Lisbon School
of Economics
& Management
Universidade de Lisboa

MASTER

MANAGEMENT AND INDUSTRIAL STRATEGY

MASTER'S FINAL WORK

DISSERTATION

STRATEGY FOR RESOURCE ALLOCATION PROCESS:

A DATA-DRIVEN MODEL FOR OPTIMAL CANDIDATE MATCHING

JOANA ALVES MOURA

OCTOBER – 2024

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SUPERVISION:

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Acknowledgements

It is with immense pride, relief, and joy that I reach the final part of this dissertation. The past few months have been challenging, filled with hard work and numerous ups and downs. Balancing my role at a consulting firm with the demands of this thesis was no easy feat, and there is much to be grateful for.

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I dedicate this thesis to my grandmother Graciete. While I cannot share this achievement with you in person, I hope you are proud of me wherever you are. Thank you for being my refuge and for always being present in my prayers.

"What if I fall?

Oh, but darling, what if you fly?"

Erin Hanson

Glossary

AHP	Analytical Hierarchy Process
DSR	Design Science Research
F-SWARA	Fuzzy Step-wise Weight Assessment Ratio Analysis
MCDM	Multi-Criteria Decision-Making
OCRA-G	Grey Operational Competitiveness Rating Method
SCE	Skills Calculation Engine
SWOT	Strengths, Weaknesses, Opportunities, and Threat
VBA	Visual Basic for Applications

Abstract

Efficient Resource Allocation to projects is a significant challenge for companies, as it directly affects key metrics such as opportunity costs, project efficiency, and client satisfaction. This study aims to develop an automated process for Resource Allocation, inspired by the consulting industry, specifically designed to improve efficiency by minimizing the time spent on allocating resources and increasing the accuracy of matching personnel to project requirements. The research addresses two main problems: the time-consuming nature of traditional Resource Allocation methods and the lack of precision in identifying the ideal fit for project roles, often leading to inefficiencies and suboptimal results.

The approach follows the Design Science Research (DSR) methodology, which ensures the development of innovative and practical solutions through iterative design and evaluation. The process analyzes key project characteristics and automatically selects the most suitable individual for the task, thus optimizing both time and Resource Allocation accuracy. Several factors related to project typology and organizational needs are parametrized throughout the process to enhance decision-making precision.

The results demonstrate that the proposed model significantly reduces the time required for Resource Allocation and increases the precision of assigning individuals to projects. This leads to higher project success rates and improved satisfaction among stakeholders.

The main contributions of this study are threefold: first, the development of an automated Resource Allocation model designed to address specific organizational challenges; second, the enhancement of the decision-making process by making it faster, more precise, and less prone to human error; and third, the creation of a scalable and flexible model that can be adapted to various industries.

Keywords: Resource Allocation Process; Project Management; Strategic Decision Making; Optimal Resource Matching; Automation Model.

Table of Contents

Index of Figures

Index of Tables

I. Introduction

1.1 IDENTIFICATION OF THE SCOPE AND CONTEXT

Resource Allocation in project management presents an ongoing challenge for companies, as it influences critical factors such as project efficiency, opportunity cost, and client satisfaction, all of which are directly tied to the overall success of the project (Bibi et al., 2021; Dye & Pennypacker, 2000; Patanakul et al., 2007). As organizations expand and their workforce grows, the task of efficiently managing Resource Allocation becomes more pronounced (Varajão & Cruz-Cunha, 2013). Surprisingly, despite its importance, a notable gap in the literature specifically addresses the allocation of financial, technological, physical, and Human Resources that form the foundation of firm strategy (Maritan & Lee, 2017; Patanakul et al., 2007). Consequently, conventional methodologies often serve as the primary approach to managing these allocations despite potential efficiency and effectiveness challenges for companies and their decision-making processes.

The complexity of Resource Allocation is shaped by a critical decision-making process (Jazebi & Rashidi, 2013) considered across three pivotal dimensions: the impact on stakeholders, including resource availability and skill alignment; organizational implications, such as cost efficiency and strategic priorities; and project management factors, including timelines, deliverables, and risk mitigation (Ochoa et al., 2023). Ineffective human resource allocation can significantly reduce project success rates (Patanakul et al., 2007; Sharma & Kumar, 2018), leading to negative consequences for the company, including diminished customer satisfaction and compromised project efficiency.

Therefore, this thesis aims to address the limitations of the Resource Allocation process by proposing an automated model that bridges the gap in the literature by developing a practical artifact specifically designed to meet the real-world needs of organizations. Inspired by consulting practices, the model offers flexibility to adapt to various organizational contexts, ensuring enhanced efficiency, precision, and alignment with dynamic project requirements. The model provides a structured yet adaptable approach to streamline Resource Allocation and improve decision-making processes by integrating practical insights and theoretical foundations.

1.2 RELEVANCE OF THE INVESTIGATION & MOTIVATION

To address the challenge of making the Resource Allocation Process more effective and efficient, companies increasingly rely on consulting firms for expert guidance through the complexities of resource allocation. However, even within consulting firms, the resource selection process remains largely manual, time-consuming, and prone to human error, as highlighted on an interview with one member of KPMG's management team, a KPMG advisor and a data analyst manager of an international company. The struggle to efficiently match candidates with project requirements while balancing variables like availability, technical skills, and experience often leads to delays and inaccuracies.

This thesis is driven by the need to solve these challenges by developing an automated, data-driven model that optimizes the process of matching candidates to projects. The motivation behind this work is to reduce the manual effort currently required in resource allocation while simultaneously improving the precision of selections. The model provides decision-makers with dynamically ranked top candidates based on a comprehensive set of criteria, offering both efficiency and flexibility in the selection process.

Furthermore, the model supports organizations by enabling a more structured, data-driven approach that minimizes human error and ensures a closer alignment between project needs and resource capabilities. Ultimately, the motivation is to create a system that accelerates decision-making and enhances resource allocation's accuracy and strategic alignment across diverse project environments.

1.3 PROBLEM FORMULATION

The Resource Allocation process is a pivotal and indispensable phase in the preliminary stages of project initiation (Choothian et al., 2009) since, according to Çelikbilek (2018), "everything in the business starts with selecting the most appropriate personnel" (p.763). Companies often encounter significant challenges in effectively managing this process despite its critical importance.

The ability to quickly identify available resources and assess whether they meet specific project requirements is frequently hindered by organizational constraints, such as the lack of centralized data, reliance on outdated or manual methods, and limited visibility into employees' skills, availability, and past experiences. These inefficiencies often lead to delays in project initiation, suboptimal resource allocation, and increased operational costs. Furthermore, the subjective nature of manual decision-making introduces biases and inconsistencies, further undermining the process (Bibi et al., 2021; Patanakul et al., 2007; Sharma & Kumar, 2018).

