to make sure that program benefits can be sustained once they have been transferred to operational areas. When the organization, community, or other program beneficiaries can make use of these benefits, value has been delivered. Activities include in this phase are;

- Confirming that the program's integration, transition, and closure meet or surpass the benefit realization criteria established to satisfy the program's strategic goals.
- Creating a transition strategy that would enable the continued realization of benefits once it is transferred to the affected operational areas.

Benefit Sustainment

The benefits sustainment phase's goal is to make sure that the program's outcomes and improvements continue to be generated long after the program has ended. This is done by continuing maintenance tasks carried out by recipient organizations. As the program comes to an end, it may be up to another organization or program to continue providing the benefits it offered. Operations, maintenance, the addition of new components, or other initiatives may be used to maintain benefits. Prior to program completion, a benefits sustainability plan should be created to define the risks, procedures, measurements, and instruments required to guarantee the ongoing realization of the benefits provided.

The program manager and component project managers should plan for ongoing maintenance of program benefits as the program is being implemented. [1]

2.4.3 Program Stakeholder Engagement

It is a performance domain that controls expectations and communications while identifying and analyzing stakeholder needs in order to get their support. Program Stakeholder engagement include following processes;

Stakeholder Identification

A stakeholder is a person, a group, or an organization that could have an impact on, be impacted by, or perceive itself to have an impact on a choice made throughout the course of a project, program, or portfolio. Stakeholder can be internal or external to the organization.

All significant stakeholders (or stakeholder groups) in the stakeholder register are meant to be systematically identified as part of the program stakeholder identification process. This register includes a list of the stakeholders and categorizes each one according to how they relate to the program, how much they can influence its outcomes, how much support they have given it, and any other traits or qualities the program manager believes may have an impact on how the stakeholders view the program and its results. [4]

Example of Stakeholder register is illustrated below:

Name	Organizational Position	Program Role	Support Level	Influence	Communication	Other Characteristics
Stakeholder 1	Director	Supplier	Neutral	Low	Email monthly	Interests
Stakeholder 2	Customer	Recipient	Supportive	Medium	Conference weekly	Needs
Stakeholder 3	Sr. Vice President	Sponsor	Leading	High	Status report quarterly	Status—engaged

Figure 3: Stakeholder Register [1]

The stakeholder register is an evolving piece of writing. New stakeholders may appear as the program develops, or the interests of existing parties may change. The program manager should keep an eye on the environment, prepare the register, and update it as needed.

Some of the key stakeholders include Program Sponsor, Steering Committee, Portfolio Manager, Program manager, Project manager, Team members, Fund providers, customers, regulators, suppliers, etc.

Stakeholder Analysis

Once stakeholders are identified and listed in Stakeholder register, the next step is to categorize these stakeholders based on their influences, needs or expectations. This categorization is referred as stakeholder analysis. This analysis is crucial because it aids project managers in comprehending the viewpoints and objectives of stakeholders, enabling them to interact and engage with them in a productive manner throughout the course of the program. Program managers can spot possible risks and opportunities and create plans to handle stakeholder interactions in a way that maximizes program success by taking into account the requirements and expectations of stakeholders. Additionally, this data can be used to manage program modifications over the course of its lifecycle, decide which resources to prioritize, and make decisions.

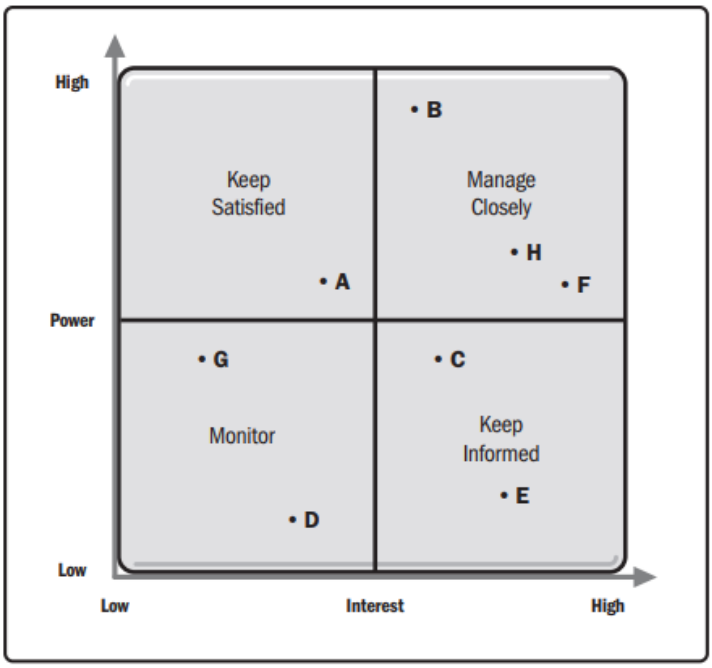

Figure 4:Power/Interest Grid , Stakeholder map [1]

Power/interest grid is one of the tool to map the stakeholders based on their authority level (power) and concern (interest) about the project results. An example of power/interest grid is illustrated above.

Stakeholder Engagement

Stakeholder involvement is a constant program activity because as the program develops and produces results, the list of stakeholders, as well as their attitudes and opinions, change. Making sure all stakeholders are fully and effectively involved over the course of the program is one of the program manager's main responsibilities. This approach is directly supported by identifying stakeholders, mapping their interests, and planning for stakeholder interaction. stakeholder register and map should all be often consulted, assessed, and updated as necessary.

Stakeholder Communications

Stakeholder engagement in a program is centered on communication. It is essential for carrying out program initiatives and, eventually, providing advantages to the organization. This crucial element serves as a platform for information exchange, negotiate, and cooperation among the program team members to propel program implementation activities. It’s the responsibility of program manager to actively engage stakeholders throughout the cycle of program. There should be different strategy of communication for each stakeholders based on their influence and power as described in stakeholder register and map. With the constant communication feedback on project progress can be obtained which would definitely benefit the overall result.

2.4.4 Program Governance

Program governance is the set of processes, structures, and policies that guide and manage the development, execution, and monitoring of a program or portfolio of projects. The purpose of program governance is to ensure that the program aligns with the organization's overall strategy, is executed in a consistent, efficient, and effective manner, and delivers value to the organization and stakeholders. [1]

Program governance offers a crucial method for programs to get approval and support for constantly changing plans or strategies in reaction to unexpected outcomes. It is likely that a

program within a portfolio will be governed by the parameters of the portfolio. Programs, initiatives, and operations within the portfolio structure are overseen, controlled, integrated, and subject to decision-making procedures thanks to the framework, duties, and procedures provided by portfolio governance. The actions to develop the idea and authorize the program should be carried out inside the organizational governance framework if the organization does not have portfolios of programs and projects. [5]

Program Governance Practices

Some of the program governance practices includes;

Governance Framework: A governance framework is a formal set of policies, processes, and procedures that define how the program will be governed. The framework should outline the governance structure, decision-making processes, risk management procedures, and communication channels.

Stakeholder Engagement: Effective program governance requires the engagement of all stakeholders, including program managers, project managers, sponsor, customers, and end-users. Stakeholder engagement helps to ensure that the program remains aligned with the organization's goals and objectives and that all stakeholders are informed and involved in decision-making processes.

Performance Management: Performance management is a critical component of program governance. It involves regularly measuring and evaluating program outcomes and progress against defined goals and objectives, and using this information to make informed decisions about program direction and to identify areas for improvement.

Program Governance Roles

We will discuss some of the main roles involved in Program governance:

Program Manager: The program manager is responsible for leading the overall program and ensuring that it is aligned with the organization's strategy and goals. The program manager works closely with the governance structure to ensure that the program is executed in a consistent and efficient manner.

Steering Committee: The steering committee is the primary decision-making body for the program. It is responsible for setting the program's direction, making decisions about program initiatives and changes, and ensuring that the program is aligned with the organization's goals and objectives.

Project Managers: Project managers are responsible for delivering specific projects within the program. They work closely with the program manager and other stakeholders to ensure that their projects align with the program's overall goals and objectives. [1]

2.4.5 Program Life Cycle Management

Programs operate similarly to projects in that they are defined, their intended advantages are realized, and they are closed. Programs, however, require more coordination and sequencing of various components than is necessary at the level of a single project. The activities carried out throughout the program life cycle depend on the particular type of program and typically start prior to funds being granted or the appointment of the program manager. [3]

Program Life Cycle Phases

The typical program life cycle are divided in three phases; [1]

Program Definition Phase: In this phase, program activities are carried out to approve the program and create the program roadmap necessary to provide the desired results. Program business cases and charters are developed as part of program definition. The program management plan is made once it has been authorized.

Program Delivery Phase: The actions that make up a program's delivery are those that are carried out in line with the program management plan to bring about the planned outcomes of each component. This phase sees the beginning, planning, execution, transition, and closure of each individual component as well as the delivery, transfer, and maintenance of benefits.

Program Closure Phase: The program actions required to smoothly conclude the program and transfer its advantages to the sustaining organization are included in this phase. Program closure involves moving work to another program, closing the current one, or terminating it early. [6]

2.5 Construction Program Management

Construction Program Management (CPM) is a comprehensive approach to planning, coordinating, and controlling multiple construction projects and activities within an organization. The main goal of CPM is to ensure that the projects are completed within the desired timeframe, budget, and quality standards.

The process of CPM involves several key activities, including project planning and scheduling, resource allocation and management, risk management, budget management, communication and coordination, and quality control.

Project Planning and Scheduling involves defining the scope of work, creating project schedules, and allocating resources. It requires a detailed project plan outlining tasks, resources, and the timeline for completion.

Resource Allocation and Management is the process of determining the resources needed for each project, including personnel, equipment, and materials, and ensuring they are available when necessary. Effective resource management is crucial for project success and efficient use of resources.

Risk Management involves identifying potential risks and developing strategies to mitigate them. This involves assessing the likelihood and impact of risks and implementing strategies to minimize or eliminate them. Risk management helps ensure projects are completed on time and within budget, and the quality of work is maintained.

Budget Management is the process of establishing a budget for each project and monitoring it to ensure the project is completed within budget. This includes creating a budget plan, monitoring expenses, and making adjustments as needed. Effective budget management helps ensure resources are used efficiently and projects are completed within budget.

Communication and Coordination is the process of keeping all stakeholders informed of project progress and allowing them to provide input and feedback. Regular meetings and updates, as well as clear communication channels, are essential for good communication and coordination.

Quality Control involves monitoring and controlling the quality of work being done to meet the required standards. This includes regular inspections and testing and implementing quality control procedures and protocols. Quality control helps ensure the work is of high quality and projects are completed to the desired standards.

CPM is a complex process that requires a variety of skills and expertise, including knowledge of construction processes, project management, risk management, budget management, and communication and coordination. Construction program managers must have a strong understanding of the construction industry and the projects they are managing, as well as the ability to work effectively with different stakeholders.

CPM is vital for the success of large and complex construction projects. It ensures that resources are used effectively, risks are managed proactively, and projects are completed on time and within budget. This minimizes risks, improves organizational efficiency, and ensures projects meet the desired standards.

However, balancing the demands of multiple projects and managing the complexities of large construction projects can be challenges for construction program managers. They must be able to make difficult decisions and think creatively and proactively to handle unexpected events and changes in project scope or budget. [7]

In conclusion, Construction Program Management is an essential part of the construction process, ensuring projects are completed within the desired timeline, budget, and quality standards. It requires a team of experienced professionals with a range of skills and expertise to ensure successful outcomes.

2.6 Portfolio and Program Management Software

As the projects in company's portfolios increases, it gets difficult to handle them and it became difficult to consolidate information. At this stage, Project Portfolio Management tools are needed. By gathering data and creating useful reports, project portfolio management systems typically boost basic project management and scheduling processes. These tools can help

businesses monitor project progress throughout every stage of its lifecycle. Businesses may increase the efficiency of business processes, automate time-consuming procedures, and continuously innovate for the future with the help of clear end-to-end process visibility.

You may observe your projects in a high-level view, their progress, and how they link to other projects with the use of the project portfolio management tools. You can Utilize this information to manage communications with various PMs within your company and connect project outcomes to corporate objectives. [8]

2.6.1 Benefits of PPM Software

Portfolio and Program Management software (PPM) solutions are increasingly being adopted by organizations around the world as they seek to manage complex projects and programs more effectively. By using a project portfolio management platform, a business can prioritize project portfolios that enhance its value and overall health. According to statistics, PPM solutions are used to oversee everyday operations by 89% of the most effective firms.

These software tools provide a range of benefits, which are discussed in detail below. [8]

Centralized Project Management

One of the most significant benefits of PPM software is that it provides a centralized platform to manage all aspects of a project. Project managers can access a single dashboard to view project timelines, budgets, resources, risks, and issues. This makes it easier to monitor and track progress, identify potential issues, and make data-driven decisions.

PPM software also provides visibility into all the projects being executed by an organization. This helps senior executives to make informed decisions about which projects to pursue, which to pause, and which to cancel. By having a centralized view of all projects, organizations can avoid duplication of effort and ensure that resources are used more efficiently.

Decision Making

Tools can help businesses make better judgments. Solid data and visibility, which are vital from tactical and strategic viewpoints, are the result of smart business decisions.

By providing you with information on previous project indicators, a portfolio management tool makes it simpler to predict results. By examining their success, it also aids in weeding out projects that aren't advancing an organization's corporate goals. [9]

Improved Collaboration

PPM software solutions offer collaboration tools that enable project teams to work together in real-time, regardless of their physical location. This helps to break down silos, facilitate knowledge sharing, and ensure that everyone is working towards the same goals.

For example, PPM software often includes a project management portal that allows team members to collaborate on documents, share files, and track progress. This helps to ensure that everyone is working from the same information, reducing the risk of errors and miscommunications. [9]

Efficient Resource Allocation

PPM software can help organizations optimize resource allocation, which can reduce costs, minimize risks, and improve project outcomes. By having a holistic view of all ongoing projects, project managers can allocate resources more effectively and ensure that everyone is working on the highest-priority tasks.

PPM software provides a range of tools that enable project managers to manage resource allocation more efficiently. For example, resource utilization reports can help project managers to identify areas where resources are being underutilized or overutilized. This enables them to make data-driven decisions about how best to allocate resources.

PPM software can also help organizations to manage their workforce more effectively. For example, PPM software can be used to identify skill gaps in the workforce and to develop training programs to address those gaps. This helps to ensure that the organization has the right skills and expertise to deliver on its strategic objectives. [9]

Better Risk Management

PPM software provides tools to identify, assess, and manage project risks. This allows project managers to anticipate potential problems, develop contingency plans, and take corrective actions before issues become major problems.

For example, PPM software often includes a risk register, which is a database of potential project risks. Project managers can use this register to assess the likelihood and impact of each risk and to develop a risk mitigation plan. By having a clear view of project risks, project managers can take proactive steps to minimize the impact of those risks on project outcomes.

PPM software can also help organizations to manage compliance risks. For example, PPM software can be used to ensure that projects comply with regulatory requirements or industry standards. This helps to reduce the risk of fines or legal action, which can have a significant impact on an organization's financial performance. [10]

Improved Reporting

PPM software generates real-time reports and dashboards, which provide insights into project performance, risks, and issues. This helps project managers to make informed decisions, and communicate progress and issues to stakeholders.

PPM software provides a range of reporting tools that enable project managers to monitor project progress and identify potential issues. For example, project dashboards provide a high-level view of project progress, highlighting areas where attention is needed. Project status reports can provide more detailed information on project performance, risks, and issues, enabling project managers to take corrective actions where necessary. [10]

PPM software can also be used to generate financial reports. For example, PPM software can help organizations to manage their project budgets more effectively by providing real-time visibility into project costs. This enables project managers to track project expenses, monitor resource utilization, and ensure that the project remains within budget. By having a clear view

of project costs, project managers can identify areas where costs can be reduced or where additional funding may be required.

Improved Project Governance

PPM software can help organizations to improve project governance by providing a framework for managing projects more effectively. This framework helps organizations to establish clear project objectives, define project scope, identify project risks, and develop a project plan.

PPM software also provides a range of tools that enable project managers to manage project stakeholders more effectively. For example, stakeholder management tools can be used to identify project stakeholders, analyze their interests and concerns, and develop strategies for managing those stakeholders. This helps to ensure that stakeholders are engaged in the project and that their interests are addressed.