As projects grow in complexity and companies face increasing demands for agility and precision, the limitations of traditional approaches become more evident. Organizations risk compromising project timelines, quality, and overall business outcomes without an efficient and accurate Resource Allocation process.

To address these pressing challenges, this study is structured around a central research question alongside a general goal and two specific objectives aimed at providing a solution to optimize the Resource Allocation process:

Main Research Question: Can the development of an automated model improve the efficiency of Resource Allocation Processes?

Generic Goal: Propose an automated model that makes the Resource Allocation Process simpler and more efficient and makes the decision-making process more accurate.

Specific Objective 1: Design a model that outlines a structured approach to enhance the decision-making process in resource allocation, aiming for increased efficiency and effectiveness in human resource selection.

Specific Objective 2: Demonstrate a reduction in manual effort when identifying the most suitable individuals for specific project requirements, evidenced by a faster and more efficient matching process through automated criteria evaluation.

To address the research question and achieve the outlined objectives, two key tasks must be executed:

Task 1: Review foundational literature to identify, analyse, and compare diverse algorithms utilized in Resource Allocation processes, identify their conclusions, and explore their alignment with the proposed approach.

Task 2: Define the criteria influenced by the Resource Allocation decision, which should be present in the database that feeds the interface model.

By accomplishing these tasks, this study aims to develop a robust and automated model that improves the resource allocation process, addressing the inefficiencies of current manual systems while ensuring more precise and timelier candidate matching for projects.

1.4 STUDY'S STRUCTURE

This study is structured into five main chapters. The Introduction (*Chapter I*) sets the stage by identifying the scope and context of the research, followed by a formulation of the core problem and a concise explanation of the proposed model.

Chapter II: Literature Review presents the historical background and foundational insights into Resource Allocation, which are explored, followed by a comparative analysis of key algorithms and project management tools to develop the proposed model.

Chapter III: Methodology outlines the research design using the Design Science Research approach. This chapter explains the DSR methodology and elaborates on how each phase is applied to this study.

Chapter IV: The Design and Development of the Artefact follows the methodology, presenting a comprehensive application of the model development across each phase detailed in Chapter III. It covers the process from problem identification to the proposal and demonstration of the artefact, with clear explanations of each step involved.

Chapter V: The Results section, encompassing the Model Demonstration, explores the real-world application of the model to enhance candidate selection for projects. This is followed by the Evaluation, where a SWOT analysis derived from interviews is presented, validating the model's effectiveness in practical scenarios. A complete analysis of these results highlights the model's impact on improving efficiency and decision-making.

Chapter VI: Analysis and Discussion of results provides a summary of the research findings, a reflection on the practical implications of the results achieved, and a comparison with the literature.

Finally, *Chapter VII:* Conclusion summarizes the key findings of the research, reaffirming the advantages of the developed model while also identifying its limitations. It addresses potential areas for refinement and outlines suggestions for future research.

II. Literature Review

The literature review will progress logically, starting with exploring the origins, historical foundations, and motivations driving the investigation into Resource Allocation. Subsequently, it will examine pertinent studies closely intertwined with the model developed. Finally, it will culminate with a discerning analysis of more technical research endeavors and software applications, poised to serve as a comparative framework for the developed model.

2.1 FOUNDATION OF RESOURCE ALLOCATION: INSIGHTS FROM BOWER'S FRAMEWORK

Understanding the evolution of the study surrounding Resource Allocation's significance relies on recognizing the pivotal moment when its importance was acknowledged and how it evolved over time. Towards the late 1960s, within investigations into investment decision-making, it became apparent that the abstractions provided by financial models of capital budgeting did not consider both human behaviour and organizational characteristics, focusing solely on quantitative evaluations of investment opportunities to achieve an optimal choice (Maritan & Lee, 2017). This realization prompted management researchers, exemplified by the work of Bower (1970), to conduct field studies scrutinizing the actual execution of investments. Renowned for his contributions to understanding corporate strategies and business management, Bower defines the central theme of the special issue by stating, "In management, the problem of Resource Allocation is the essence of the strategy" (Maritan & Lee, 2017). This notion gains further support from Bower's remarks in 2017, where he emphasizes that the problem of Resource Allocation is central to economics and the companies' strategic management.

Bower (2017) highlights how consulting firms attempted to fill this gap by developing models of business portfolios to aid in framing Resource Allocation choices among business units. However, despite these efforts, the complexities faced by companies evolved over time, rendering the models and concepts used by academic researchers insufficient. These complexities led to difficulties in developing robust models. This conclusion underscores the concern that the practical challenge of Resource Allocation was often overlooked and inadequately addressed (Maritan & Lee, 2017).

2.2 BUILDING BLOCKS: KEY STUDIES SHAPING MODEL DEVELOPMENT

In a multicultural company with a complex environment, allocating human resources to projects has become a significant challenge for project managers.

As is common in consulting firms, which require the right people to achieve the best results on each project type, Grigore et al. (2020) emphasize the criticality and impact of resource allocation on product delivery, highlighting the need for dedicated processes to ensure its successful implementation.

The importance of Resource Allocation is underlined by the fact that a resource issue in one project can quickly cascade into problems in other projects (Ponsteen and Kusters, 2014), which impacts an organization's performance. That is why solving the resource allocation problem should be a priority for companies (Grigore et al., 2020).

In Resource Allocation, personnel selection emerges as a critical and complex decision-making challenge within Human Resources Management. Project success is closely tied to the individuals responsible for execution (Sharma & Kumar, 2018), and selecting the right resources can create a competitive advantage in achieving organizational goals (Chaghooshia et al., 2016). Depending on the specific needs of the projects and clients, significant decisions must be made during the selection process to ensure optimal outcomes (Bower, 1970; Çelikbilek, 2018; Maritan & Lee, 2017).

In response to this challenge, in 2018, Çelikbilek used a Grey-Based Analytic Hierarchy Process (AHP) methodology to facilitate the selection of project managers for a software project of an energy company.

This approach categorized criteria into five primary domains: Basic Criteria, Character Criteria, Project Criteria, Software Criteria, and Energy Criteria, and addresses the inherent complexity of the personnel selection process, offering an efficient method that can be adapted and integrated with other multi-criteria decision-making (MCDM) methodologies. (Çelikbilek, 2018).

Çelikbilek (2018) constructed a hierarchical structure comprising 25 sub-criteria derived from a synthesis of literature and insights gathered from decision-makers within the company and identified the most important sub-criteria within each domain to facilitate clearer and more objective decision-making.

The hierarchical structure of these sub-criteria is visually represented in Figure 1.

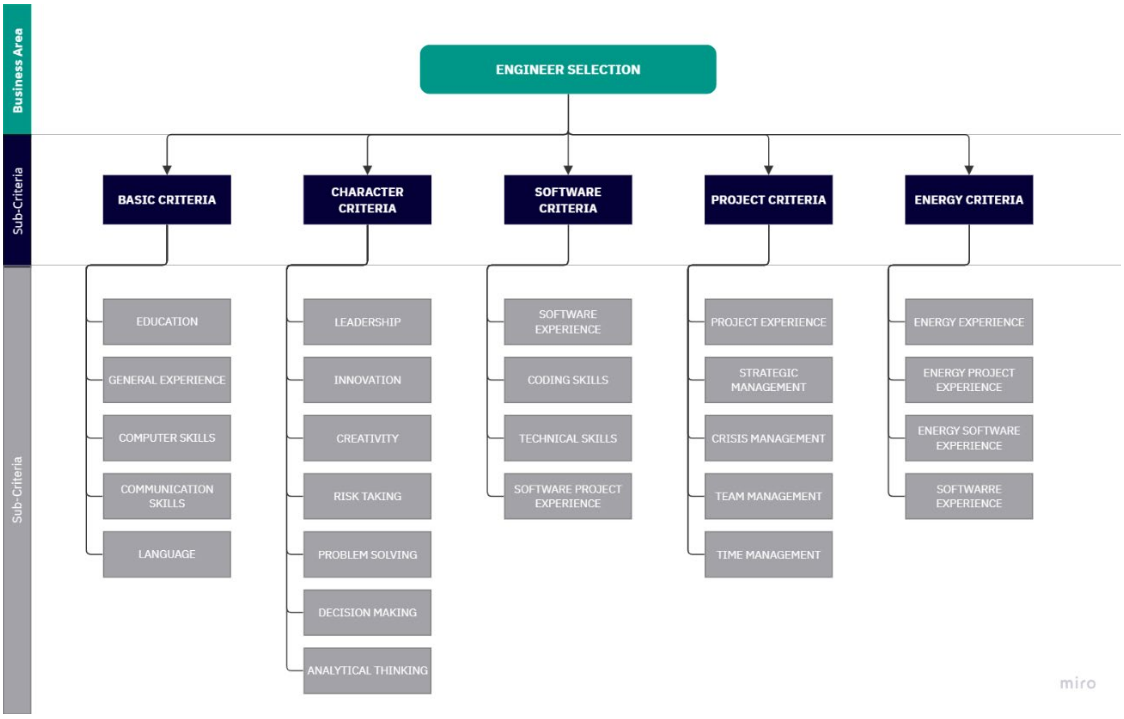


Figure 1. The hierarchical structure of Sub-Criteria

Source: Adapted from Çelikbilek (2018)

According to Çelikbilek (2018), the most important sub-criterion for each category is as follows: computer skills for Basic Criteria, risk-taking for Character Criteria, software experience for Software Criteria, project experience for Project Criteria, and energy software experience for Energy Criteria.

After this, in 2023, Kara et al. undertook an extensive review of the general project manager selection criteria found in the literature, and interviews were conducted with the management team of a manufacturing company. The Grey Operational Competitiveness Rating Method (OCRA-G) was utilized to establish a hierarchy of criteria for the supply chain project manager selection problem. Initially, the criteria identified from the literature were presented to the managers. Based on their feedback, a refined set of criteria for selecting the supply chain project manager was developed, as detailed in Table 1.

Table 1. Selected Criteria

Project Management Skills (C1)	Project management skills refer to the management abilities of prospective supply chain project managers in the successful planning, execution, management, and conclusion of the project.
Basic Management Skills (C2)	Basic management skills refer to the ability of project manager candidates to get people to work.
Education (C3)	Education refers to the educational level from which the project manager candidate most recently graduated.
Experience (C4)	Experience refers to the projects and durations in which project manager candidates serve as project managers.

Personality Traits (C5)	Personality Traits refers that project manager candidates having the personality traits required for project management (Endurance, Patience, effective communication, awareness, analytical thinking, perspective, etc.)
Interpersonal Skills (C6)	Interpersonal skills refer to the project manager's skills in coordinating individuals in different tasks within the project's scope.
Computer Knowledge (C7)	Computer knowledge refers to the ability to effectively use computers used in the execution of projects.

Source: Adapted from Kara et al. (2023)

F-SWARA (Fuzzy Step-wise Weight Assessment Ratio Analysis) method was used to weight the criteria, and the conclusion was that the "Experience" (C4) criterion was the most relevant for the definition of the project manager, followed by "Project Management Skills" (C1) and "Basic Management Skills" (C2).

2.3 ADVANCING RESOURCE ALLOCATION: EVALUATING SOFTWARE AND MODELS

In 2001, Mellentien and Trautmann developed a study that evaluated Project Management Software packages, including Acos Plus.1, CA SuperProject 5.0a, CS Project Professional 3.0, Microsoft MS Project 2000, and Scitor Project Scheduler 8.0.1. They concluded that these software packages are critical in managing resource-constrained projects. However, their benchmark testing revealed a significant gap: none of the software's Resource Allocation methods could compete with the state-of-the-art algorithms documented in the literature.

Later, Bibi et al. (2021) highlighted the issue of ineffective skill management within organizations, which results in assigning tasks to unskilled employees that can lead to project failure. To address this gap, a survey was conducted across various software organizations to identify best practices for skill management and gather requirements for a skills management framework. The Skills Calculation Engine (SCE) was developed for managers to enhance their decision-making capacity when assigning tasks to appropriately skilled workers. Using C# and Visual Studio, employee skills based on education, experience, project performance, and training were calculated, and a skill matrix was established to track and assess individual performance continuously. This study reinforces the concern about how Resource Allocation can impact projects and the existing market challenges in addressing these issues.

2.4 COMPARATIVE ANALYSIS OF LITERATURE

This section aims to compare some of the various mentioned papers. Through this analysis, the significance of the topic of Resource Allocation to projects is underscored, as evidenced by the variety of studies conducted using different approaches to address this challenge.

Çelikbilek (2018) and Kara (2023) have emerged as key contributors to shaping this research since both authors not only explore the challenges of Resource Allocation but also propose practical models to address these issues. Çelikbilek (2018) utilizes the Grey Analytical Hierarchy Process (Grey AHP) model, providing a structured and systematic method to improve the selection of project managers by considering criteria such as software proficiency and project experience. Similarly, Kara (2023) employs the F-SWARA method, a weighted decision-making approach that prioritizes experience as the most critical factor in Resource Allocation. These models showcase how structured methodologies can be applied to solve real-world Resource Allocation challenges, reinforcing the importance of systematic approaches in addressing these complexities. Together, these studies provide a robust theoretical and practical foundation for developing effective Resource Allocation solutions, aligning with the goal of this research to propose an automated model tailored to organizational needs.