PPM software can also be used to implement project methodologies, such as Agile or Waterfall. These methodologies provide a structured approach to project management, enabling project teams to deliver projects more efficiently and effectively.

Improved Project Delivery

PPM software offers a variety of tools that help project managers manage projects more efficiently, which can help firms enhance project delivery. For example, project scheduling tools can be used to develop project timelines and manage project deadlines. Project planning tools can be used to develop a project plan, including a project scope, budget, and resource plan. These tools help to ensure that projects are delivered on time, within budget, and to a high level of quality.

PPM software can also be used to manage project dependencies. This enables project managers to identify areas where projects may be impacted by other projects, and to develop strategies for managing those dependencies. By managing project dependencies more effectively, organizations can reduce the risk of project delays and ensure that projects are delivered on time.

Improved Project Quality

PPM software helps organizations to improve Project quality can also be improved by using PPM Software as it provide a range of tools that enable project managers to manage project risks and issues more effectively. For example, issue management tools can be used to track project issues and develop strategies for resolving those issues. Quality management tools can be used to ensure that project deliverables meet the required quality standards.

Using PPM software, project governance frameworks like ISO 9001 can be implemented. These frameworks give firms an organized approach to quality management so they can consistently produce high-quality projects.

Faster Project Turnaround

These technologies automate repetitive tasks needed in finishing a project portfolio by streamlining workflows. In addition to increasing productivity, they keep work cycles well-oiled by providing the most fundamental question: what should we do next? These tools ensure that firms don't lose sight of initiatives with strategic alignment and improved business outcomes. Additionally, faster turnaround time gives organizations an advantage over rivals.

Enhanced Project Portfolio Management

Utilizing PPM software can enhance an organization's project portfolio management by offering various tools to manage project portfolios more effectively. Portfolio management tools can be utilized to develop a portfolio strategy, manage portfolio risks, and distribute resources across the portfolio.

Additionally, the software provides tools that enable organizations to evaluate project performance, pinpoint areas where projects can be enhanced, and develop strategies to improve project outcomes. By identifying and addressing areas of improvement, an organization can better align their project portfolios with their strategic objectives, leading to better business performance.

Improved Business Performance

Incorporating PPM software into an organization's project management toolkit can result in improved business performance. By identifying areas of improvement, developing strategies for improving project outcomes, and implementing those strategies effectively, organizations can achieve better project outcomes.

Better project outcomes can help organizations achieve their strategic objectives, reduce costs, and increase revenue, ultimately enhancing their financial performance and competitive edge. PPM software provides organizations with the capability to enhance project management and ultimately lead to better business performance.

Decreases Overspending

An efficient PPM tool establishes a balance between project expenses and excessive spending on pointless actions. Overspending can result from several issues, including inadequate project estimates, incorrect resource scheduling, inaccurate scheduling, and lack of visibility into project data. As a result of these solutions' precise project estimations and effective resource allocation, users have experienced less overspending.

Increases Project Delivery Success Rate

Project failure is the result of poor project execution. A project's failure can be caused by a variety of elements, including cost overruns, unclear specifications, technological difficulties, or unresolved concerns. During project delivery, PPM tools assist organizations in reducing these factors. They also provide the ability to strategically align projects with resources, plan projects based on those resources, accurately predict costs, and boost the likelihood of successful project execution. [11]

2.6.2 Choosing Right PPM Software

A correctly chosen tool offers a wide range of advantages and makes it easier to integrate people skills, data, and projects in an efficient manner. Now let’s look for some essential features which a PPM tool should have;

Essential Features:

Project Roadmaps

PPM tools aid in the definition of project roadmaps, which include program goals and deadlines for all contributing projects. They assist companies in developing realistic long-term roadmaps that outline vision, objectives, views, activities, strategies, milestones, and more. They provide program managers with tools to design plans that specify delivery deadlines, identify significant checkpoints, set release dates, and communicate these stages across enterprises. [12]

Projects Demand Management (Prioritizing Project Requests)

Demand management is a critical function of project portfolio management (PPM) software. It is the process of identifying and capturing project requests from stakeholders, analyzing their potential value and feasibility, and prioritizing them based on strategic goals and resource availability. Demand management helps organizations to ensure that they are investing in the right projects and initiatives that align with their strategic objectives. PPM software provides tools and features to manage project requests, including intake forms, request templates, and workflows for approval and prioritization. It also provides dashboards and reports to track and manage the demand pipeline, helping project managers to make informed decisions about which projects to pursue and which to defer or cancel. By effectively managing project demand, organizations can optimize their portfolio investments and achieve greater alignment with their strategic goals. [8]

Resource Management

One of the primary features of PPM software is resource management. It's essential to look for a software that provides efficient resource management capabilities. Resource management features should include resource allocation and utilization, capacity planning, scheduling, and tracking. The software should provide team managers with the ability to analyze resources, check their availability, and ensure that resources are used effectively. [13]

Financial Management

Budget forecast that are realistic, assist companies evaluate their performance and develop their organizational strategy. Your tool should give you the ability to manage your budget and

keep track of all project expenses, including operational, non-labor, and labor costs. They oversee the lifecycle of a project, its programs, and its entities' predicted and actual budgets. Program managers may track costs, track progress, and inform stakeholders of a project's status with the help of the cost tracking feature. These systems use billing and cost rates to determine project cost and revenue cost.

Risk Management

Risks can be filtered using an effective technique based on likelihood and severity. The ability to simulate resources, tasks, expenses, and access risk management choices is a feature of project portfolio tools. Users can activate risk mitigation strategies and assess the likelihood of an event occurring with the aid of simulations. Some systems group risks with the same probability and impact level using color-coded filters, making it simpler for firms to take appropriate risk mitigation measures. [11]

Reporting and Analytics

In-depth reporting capabilities are crucial for PPM software. The software should be able to generate standard reports, dashboards, and ad-hoc reports that can help you measure progress and identify areas that require attention. The software should provide features for data visualization, such as charts and graphs, to better understand project performance. Reports should be customizable to meet the organization's specific needs. [14]

Time and Task Management

Time and task management is feature enables project managers to efficiently manage project timelines, deadlines, and deliverables. Time and task management tools allow project managers to set up project schedules, create and assign tasks to team members, and track progress against milestones and deadlines. PPM software provides features like Gantt charts, task lists, and calendars to help project managers visualize and manage project timelines and ensure timely completion of tasks. The software also enables project managers to monitor resource utilization and availability, and adjust project schedules as needed to optimize resource allocation. Time and task management features in PPM software are particularly useful for complex projects with multiple dependencies, as they help project managers to manage

interdependencies and ensure that all tasks are completed on time. By effectively managing project timelines and tasks, project managers can deliver projects on time, within budget, and with the desired quality, ultimately leading to greater success and customer satisfaction.

Scheduling

Project managers may design, manage, and track project schedules with the help of scheduling, a crucial component of project portfolio management (PPM) software. Project managers can quickly spot potential delays and modify project schedules thanks to the scheduling component of PPM software, which presents project timelines, dependencies, and milestones visually. To guarantee that projects are finished on time and within budget, project managers can create and assign tasks, set deadlines, and allocate resources using the scheduling feature. Project managers can also monitor progress in relation to project timelines using PPM software, which also gives them real-time updates on the state of the project and flags any deviations from the original plan.

This helps project managers to quickly identify potential issues and make adjustments to project schedules to keep projects on track. Scheduling features in PPM software are particularly useful for managing complex projects with multiple dependencies, as they allow project managers to monitor progress across all tasks and ensure that projects are completed on time. By providing project managers with a clear understanding of project timelines and progress, PPM software helps to ensure timely project delivery and increases the likelihood of project success.

Collaboration

Collaboration features are also essential for PPM software. The software should provide features that allow team members to collaborate in real-time, share project-related information, and provide feedback. Collaboration features should include messaging, chat, document sharing, and team task management. This can help team members work together more effectively and ensure that projects are delivered on time.