Various studies on Resource Allocation in project management highlight its critical impact across different sectors. Effective Resource Allocation enhances decision-making, improves versatility in project manager selection, and significantly impacts product delivery and managing project dependencies (Bibi et al., 2021; Grigore et al., 2020). Experience is identified as a crucial criterion, especially in manufacturing (Kara et al., 2023). The importance of Resource Allocation in strategic management is underscored, and performance gaps between current project management methods and advanced algorithms are noted (Mellentien & Trautmann, 2001). These findings underscore the importance of optimizing Resource Allocation to improve project outcomes.

III. Methodology

In formulating the methodology central to this thesis, an approach in alignment with Design Science principles has been chosen to provide a comprehensive and complete understanding of the study.

This Design Science methodology was developed and selected to address the primary objective of the study: to develop a model that optimizes the resource allocation process.

3.1. WHAT IS DESIGN SCIENCE RESEARCH?

Design Science serves as the foundational framework for understanding artificial phenomena. When the objective is to create an artefact or propose a solution, Design Science Research (DSR) is a methodology referenced in the literature within the scope of project management (Chaves, 2021), providing a systematic approach for conceptualization and implementation. This methodology is applicable both in academic research settings and within organizational contexts (Dresch et al., 2015; Aparicio et al., 2023).

Organizations with higher maturity levels tend to employ more sophisticated project management techniques (Gomes & Romão, 2024), and DSR adopts a structured approach to problem-solving, evaluation, and knowledge dissemination within artificial systems (Çağdaş & Stubkjær, 2011). By enabling a deep understanding of the issue under consideration, this methodology facilitates creating and assessing artefacts to alter existing conditions, thereby transforming processes into more favourable or optimized conditions. The developed artefacts can include a variety of entities, such as constructs, models, methods, and instantiations (March & Smith, 1995).

This thesis is based on the model proposed by Peffers et al. (2007), which outlines six key steps: problem identification, definition of expected results, design and development, demonstration, evaluation, and communication. Each step is crucial for systematically addressing research problems and developing effective solutions.

The model emphasizes flexibility, allowing researchers to adapt each phase to the specific problem and research objectives, ensuring a more tailored and relevant application (Peffers et al., 2007), and is represented in Figure 2.

Figure 2. Design Science Research Methodological Phases

Source: Adapted from Aparicio et al. (2023)

3.2. DESIGN SCIENCE RESEARCH APPLIED TO THIS THESIS

In this section, the structure described in Figure 2 will be followed to provide a clear logical flow that facilitates the understanding of all the steps taken in the development of the thesis, from problem identification to artefact evaluation. The description of each phase will be reinforced by the inclusion of Table 2, facilitating comprehension of the objectives, approach, and methods employed and the specific outcomes yielded by phase, providing a solid base for subsequent development.

Table 2. Design Science Tool – Applicated to this study

Phase	Objective	Approach & Methods	Resulting Outcome
1	Identify Problem & Motives	Observation of reality; Literature Review	Problem Statement: The complexity of Resource Allocation in expanding companies presents a significant challenge. This complexity arises from the need to balance resources effectively across various projects and departments, ensuring optimal utilization and efficiency. Motivation: The motivation for addressing this problem is twofold. Firstly, solving this problem aligns with the goal of DSR to develop applicable knowledge that can solve field-specific problems. Secondly, by addressing this issue, it can enhance operational efficiency within companies, leading to improved project outcomes and overall success.
2	Define objectives of a Solution	Process of reasoning from problem definition	Generic Goal: Propose an automated model that make the Resource Allocation Process simpler and more efficient, and the decision-making process more accurate. Specific Objective 1: Design a model that outlines a structured approach to enhance the decision-making process

			in resource allocation, aiming for increased efficiency and effectiveness in human resource selection. Specific Objective 2: Demonstrate a reduction in manual effort when identifying the most suitable individuals for specific project requirements, evidenced by a faster and more efficient matching process through automated criteria evaluation.
3	Artefact Proposal	Literature Review; Observation of Reality; Analysis and Design	Starting with the identification of key selection criteria and leveraging Excel, an automated model will be developed. The model calculates the ideal candidate for a given project by dynamically evaluating criteria and their associated parameters, ensuring the diverse requirements of both the client and the company are accurately addressed.
4	Artefact Demonstration	Use Artefact to solve Problem	The artefact will be demonstrated in a real-world situation, to test and validate the artefact's performance against predetermined criteria.
5	Artefact Evaluation	Observe how the effectiveness and efficiency of using qualitative methods or quantitative methods	Test and evaluate artefact in specific context: 1) Interviews to understand the effectiveness, efficiency, and limitations of the interface model.
6	Communication	Publish	Academic Presentation and Publication

It is essential to acknowledge, echoing Dresh, A. et al (2015), that DSR should prioritize the relevance of findings to organizations. The practical applicability of research outcomes is essential, as they are intended for professionals within organizations to effectively address real-world challenges.

As such, the Resource Allocation Model, along with its construction, findings, and details, is deeply rooted in the concept of DSR. Given its significant importance for companies, every aspect of its development aligns closely with the principles of DSR, emphasizing practical relevance and rigor in its design and implementation.

IV. Design and Development of the Artefact

4.1. IDENTIFY PROBLEM AND MOTIVES

In the first phase of Design Science Research, identifying a relevant problem is crucial. This involves recognizing a deficiency in a current system and justifying the value of finding a solution to the problem (Hevner, A. 2010). After the problem is identified, a comprehensive review of existing research on the topic is conducted, aligning with the literature review, to gain a deeper understanding and create a focus research direction.

In the context of this thesis, the identified problem is the complexity of Resource Allocation within companies. This complexity arises from the difficulty of quickly identifying which resources are available, whether they meet specific projects' technical or experiential requirements, and balancing these constraints with availability and organizational priorities. As highlighted in an interview with the KPMG management team, the resource allocation process remains highly manual and inefficient, requiring significant time and effort to match employees to projects. Furthermore, the lack of structured, centralized systems often forces managers to rely on informal methods, such as directly asking employees for their availability or experience, leading to inaccuracies and delays.

Despite the significance of this problem, there is a surprising lack of substantial literature specifically dedicated to allocating financial, physical, technological, and human resources that underpin firm strategies. This literature gap underscores the research problem's novelty and creativity.