Data Visualization and Real-Time Monitoring

Real-time monitoring and data visualization enable project managers to monitor project performance and progress in real-time and display data in a format that is simple to comprehend and use. Dashboards, charts, and graphs that represent project data, such as resource allocation, project status, financial health, and risk assessments, are made possible by data visualization technologies. This data is essential for making decisions since it enables project managers to immediately pinpoint problem areas, allocate resources more effectively, and make sure that projects are moving forward. Project managers can monitor projects' performance and development in real-time using real-time monitoring technologies, which gives them quick access to information about any problems or obstacles that might be impeding project progress. [15]

By quickly identifying issues, project managers can take corrective actions to mitigate risks and ensure timely project delivery. Overall, data visualization and real-time monitoring features in PPM software help project managers to make informed decisions, improve project outcomes, and ensure that projects are aligned with organizational objectives.

Workflow Automation

One essential function of project portfolio management (PPM) software that aids in streamlining and boosting productivity is workflow automation. With the help of this function, project managers may automate repetitive processes like sending notifications, updating the status of their projects, and giving team members responsibilities. This lessens manual labor and lowers the possibility of human error, which increases production and saves time. PPM software provides a variety of workflow automation capabilities, including automated approvals, notifications, and reminders, to assist guarantee that project activities are finished promptly and that project schedules are followed. By offering a central platform for communication and job management, workflow automation also aids in enhancing teamwork. With this feature, project managers can focus on high-level decision-making and strategic planning, while the software takes care of the routine tasks. By automating project workflows, PPM software helps to increase efficiency, reduce costs, and ensure that projects are completed on time and within budget.

Integration

Since, there is not a single tool available to handle all the needs of portfolio management so the integration of PPM software with other enterprise software such as customer relationship management (CRM) software, enterprise resource planning (ERP) software, and other project management software can improve efficiency and streamline operations. PPM software should be able to integrate with other software to enable seamless data sharing and reduce manual data entry.

3. Research Methodology

The Main focus of our research is to select a software tool for Project Portfolio Management. We will be studying 5 different PPM software including their features and other attributes and then will develop a framework to select the most suitable software.

3.1 Studying Software Tool

3.1.1 MS Poftfolio Project Management Solution

Microsoft Project Portfolio Management is a solution that helps organizations effectively plan, prioritize, and manage projects and resources. It allows managers to gain insight into the status of projects and resources, as well as make data-driven decisions to optimize resource utilization and project performance. The solution includes tools for project management, portfolio management, and resource management, and is integrated with other Microsoft products such as SharePoint and Outlook. It can also be used in conjunction with Microsoft Project, a project management software that allows users to create and manage project schedules, tasks, and resources.

Salient Features:

- Project management: Allows users to create and manage project schedules, tasks, and resources using the Microsoft Project software.
- Portfolio management: Provides a centralized view of all projects and resources, allowing managers to make data-driven decisions about which projects to prioritize and how to best utilize resources.

- Resource management: Allows managers to view the availability and utilization of resources across all projects and make adjustments as needed.
- Demand management: Provides a way for stakeholders to submit project requests, which can then be evaluated, prioritized and approved.
- Business intelligence: Provides an accurate view of project performance, resource utilization, and portfolio health, as well as the ability to create custom reports and dashboards.
- Integration: Integrates with other Microsoft products such as SharePoint and Outlook, as well as with other third-party tools and systems.
- Collaboration: Provides tools for team members to work together and share information, such as task assignments and progress updates.
- Time Management: Manage timesheets, budget, and expenses in one place.
- Scalability: Can be used by small teams or large organizations, with the ability to handle large amounts of data and users.
- Mobile Access: Allows users to access the solution from anywhere and on any device through its mobile app. [16]

Integration:

It integrates with different other software and tools , some of them are listed below:

- MS Project
- Microsoft apps; Teams, Power BI, Outlook, Sharepoint, etc.
- Google Drive
- Email
- Jira , etc…

Pricing & Plans:

Here are the pricing and plan options for Microsoft PPM:

Microsoft Project Plan 1: This plan includes the web version of Project, which allows for task management, Gantt charts, and basic resource management. This plan is priced at $10 per user per month.

Microsoft Project Plan 3: This plan includes all the features of Project Plan 1, as well as time and expense tracking, portfolio optimization, and advanced analytics. This plan is priced at $30 per user per month.

Microsoft Project Plan 5: This plan includes all the features of Project Plan 3, as well as demand management, enterprise resource management, and capacity planning. This plan is priced at $55 per user per month.

In addition to these plans, Microsoft also offers an on-premises version of Project Server, which allows for more customization and control but requires additional infrastructure and licensing costs. [17]

3.1.2 Celoxis

Celoxis is a comprehensive all-in-one solution for Project Portfolio Management that combines traditional project management practices, modern agile methodologies, and workflow automation. It is user-friendly and suitable for teams of all sizes. With Celoxis, resource management is made easy. You can quickly allocate resources based on their skills, roles, and availability and view cross-portfolio resource workload to make the most of your workforce. The platform offers a range of resource management tools, including project requests, demand management, and capacity planning. Additionally, Celoxis automatically calculates cost/revenue projections from your plans, while also managing project finances. This allows you to send accurate invoices to your customers on time, thus eliminating billing leaks and keeping track of budgets, expenses, and profits in real-time.

Celoxis provides users with customizable reporting features, enabling them to slice, dice, and present data according to their needs. With fully customizable portfolio planning dashboards, you can obtain a bird's eye view of your projects, including aggregated information. The platform comes with built-in routines for bug/issue tracking and risk management, which can be further customized to suit your organizational processes, without the need for spreadsheets and emails. Overall, Celoxis offers a comprehensive solution for Project Portfolio Management, designed to simplify resource allocation, improve reporting, and streamline project workflows. [8]

Salient Features:

- Project Request Tracking: Sort project request based on KPIs and business value.
- Project Planning & Tracking: Dynamic project planning and keeping track of task completion.
- Resource Management: Allocation of resources to task based on availability, demand and skills.
- Project Accounting: Real time visibility of spend budget and profitability across projects and portfolios.
- Portfolio Management: Customizable dashboard to visualize aggregate information regarding portfolios.
- Dynamic Dashboard and Reporting: All types of reports can be viewed or downloaded from dashboard.
- Collaboration: Communication, sharing files and notifications are possible through this tool.
- Time & Expense Management: Built in time sheet and expense module allows to track time and expenditures. [18]

Integration:

- MS Project
- MS Excel
- Google Drive
- Outlook
- Email
- Jira , etc…

Pricing & Plans:

Celoxis offers various pricing plans to fit the needs of different types of organizations.

A self-hosted version (On-premise) that starts at $450 per user per year, and the cloud-hosted version(SaaS) starts at $25 per user per month.

The cloud-hosted version has a minimum subscription of five users and offers a free 30-day trial. There are also enterprise-level pricing plans available for organizations that require a higher level of support, customization, and security. Celoxis also provides a range of optional add-ons, such as advanced resource management and expense management, that can be added to any pricing plan for an additional fee. [18]

3.1.3 Monday.com

Monday.com is a project portfolio management tool that emphasizes simple, aesthetically pleasing layouts that make it easier to understand the sequence of tasks. It can manage from simple to complex project very easily.

It lets you track several projects using dashboards that offer high-level insights in a visual and straightforward way, assign and prioritize work, use different views to see where everything stands, and allocate and prioritize jobs. You can modify the platform to fit your workflow because it is totally adaptable. The software also offers automation and robust notifications that are configurable, allowing you and your team to concentrate on the most crucial tasks.

You can plan, monitor, and track your budgets using Monday.com's user-friendly interface. You can keep track of costs, earnings, dates, and the necessary files to each item. You may also filter items using many different criteria, including status, individuals, text, time, location, and others, owing to the many columns. There are also formula columns available in this tool. Although monday.com doesn't provide standard automated reporting, it is designed to give you a quick overview of your projects' overall status on a big picture. [8]

Salient Features:

Customizable Dashboards: Monday.com allows users to create custom dashboards to track the progress of their projects. These dashboards offer high-level insights in a visual and straightforward way.

Project Management: The platform offers features such as task tracking, project timelines, calendars, and Gantt charts to help manage your projects more efficiently.

Workflow Automation: Monday.com offers automation features that help streamline workflows and save time, including the ability to set up automated notifications and create custom triggers based on specific actions.