The motivation for this research arises from the real-world implications of this challenge. As the complexities of Resource Allocation increase, companies often turn to consulting firms for assistance. However, there is a need for a more streamlined process of Resource Allocation within projects to simplify internal company operations and improve efficiency. For example, the lack of visibility into employees' previous project experiences or their availability, as reported in the interviews, frequently results in inefficiencies and delays that could be mitigated through automation.

In conclusion, this problem's solution aligns with DSR's objective of creating applicable knowledge to tackle industry-specific issues. In this context, the practical challenge of Resource Allocation, faced by many companies, was identified and is being addressed in this research. The proposed solution focuses on reducing manual effort, ensuring more precise matches between resources and projects, and providing managers with an automated, adaptable tool that addresses the needs of growing and complex organizations. This effort not only contributes to the field but also aims to enhance efficiency within companies.

4.2 DEFINE OBJECTIVES OF A SOLUTION

After identifying the problem and its underlying motivations, the next phase involves defining the research objective(s), which serve as a guiding line, providing focus and direction to the research efforts (Peffers et al., 2007). When formulating these quantitative or qualitative objectives, it is crucial to consider their feasibility and achievability. They will serve to determine whether the artefact has successfully addressed the identified problem (Doyle, C. et al., 2016; Peffers et al., 2007).

For this research, a generic goal and two specific objectives have been defined to guide the achievement of the primary goal. The generic goal of this research is to propose an automated model that makes the Resource Allocation process simpler and more efficient, while also improving the accuracy of the decision-making process. The specific objectives are to design a model that outlines a structured approach to enhance the decision-making process in resource allocation, aiming for increased efficiency and effectiveness in human resource selection, and to demonstrate a reduction in manual effort when identifying the most suitable individuals for specific project requirements, evidenced by a faster and more efficient matching process through automated criteria evaluation. These qualitative objectives have been set to focus research efforts on developing a model that optimizes Resource Allocation and decision-making processes, benefiting organizational efficiency and effectiveness.

4.3 ARTEFACT PROPOSAL

In this section, following the third phase of DSR, the central artefact is proposed and explained in general terms, focusing on its role in achieving the main goal of this study: make the Resource Allocation process simpler and more efficient, while also improving the accuracy of the decision-making process.

The model is structured to consider various variables that influence decision-making, allowing for the identification of priority sub-criteria within each main criterion relevant to the project. By enabling the adjustment of parameters based on whether they are mandatory or not, the model ensures a precise alignment between the selected criteria and the specific project requirements.

Implemented through an Excel framework, the model aims to identify the ideal candidate for a given project accurately. This approach allows for the adjustment of variable parameters, resulting in a customized solution that meets the diverse requirements set by both the client and the company. The model's flexibility ensures that it can adapt to the unique demands of each project scenario, leading to a more precise alignment between the candidate's qualifications and the project's needs.

Comparison with the Analytic Hierarchy Process (AHP)

After outlining the proposed model and its intended outcomes, it is relevant to compare it with the Analytic Hierarchy Process, a decision-making framework discussed in the literature review.

The AHP is a commonly used method for prioritizing and selecting among alternatives based on a predefined set of criteria. It involves making pairwise comparisons of criteria and alternatives, which are then aggregated to generate rankings or scores. However, the AHP model presents certain limitations when applied to dynamic project environments, particularly in Resource Allocation, such as:

1) Fixed Criteria: The AHP assumes that criteria are fixed and universally applicable across all decisions and alternatives. This rigid approach is not suitable for real-world projects where criteria often need to be customized to meet specific project requirements.

2) Linear Comparison: The AHP relies on linear pairwise comparisons (Ishizaka & Labib, 2009) and aggregates these into a fixed hierarchical structure that can be inadequate in contexts where the importance of criteria shifts based on the project's specific requirements.

Real-world projects are complex and variable, necessitating a more flexible model that can adapt to changing priorities and contexts.

4.3.1 DESCRIPTION OF THE MODEL

This sub-section outlines the resource allocation model, providing a detailed explanation of its design through a model overview. The model is designed to respond to the specific requirements of each project by providing flexibility in defining criteria tailored to the project's needs. While the weighting process itself is automated, fixed scores are assigned to mandatory, and non-mandatory criteria receive variable scores that are automatically calculated.

Model Overview: The proposed model for resource allocation optimizes the selection process by using a structured framework that relies on key data inputs to match candidates to project needs efficiently. It is designed to be adaptable to different implementation environments, focusing on the following key components:

1) Data Used for the Model

The class diagram in **Figure 3** outlines the key datasets used in the resource allocation model, including Candidate Profiles, Project Requirements, Availability Data, and Historical Data. The cardinality between "Resource" and "Roles" is 1 to 0..*, meaning each resource can be associated with multiple roles, while each role is tied to a specific resource. Similarly, the cardinality between "Roles" and "Project" is 1 to 0..*, indicating that a project can require multiple roles, but each role must belong to a single project.

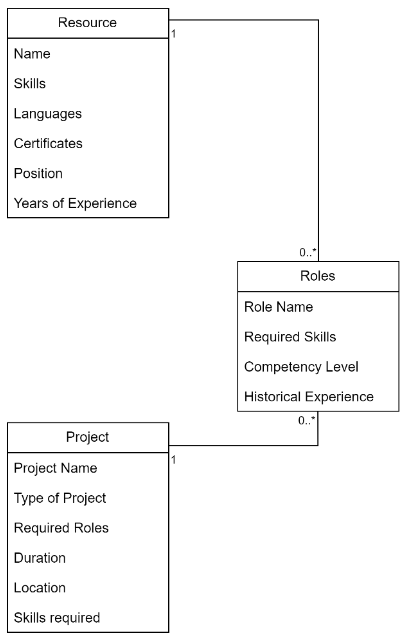


Figure 3. Class Diagram – Data Used for the Model

Resource (Candidate Profiles): The class that represents people in the system, containing personal data like competencies, languages, certifications, and availability.

> **Candidate Profiles:** This dataset includes key details about each candidate, such as their competencies, languages spoken, certificates acquired, and current position. These attributes form the foundation for accurately matching candidates to the specific requirements of upcoming projects.

Role (Historical Data): A class that bridges resources and projects, capturing what roles the candidates have taken and the required roles for a given project.

> **Historical Data:** This dataset contains a detailed account of past performance, including feedback from previous projects, types of projects worked on, roles performed, and the candidates' years of experience. By incorporating this historical data, the model gains deeper insights into a candidate's reliability and suitability, enhancing the accuracy of future assignments.

Project (Project Requirements): A class that holds data about the different projects, including required roles and skills.

> **Project Requirements:** A dataset with the essential qualifications and skills that can be needed for each project, that are a vital input for the matching process, ensuring that the resources allocated are the best fit for the project's demands.

2) Artefact Functionalities

This topic outlines the essential functionalities of the resource allocation model, as depicted in the use case diagram – **Figure 4**. Each use case is designed to streamline the resource allocation process, from data consolidation to candidate ranking, ensuring alignment between project requirements and candidate profiles.

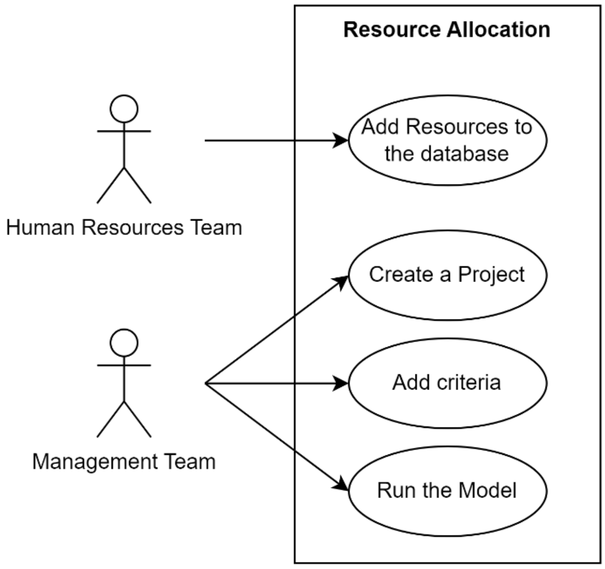


Figure 4. Use Case Diagram – Artefact Functionalities

Add Resources to the Database (Data Consolidation): Gather and centralize the necessary data inputs, ensuring that candidate profiles are up-to-date and accurate.

Create a Project (Understand Project Needs): Define and articulate a project's specific needs and objectives.

Add Criteria (Criteria Definition): Establish criteria for evaluating candidates based on the specific needs of each project. This includes knowing if the criteria are mandatory or not.

Run the Model (Obtain Candidate Ranking): Employ an algorithmic approach to rank candidates based on their alignment with project criteria. The model generates a list of suitable candidates, prioritizing those who best meet the defined requirements.

The matching process involves applying a mathematical formula to assess how well candidates meet the established criteria. The formula can be expressed as the following:

$$Candidate\ Score = \sum (Weight_i \times\ Criterion_i)$$

Where $Weight_i$, represents the weight assigned to criterion i, and $Criterion_i$, indicates the candidate's qualification against that criterion.

To effectively leverage the model post-implementation, the focus should be on:

Human Oversight: Facilitate a review process where managers can assess the ranked list, allowing for nuanced decision-making that considers soft skills and team fit, which cannot be fully automated.

Feedback Loop: Implement a mechanism to gather feedback on the performance of selected candidates and the model's effectiveness. This iterative process ensures continuous improvement of the selection criteria and data accuracy.

By following this framework, organizations can implement the model using any suitable tool or platform, enhancing the efficiency and effectiveness of their resource allocation processes.

4.3.2 DEVELOPMENT OF THE SOLUTION

The first step in developing the solution was establishing an Excel-based database using KPMG's proprietary data. This data encompasses both quantitative and qualitative information regarding the employees within the organization. The database includes employee details such as certifications, seniority level, years of experience, skills, and other relevant attributes. To ensure confidentiality, the employee names are encoded.

Step 1 – Variable Selection and Possible Values: Start by carefully selecting the key variables influencing the resource allocation process. These variables encompass quantitative and qualitative employee data, ensuring a comprehensive view of each resource. Once the variables were defined, possible values were assigned to each, reflecting a range of options that accurately represent the diverse skills and attributes across the workforce.

Step 2 - Data Refinement: After choosing the variables and possible values, the data structure had to be refined to avoid duplication. For example, some employees had the position repeated several times, which, if left unchecked, could skew the scoring process by giving a score to the same employee multiple times. After reaching the final structure, this database must be automatically updated whenever a new employee joins the company or an existing employee leaves. Ideally, HR could update this sheet during onboarding or offboarding, or alternatively, employees could fill out a form that feeds directly into the Excel sheet.

Step 3 - Data Integration and Sheet Updates: Once the database is populated and cleaned, pivot tables are used to dynamically update the information. Whenever a new employee is added, the pivot tables will refresh automatically ensuring that the subsequent steps in the process reflect the most current data. This updated data is utilized in the next sheet, where the project/client requirements are filled out.

Step 4 - Criteria Selection and Weighting: In the criteria selection sheet, the number of variables required for the project is defined, and the rows to be filled will be automatically highlighted in a light gray color. The user inputs the desired variable, the possible value, and whether the requirement is mandatory or not.

Calculations for mandatory values will assign a score of 1, while optional values will be scored based on a fractional value. For instance, if there are three optional values, each will receive a score of 0.33, ensuring that all combined optional values total to 1.

Each employee is then assigned a score based on how closely they match the project requirements.

Step 5 - Ranking and Final Selection: In the final sheet, a pivot table called "Final Ranking" is refreshed to rank employees according to their scores based on the defined project criteria. The top three employees with the highest scores are displayed in a table alongside their attributes. This ranking is automatically updated, allowing for a quick and efficient selection process for the project. This rationale is illustrated in Figure 3, which shows a step-by-step breakdown of how the model works, progressing through stages one to five.

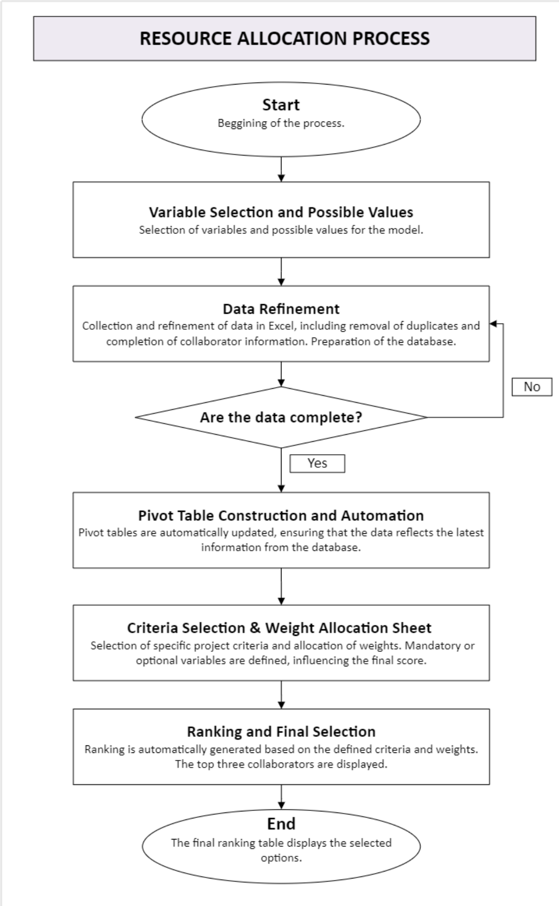


Figure 5. Flowchart describing the development of the Resource Allocation Automation Process

Structure and Functionality of the Excel Model

To understand the application of each step, it's essential to comprehend the structure of the Excel model. The Excel Model is organized into three main sheets, each serving a distinct purpose, which will be explained at a high level. It begins with the R*esource Database*, where all relevant employee information is stored, and culminates in the third sheet, *Evaluation, and Scoring*, where the automated model processes the data to generate the final scores and rankings of the candidates.