Budget Tracking: The software provides an easy-to-use interface for planning, monitoring, and tracking budgets. Users can keep track of costs, earnings, dates, and the necessary files for each item. There are also formula columns available in this tool.

Customizable Workflows: The tool has pre-built workflows for common routines such as bug/issue tracking and risk management, which are incredibly customizable to organizational processes.

Collaboration: Monday.com allows users to collaborate with team members, share files, and provide feedback in real-time.

Integration: The software integrates with other tools such as Slack, Trello, Google Drive, and Dropbox, making it easier to manage projects and collaborate with others.

Data Analysis: Users can customize how data is sliced, diced, and shown using Monday.com's reporting features. While it doesn't provide standard automated reporting, the platform is designed to give a quick overview of project status on a big picture.

Integration:

- Outlook
- MS Teams
- Dropbox
- Slack
- Trello
- Google drive

Pricing & Plan:

Monday.com offers several pricing plans to meet the different needs of businesses. The plans are based on the number of users and features required by the business.
The Basic plan starts at $8 per user per month and includes basic features such as unlimited boards, tasks, and columns, and 24/7 customer support.
The Standard plan starts at $10 per user per month and includes additional features such as a timeline view, calendar view, and customizable forms.
The Pro plan starts at $16 per user per month and includes all the features of the Standard plan, as well as time tracking, private boards, and automation.
The Enterprise plan offers custom pricing and includes advanced security features, dedicated customer success manager, and customized onboarding and training.
Monday.com also offers a free trial for all its plans. Users can sign up for a 14-day free trial to test out the software before making a purchase. [19]

3.1.4 WRIKE

Wrike is a highly flexible, award-winning project portfolio management tool with AI features that can identify at-risk projects and help you optimize your portfolio. Workflows, dashboards, reports, request forms, and more may all be customized by users.

Users can switch between Kanban boards, interactive drag-and-drop Gantt charts, and conventional workload views on its interface, giving them a complete picture of the available resources in real-time. Advanced portfolio insights are another tool offered by Wrike. These include reports on project and team performance, resource management and allocation, time tracking, and more. The reporting features give you a precise picture of your portfolio, reducing risk. Additionally, you may set up real-time insights to be delivered to your mailbox to get a sense of the general health of your portfolio. [8]

Salient Features:

Project Request Management: With Wrike's project request management feature, you can streamline the process of initiating new projects, prioritize requests, and ensure that you only take on projects that align with your business objectives.

Project and portfolio management: Wrike PPM software provides end-to-end project management and portfolio management capabilities, allowing users to plan, execute and monitor multiple projects with ease.

Time Tracking: With Wrike, you can track the time spent on each task and project, monitor progress, and ensure that you stay on schedule.

Reporting and Analytics: Wrike offers a range of reporting and analytics tools to help you track progress, identify issues, and make data-driven decisions.

Custom Workflows: Wrike's customizable workflows enable you to automate processes and streamline your team's work.

Resource Management: Wrike provides resource management tools to help you allocate resources efficiently, monitor workloads, and avoid overburdening your team.

Collaboration: Wrike's collaboration tools make it easy for teams to work together, share files and information, and communicate in real-time.

Mobile App: Wrike's mobile app enables you to manage your projects on the go, view tasks and notifications, and communicate with your team. [20]

Integration:

- Google Sheet
- MS Teams
- Google Drive/One Drive
- Slack
- Tableau

Pricing & Plan:

Wrike offers four pricing plans: Free, Professional, Business, and Marketers.

The Free plan includes basic features like task management, a shared team workspace, and email integration. It supports up to 5 users and provides 2GB of storage.

The Professional plan is $9.80/user/month, billed annually. It includes additional features like Gantt charts, time tracking, subtasks, and automation. The plan supports up to 15 users and provides 5GB of storage.

The Business plan is $24.80/user/month, billed annually. It includes advanced features like custom fields, report templates, workload management, and request forms. The plan supports up to 200 users and provides 50GB of storage.

The Marketers plan is designed specifically for marketing teams and includes features like a custom workspace, proofing and approval, Adobe Creative Cloud extension, and digital asset management. This plan starts at $34.60/user/month, billed annually.

Wrike also offers a free trial for its paid plans, and customized pricing for enterprises with more than 200 users. [20]

3.1.5 Click-up

ClickUp is a cloud-based project portfolio management (PPM) software that offers a wide range of features to assist teams in managing their projects, tasks, and workflows. It allows businesses to streamline and automate their project management process, from planning and execution to monitoring and reporting. ClickUp is a highly configurable and customizable platform that can be tailored to meet the specific requirements of businesses of any size and industry. With its user-friendly interface, advanced automation tools, and real-time communication features, This is a powerful and efficient solution for project portfolio management. [8]

Salient Features:

Project management: Clickup offers a wide range of tools for project management, including project planning, time tracking, and team collaboration.

Task management: It allows you to create and organize tasks, assign them to team members, and set deadlines. You can also track progress, add comments, and attach files to tasks.
Resource management: Clickup lets you manage your team's workload and availability, and allocate resources according to skills, roles, and availability.

Budget tracking: The software allows you to set project budgets, track expenses, and monitor financial performance.
Time tracking: Clickup has a built-in time tracker that lets you track time spent on tasks, projects, and clients.
Collaboration: Like other PPM software we discussed earlier, Click-up allows team members to collaborate with each other. With these features, members can share files, assign tasks , give deadlines, monitor progress and communicate with each other within the app. Team members can also provide feedback on project tasks.
Reporting: Clickup offers a range of reporting options, including Gantt charts, calendars, and customizable dashboards, giving you a comprehensive view of your projects.
Project request management: Clickup offers a project request management feature that allows you to manage project requests from clients or other stakeholders. You can easily prioritize requests, assign them to team members, and track progress. [21]

Integration:

- Slack
- G Suite
- Cloud Storage (Dropbox, Google Drive)
- MS Teams
- Zapier (multiple apps)

Pricing & Plan:

ClickUp offers a range of pricing plans that cater to the needs of different types of users.
The Basic plan is free and provides access to unlimited tasks, users, and storage, but it has limited features.
The Unlimited plan costs $5 per user per month, with access to all features, unlimited integrations, and advanced reporting.
The Business plan is priced at $9 per user per month and includes advanced features such as time tracking, Gantt charts, custom fields, and custom exporting.
The Enterprise plan, which includes VIP support and other advanced features, is available at a custom price.
Additionally, ClickUp offers a 30-day free trial for the Unlimited plan, and a 14-day free trial for the Business and Enterprise plans. [21]

3.2 Framework for Software Selection

In previous section we studied 5 different alternatives of PPM software tool. In this section our goal is to design a framework To select the most suitable software tool. According to review of Literature, it's found that different kind of approaches like AHP and WSM have been used by researchers to evaluate and select software packages. [22]

In our study, we will be using WSM, weighted sum method to develop the framework.

WSM, or the "Weighted Sum Method," is a multicriteria decision-making (MCDM) technique used to assess the performance of numerous alternatives in light of various criteria. It involves assigning weights to various criteria and then summing up the scores for each alternative based on the criteria weights. The alternative with the highest score is then selected as the best option.

As we discussed in the previous sections, the core features which PPM should have are the following which can be called as criteria for selection:

S.No	Core Features
1	Demand Management
2	Portfolio Management
3	Resource Management
4	Budget Management
5	Risk/Issue Management
6	Business Intelligence/Reporting
7	Time and Task Management
8	Team Collaboration/Communication
9	Data Visualization/Real Time Monitoring
10	Work flow Automation
11	Scheduling
12	Program/Project Management
13	Mobile Access

Table 1: Core Features of PPM Software

3.2.1 Evaluation Using WSM

Take into account n deterministic criteria (C1, C2,..., Cn) and m alternatives (A1, A2,..., Am). Decision matrix Sij, which quantifies how well alternative Ai performs on criterion Cj, fully characterizes the alternatives. The relative relevance of the criterion is accounted for by the weights W1, W2,..., and Wk. The option with the highest score is the best one. The following formula is used in WSM to determine the alternative AI's final score: [22]

$$S(Ai) = \sum W_j S_{ij} \qquad \text{(Eq.1)}$$

Where,

W_j= Relative importance of jth criteria

S_{ij} = Rating of the alternative A_i on criteria C_j.