Sheet 1: Resource Database - This sheet serves as the repository for all relevant information about available resources. It is structured to include various variables, each capturing different aspects of a resource's qualifications and availability.

The definition of variables involves a rigorous and strategic process that encompasses the analysis of variables that may have a direct impact or relevance in selecting a resource, regardless of the project type.

This analysis was conducted using data from KPMG and two papers: Çelikbilek (2018) and Kara et al. (2023), whose papers aided in selecting certain variables.

- **Availability:** This variable corresponds to the percentage of availability of each resource. Projects may require different levels of commitment, ranging from full-time to part-time. This dimension allows for matching resources based on their availability, ensuring that the resource can meet the project's time requirements.
- **Certificate Name:** This variable includes certifications held by the resource (e.g., Alteryx Designer Advanced). Certifications validate a resource's qualifications, making them critical for roles that require certified expertise.
- **Language:** This variable lists the languages spoken by each resource (e.g., English, French, Arabic). Language skills are particularly important for projects involving international stakeholders or specific regional requirements.
- **Position:** This variable identifies the position of the resource, which correlates with their experience and level of responsibility. Resources with higher positions are suited for roles that demand significant managerial oversight.
- **Project Type:** This variable captures the resource's expertise in specific work areas (e.g., Analytical Processes, Business Process, and Framework).
- **Technical Competences:** These variable details the technical skills and tools known by the resource. This is crucial for projects requiring specific technical expertise.
- **Travel Availability:** This variable assesses the resource's willingness and ability to travel for project-related tasks.
- **Years of Experience:** This variable quantifies the duration an employee has worked in relevant roles, allowing for a balanced selection of candidates based on experience

The table that consolidates all the variables considered for this study, the possible values they can assume for this specific context, and their type, either qualitative or quantitative, can be found in appendix 1.

Sheet 2: Criteria Selection and Weight - Project-specific criteria are defined and weighted in this sheet. For each project, the most important criteria are selected and assigned a weight based on their relevance. The process involves:

1. Defining Criteria: Specific criteria are selected based on the project's requirements. For instance, if a project needs a resource fluent in English and proficient in SQL, these would be the selected criteria.
2. Assigning Weights: Mandatory criteria are given a full score of 1 if met or 0 if not. Optional criteria, on the other hand, are distributed as fractional scores. For example, if there are three optional criteria, each is worth 0.33, ensuring that the total for all optional criteria sums to 1.

This allows the system to assign proportionate importance to different project requirements while maintaining a flexible scoring approach.

***Sheet 3: Ranking and Final Selection* -** This sheet combines data from Sheet 1 (Employee Database) and Sheet 2 (Criteria Selection and Weight) to calculate a weighted score for each resource, indicating how closely they align with the project's specific requirements. The scores are then fed into a Ranking Table, which updates automatically to rank resources based on their overall scores, ensuring an up-to-date evaluation that reflects the most suitable candidates.

4.4 ARTEFACT DEMONSTRATION

In Chapter V, the Artefact Demonstration phase of this methodology will be detailed. This phase involves highlighting the practical application of the developed artefact to address specific instances of the problem identified in this study. Through experimentation, proof, or case study (Peffers et al., 2007), the artefact's effectiveness in enhancing the decision-making process will be validated.

4.5 ARTEFACT EVALUATION

This phase of the DSR, the Artefact Evaluation, will also be detailed in Chapter V. The primary objective of this phase is to determine whether the designed artefact effectively addresses the identified problem by comparing the established solution objectives (Chapter II) with the actual results observed during the Demonstration (Chapter V) (Peffers et al., 2007).

Based on the outcomes of this evaluation, the process may involve revisiting the Artefact Proposal (Phase 3 of DSR) to refine and improve the model, aiming for greater precision. Alternatively, if the results are satisfactory, the process will advance to the final phase.

V. Results

This section presents the results of applying the resource allocation model developed in the previous section. The model was implemented to streamline the resource allocation process by matching employee qualifications with project requirements. The results demonstrate the model's effectiveness in accurately identifying the top candidates for each project based on predefined criteria.

The solution is divided into three main areas: (1) Data Integration and Preparation, where the initial database was created and refined; (2) Criteria Selection and Weighting, which highlights how project-specific requirements were mapped to employee attributes; and (3) Final Ranking, where the top candidates were selected based on their overall scores.

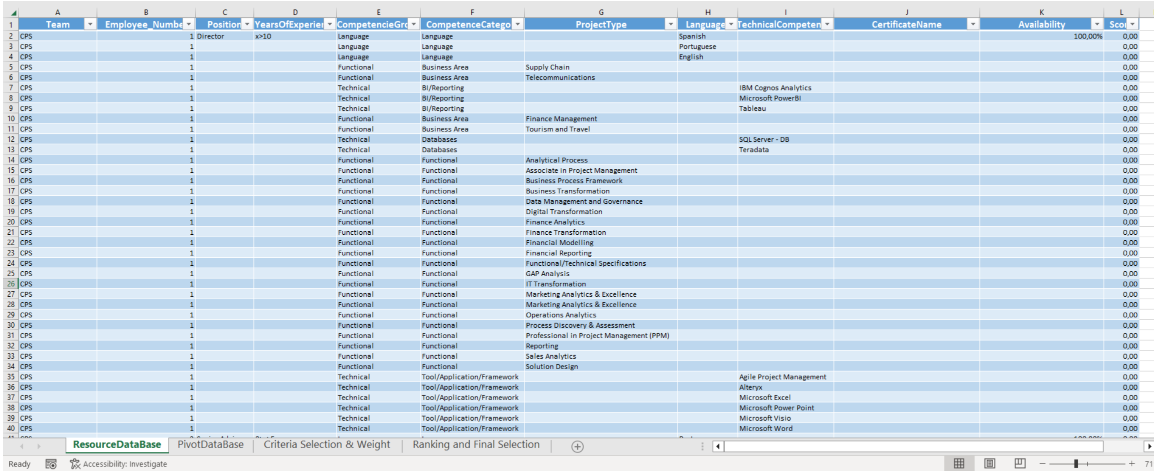
According to feedback from a member of KPMG Management team the automated model significantly reduces the time spent identifying suitable candidates, streamlining the selection process while minimizing human errors. By providing a ranked list based on specific criteria, the model centralizes essential data, making resource allocation more organized and efficient.