First Step: Assigning Relevant Importance to Criteria

To know the relevant importance of software feature(criteria), a survey has been carried out through a questionnaire on google form. Project Management professionals and student were asked to rank previously described features (table-1).Based on the results of survey , these features has been ranked and their relevant importance is assigned (Table-2)

Criteria	Ranking	Relative Importance
Demand Management	1	15%
Portfolio Management	2	13%
Resource Management	3	11%
Budget Management	4	10%
Risk/Issue Management	5	9%
Business Intelligence/Reporting	6	8%
Time and Task Management	7	7%
Team Collaboration/Communication	8	6%
Data Visualization/Real Time Monitoring	9	5%
Workflow Automation	10	5%
Scheduling	11	4%
Program/Project Management	12	4%
Mobile Access	13	3%

Table 2: Relative Importance

2nd Step: Obtaining Performance Rating of Alternatives against Criteria

To know the performance of our alternatives against different features(criteria) , I took online rating from “Gartner Peer Insight” as reference. [23]

It’s a website on which Customers share their experiences and review the goods and services provided by technology providers. Customers submit their ratings and reviews on a range of technological goods and services, including software, hardware, and IT services, on this

platform. Consumers can also discuss their opinions and experiences on the website with other prospective customers, and technology vendors can advertise their goods and services. The website offers a mechanism for technology providers to get client input and enhance their goods and services accordingly. So, based on the rating from this tool, performance rating of the criteria for the software has been defined . For example the rating for Demand Management criteria for different alternatives is as; Celoxis is 4.5; MS PPM 4.4 ; Monday.com 4.3 ; Wrike 4.3 ; Click-up 4.2. There were some criteria for which performance rating was not available on this website, so for those criteria average value of all other available criteria ratings has been taken. As for Budget Management, average is taken of all the values in the column.

I used the binary scale (1 for availability of that feature and 0 for non-availability).So, final shape for WSM table is ;

Criteria	Relative Importance (weightage) %	MS PPM	Celoxis	Monday.com	Wrike	Clickup
		Rating				
Demand Management	15%	4.4	4.5	4.3	4.3	4.2
Portfolio Management	13%	4.3	4.5	4.3	4.4	3.9
Resource Management	11%	4.3	4.6	4.3	4.3	3.9
Budget Management	10%	4.4	4.5	4.4	4.4	4.1
Risk/Issue Management	9%	4.4	4.5	4.4	4.4	4.1
Business Intelligence/Reporting	8%	4.2	4.5	4.2	4.2	4.1
Time and Task Management	7%	4.5	4.7	4.5	4.5	4.4
Team Collaboration/Communication	6%	4.4	4.5	4.5	4.5	4.1
Data Visualization/Real Time Monitoring	5%	4.4	4.5	4.4	4.4	4.0
Work flow Automation	5%	4.4	4.5	4.4	4.4	4.0
Scheduling	4%	4.4	4.5	4.4	4.4	4.1
Program/Project Management	4%	4.4	4.5	4.4	4.4	4.2
Mobile Access	3%	4.4	4.5	4.4	4.4	4.1
WSM Total Score		4.352482	4.535268	4.341357143	4.36134286	4.088464

Table 3:Weighted Sum Method

Survey form:

As discussed in step 1, that a survey was conducted from random Professionals and students of Project Management . This survey(appendix) was focused on two questions;

1) Ranking of different features of PPM software.
2) Selection of best software as per the experience.

Based on the answer of question 1, relevant importance of each criteria is given which is shown in table 2. For the 2nd question, most of the respondents ,i.e. 69% answered in favor of MS PPM.

3.2.2 Research Results

WSM Score of each alternative (software tool) has been calculated using Eq. 1. So based on WSM score, Celoxis is found out to be the best alternative among all other software tool. While as per the survey most respondent favoured the use of MS PPM.

So, one of these both software can be tested to be used for construction program and portfolio management of Polio expansion projects. Currently, As most of the project management is being done on MS Project so one of our top concern is the integration of Microsoft Project files with PPM solution. Both of the software supports the integration of MS project files, however the effectiveness of integration can be tested after using these software with some real cases. As an example , In the next section, we will be using some draft files of Polito building plan to execute them on celoxis and analyze the results.

4. Case Study

4.1 Solution A- MS Project with subproject function(Current State)

As per discussion with Polito PMO staff, currently MS Project Desktop is being used for Project Management. Project Desktop is a project management software developed by Microsoft. It allows users to plan, track, and manage projects of various sizes and complexities. The software offers a wide range of features such as Gantt charts, task lists, resource management, budgeting, and collaboration tools to help project managers and teams stay organized and on track. Microsoft Project Desktop also provides powerful reporting and visualization capabilities, enabling users to analyze project data and communicate progress and status effectively.

4.2 Solution B- Celoxis with Integration of MS Project

For better management of Projects and portfolio, PoliTo is looking for PPM software tool integrated with Project desktop. Currently PoliTo has the access to Celoxis software. In this section, we will use Polito building plans on Celoxis and study how does this software work. As primary project management software is MS Project so first step is the integration of Project files with Celoxis.

4.2.1 Limitations in importing MS Project file

Although Celoxis offers supports integration of MS project files but we have faced a number of problems while importing MS Project files. These limitations are discussed in detail below:

1) Our Project files has tasks with duration in both "d(days)" and "ed(elapsed days)" units but Celoxis does not accept "ed" unit so first of all I have converted all "ed" units to "d" units.
2) After converting units, I tried to import mpp file but Celoxis gave me error shown in below picture.

Figure 5: Celoxis Import error

To counter this, I remove these tasks as advised to reach the position where import works. After removing these task file imported successfully.

3) Celoxis does not import resources automatically if its not same as celoxis resources. So , next step was to map the resources. For labour resources its possible to assign corresponding resources from celoxis user list but for non-labor resources i-e- material resource celoxis does not offer resource map as the cost units of resource celoxis give is in per unit of hour and not in the per unit of material. So, to map the material resource, the only option left was to add resource cost as Non-Labour planned expenses in corresponding tasks.

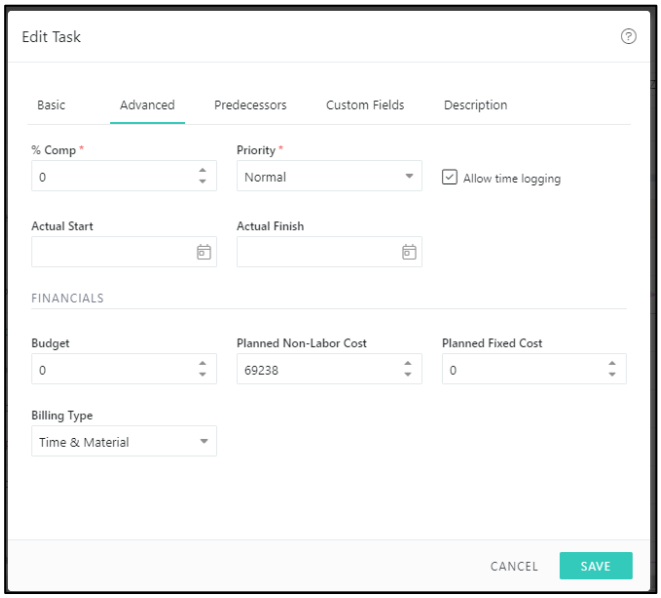

Figure 6: Non labour expenses

4) Also, after importing of file, scheduling of task disturbed automatically. And some sub task become main task.

Svolgimento Conferenza dei Servizi	21 d	Tue 6/27/23	Tue 7/25/23	65FS+20 d
Ottenimento Provvedimento Conferenz	0 d	Tue 7/25/23	Tue 7/25/23	66
Parere Vigile del Fuoco	**11 d**	**Wed 4/19/23**	**Thu 5/4/23**	
Approvazioni interne	**368 d**	**Mon 6/5/23**	**Wed 10/30/24**	
Approvazione progetto di FTE	1 d	Mon 6/5/23	Mon 6/5/23	48
Approvazione Q.T.E del FTE da parte del C.	0 d	Tue 6/13/23	Tue 6/13/23	73FS+6 d
Approvazione progetto esecutivo	0 d	Wed 10/30/24	Wed 10/30/24	58

MS Project, Task "Approvazioni Progetto di FTE"

Figure 7:Scheduling error

73	**Approvazioni interne**	31 Ott 24	20 Gen 26	318,88 days
74	**Approvazione progetto di FTE**	23 Dic 25	20 Gen 26	21 days
75	Svolgimento Conferenza dei ...	23 Dic 25	20 Gen 26	21 days
76	Approvazione progetto esecutivo	31 Ott 24	31 Ott 24	0 days
77	**Espletamento gara lavori**	5 Nov 24	28 Gen 26	321,88 days

Celoxis view, Task "Approvazioni Progetto di FTE"

As clear in the picture , that the task “Approvazione Progetto di FTE” disturbed and shows different schedule in MS project and Celoxis. Also this task become main task in Celoxis ,however it was a sub task, due to which its expenses could also not be added.

Due to these errors it’s obvious that although the file is imported to celoxis, but it does not remain original and software results can not be trusted unless these errors are sorted.

4.2.2 Software Features

New let’s discuss about the features of PPM software which was discussed in section 3.2 with respect to Celoxis.

Demand Management/Project Request Management: Project request can be managed by the option apps in main navigation menu. Here its shows the list of Project request which also indicates object, budget, risk and also project scores. Project score is based on Objective, budget and risk value. The optimal mix of request projected can be selected using what-if analysis based on the constraints of budget, margins and resource capacity, etc.

Project Portfolio Management: Portfolio management is the core feature of this software.Project request management helps to create portfolio. Portfolio balance is achieved by Resource capacity management which can be access by report features of the main menu. Celoxis also provide best practices portfolio reports like Budget allocation, portfolio analysis, schedule tracking of Projects, Gantt chart, Resource capacity and utilization.

Resource Management: Resource Management can be done by using workload option in main menu. Here we can see actual vs planned resource utilization. Over, under and optimal can also be checked on

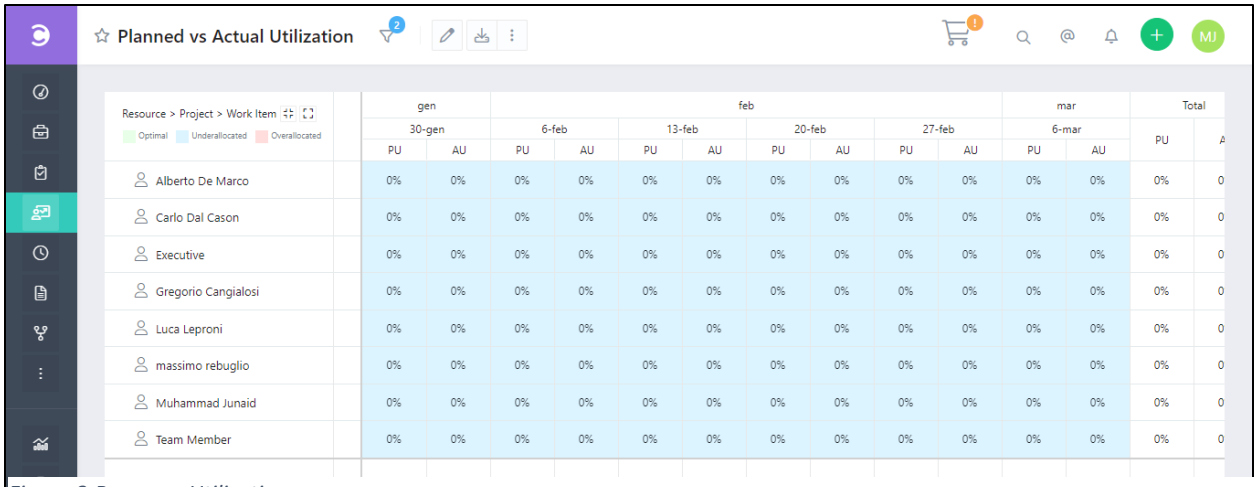

Figure 8-Resource Utilization

this view which is differentiated by colors. Its also noted that addition of material resource is not possible in celoxis as we discussed it earlier.

Budget Management: Project overview shows the planned and actual allocation of each task. Labor cost is added when human resource are defined, system will automatically calculate labor cost per task as per the utilization while non labor cost of each task is added separately.Budget utilization and tracking can be seen on dashboard and in reports section.

Risk Management: Risks of each project are added to risk register which can be viewed in project overview. Risk register shows the name of risk, its impact, risk probability, potential and mitigation cost, and the assignee. Collective risk of all the projects in portfolio can also be viewed on Dashboard and in reports.

Reporting: There are different kinds of report available on celoxis which include but not limited to budget, risk, cost, project status(Gantt), project tracking, Budget tracking, change requests, etc..These reports can be accessed from main navigation menu.These reports are real time data and customised reports can be be made

Task Management and Scheduling: From main navigation, tasks of all projects can be accessed. Time log,expenses and duration can be modified . Files related with task can also be shared.Other than main navigation , tasks can also be managed by Gantt chart view. Scheduling of task can also be adjusted in gantt chart manually or by drag option on Gantt chart.

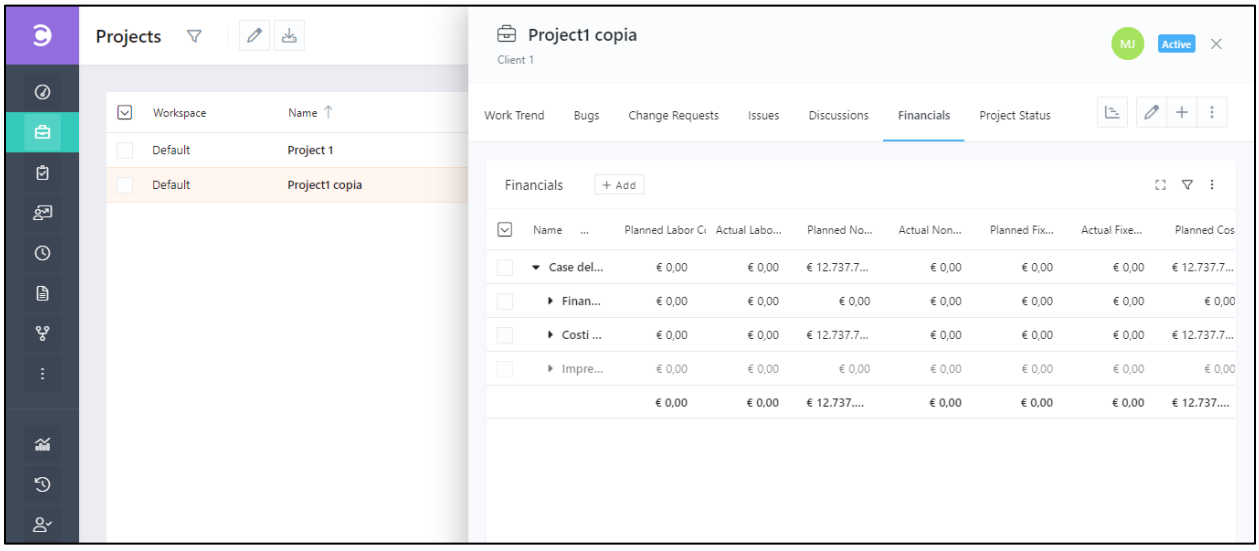

Figure 9:Project Financials

Team Collaboration/Communication : Team members can collaborate , comments and share files. Discussion can be initiated by + sign on top or within individual projects. Team member can comment or share files on discussion topic. Clients can also be added to this discussion.

Integration: Celoxis allows integration with different apps of Microsoft, cloud and work automation applications like zapier. But celoxis does not provide effective solution of Ms project integration as we discussed the issues in section above.

Now lets compare these features with MS Project desktop as this is the software which is currently being used in PoliTO as discussed in 4.1 . We will be using three numbers 0,0.5 and 1 . Where 0=Feature Not available;0.5=Partially supported Feature (supports but have limitations); 1=Feature available .Relative Importance of features has been taken from Table 2

Features	Relative Importance	Solution B	*Solution A
Demand Management	15%	1	0
Portfolio Management	13%	1	0
Project Management	4%	1	1
Resource Management	11%	0.5	1
Budget Management	10%	1	1
Risk/Issue Management	9%	1	1
Reporting	8%	1	1
Scheduling	4%	1	1
Task Management	7%	1	1
Team Collaboration (in-app)	6%	1	0
Real Time Monitoring	5%	1	0
Integration with MS Project**		0.5	-
WSM Score		0.865	0.53

Table 4: Features comparison

For Celoxis, due to the limitation problems discussed earlier, resource management and integration has been assigned 0.5.

*Score of features of MS Project desktop are compiled by PoliTo PMO.

** Integration feature has not been compared as Its only applicable in Solution B.

Score has been calculated using equation 1 in section 3.2.1

4.2.3 Case Study Result

Although Celoxis has more advance features which are effective for Project portfolio management and its score is also greater than solution A but it has limitations in integration with Microsoft Project files which is discussed in details in section 4.2.1. Since MS project is our primary software and its integration with PPM software is very crucial therefore we can not recommend Celoxis to be used for Project Portfolio Management unless its limitations are addressed.

On the other hand, MS Project desktop which is being used currently as primary software, offers many features for project management but its particularly designed to manage individual projects and not the portfolio of projects. So, for Portfolio Management we can try Microsoft Project Portfolio Management which is selected as best software in our survey discussed in section 3.2.1 , however if there is no need for extensive portfolio management , organization can rely on MS Project desktop solution.

5. Conclusion

The goal of the thesis was to study the Program and Portfolio Management and importance of software tools in this field. Establishment of framework for selection of relevant software tool for Program Management was also in scope of this study.

Number of different software were studied, and a framework has been provided with the help of multiple criteria approach. A Survey was conducted from Professionals and students of Project Management to decide the relative importance of the main features of Software tool and score was calculated for each.

In collaboration with the Project Management Office of the Politecnico di Torino, the model was applied to a case study related to projects of Politecnico. Two solutions were compared, the first related to the use of MS Project Desktop's Subproject tool, and the second such as the integration of Celoxis and MS Project Desktop.

It was found that Celoxis has some limitations when it comes to integrating with Microsoft project files. As a result, it may not be the most suitable tool for managing projects that involve the extensive use of Microsoft Project files. While Celoxis does offer robust project and portfolio management features and tools, the limitations in integrating with ms projects files may create challenges for project managers who rely heavily on this format. Therefore, organizations that primarily use MS Project for project management may need to consider alternative solutions that offer better integration with this format.

Considering the limitations of Celoxis in integrating with Microsoft Project files, MS PPM can be considered as a suitable alternative solution for organizations that rely heavily on the use of MS Project for project management. MS PPM is designed to integrate seamlessly with Microsoft Project files and offers a range of powerful project management features and tools that can be used to manage complex projects effectively.

As a future work, the software selection framework can be further improved with addition of studying further PPM software tools. Different methods for analysis of software can be done,

for example using focused research groups consisting of experience professionals from Industry.

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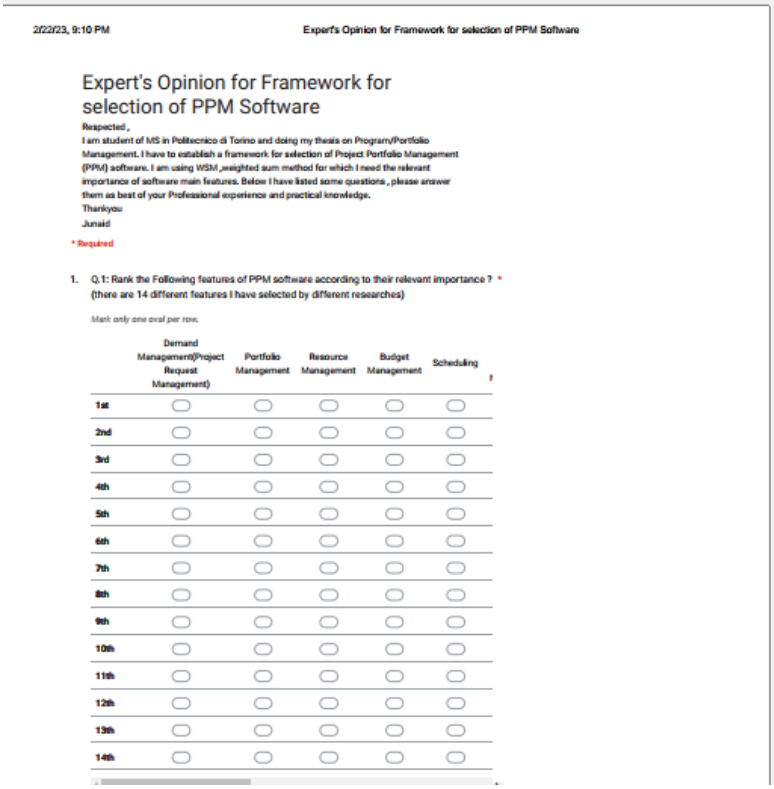
7. Appendix

Link for the google form : https://forms.gle/TK2H357LDZeL61KY9

Form preview:



2/22/23, 9:10 PM Expert's Opinion for Framework for selection of PPM Software

Expert's Opinion for Framework for selection of PPM Software

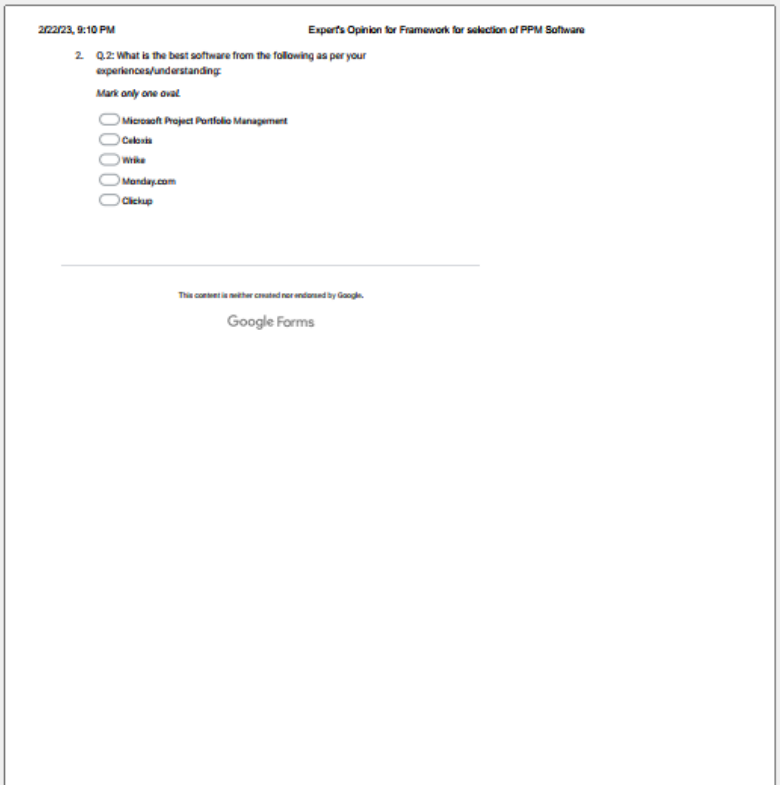
Respected ,
I am student of MS in Politecnico di Torino and doing my thesis on Program/Portfolio Management. I have to establish a framework for selection of Project Portfolio Management (PPM) software. I am using WSM ,weighted sum method for which I need the relevant importance of software main features. Below I have listed some questions , please answer them as best of your Professional experience and practical knowledge.
Thankyou
Junaid

* Required

1. Q.1: Rank the Following features of PPM software according to their relevant importance ? *
(there are 14 different features I have selected by different researches)

Mark only one oval per row.

	Demand Management(Project Request Management)	Portfolio Management	Resource Management	Budget Management	Scheduling
1st					
2nd					
3rd					
4th					
5th					
6th					
7th					
8th					
9th					
10th					
11th					
12th					
13th					
14th					



2/22/23, 9:10 PM Expert's Opinion for Framework for selection of PPM Software

2. Q.2: What is the best software from the following as per your experiences/understanding:

Mark only one oval.

- Microsoft Project Portfolio Management
- Celoxis
- Wrike
- Monday.com
- Clickup

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