The following sub-section includes screenshots of the actual results from the model. These visuals provide a clear representation of the model's functionality and its practical application.

5.1 DEMONSTRATION

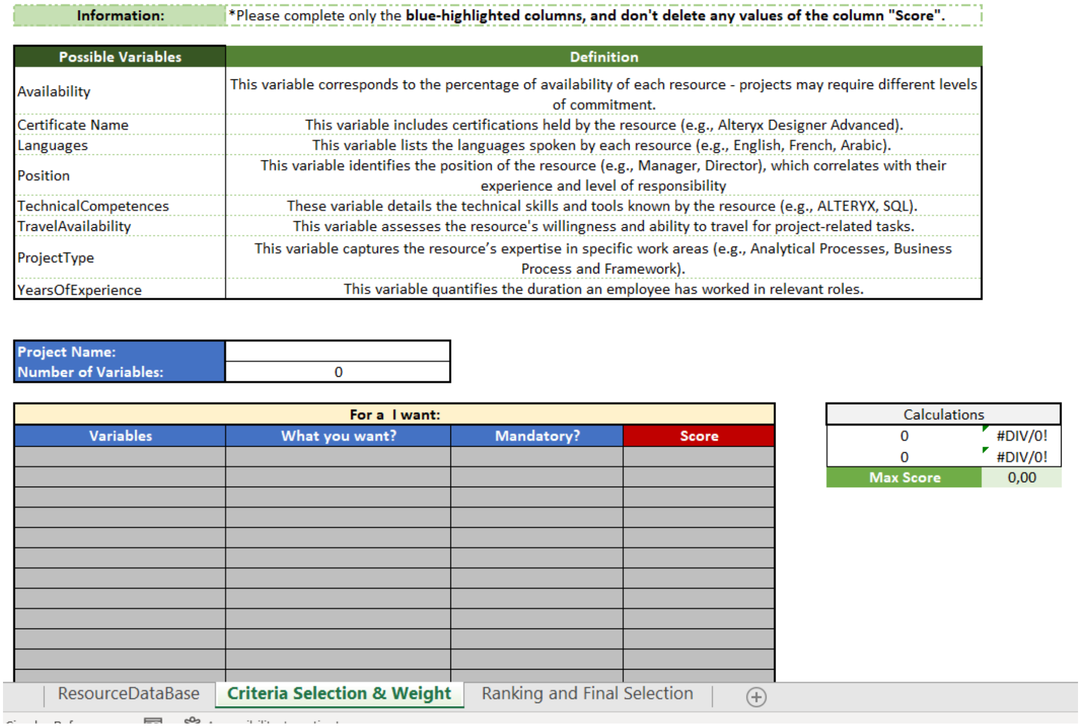
The demonstration section illustrates the application of the resource allocation model in a hypothetic scenario. It begins with the initial data input, where employee information is encoded and stored in the Excel database and concludes with the identification of the top three candidates. These candidates, along with their relevant skills and qualifications, are highlighted, demonstrating the model's ability to match the right resources efficiently and accurately to the right projects. By implementing this model, the company can reduce the manual effort on resource selection while increasing the accuracy of its decisions, ensuring that projects are staffed with the most suitable candidates.

The following figures illustrate the model and the three sheets described in the section *4.3.2 Development of the Solution* in its initial state before any specific selections:



	Team	Employee_Numbe	Position	YearsOfExperier	CompetencieGr	CompetenceCatego	ProjectType	Language	TechnicalCompeten	CertificateName	Availability	Sco
2	CPS	1	Director	x>10	Language	Language		Spanish			100,00%	0,00
3	CPS	1			Language	Language		Portuguese				0,00
4	CPS	1			Language	Language		English				0,00
5	CPS	1			Functional	Business Area	Supply Chain					0,00
6	CPS	1			Functional	Business Area	Telecommunications					0,00
7	CPS	1			Technical	BI/Reporting			IBM Cognos Analytics			0,00
8	CPS	1			Technical	BI/Reporting			Microsoft PowerBI			0,00
9	CPS	1			Technical	BI/Reporting			Tableau			0,00
10	CPS	1			Functional	Business Area	Finance Management					0,00
11	CPS	1			Functional	Business Area	Tourism and Travel					0,00
12	CPS	1			Technical	Databases			SQL Server - DB			0,00
13	CPS	1			Technical	Databases			Teradata			0,00
14	CPS	1			Functional	Functional	Analytical Process					0,00
15	CPS	1			Functional	Functional	Associate in Project Management					0,00
16	CPS	1			Functional	Functional	Business Process Framework					0,00
17	CPS	1			Functional	Functional	Business Transformation					0,00
18	CPS	1			Functional	Functional	Data Management and Governance					0,00
19	CPS	1			Functional	Functional	Digital Transformation					0,00
20	CPS	1			Functional	Functional	Finance Analytics					0,00
21	CPS	1			Functional	Functional	Finance Transformation					0,00
22	CPS	1			Functional	Functional	Financial Modelling					0,00
23	CPS	1			Functional	Functional	Financial Reporting					0,00
24	CPS	1			Functional	Functional	Functional/Technical Specifications					0,00
25	CPS	1			Functional	Functional	GAP Analysis					0,00
26	CPS	1			Functional	Functional	IT Transformation					0,00
27	CPS	1			Functional	Functional	Marketing Analytics & Excellence					0,00
28	CPS	1			Functional	Functional	Marketing Analytics & Excellence					0,00
29	CPS	1			Functional	Functional	Operations Analytics					0,00
30	CPS	1			Functional	Functional	Process Discovery & Assessment					0,00
31	CPS	1			Functional	Functional	Professional in Project Management (PPM)					0,00
32	CPS	1			Functional	Functional	Reporting					0,00
33	CPS	1			Functional	Functional	Sales Analytics					0,00
34	CPS	1			Functional	Functional	Solution Design					0,00
35	CPS	1			Technical	Tool/Application/Framework			Agile Project Management			0,00
36	CPS	1			Technical	Tool/Application/Framework			Alteryx			0,00
37	CPS	1			Technical	Tool/Application/Framework			Microsoft Excel			0,00
38	CPS	1			Technical	Tool/Application/Framework			Microsoft Power Point			0,00
39	CPS	1			Technical	Tool/Application/Framework			Microsoft Visio			0,00
40	CPS	1			Technical	Tool/Application/Framework			Microsoft Word			0,00

Figure 6. Sheet 1: Resource Database



Information:	*Please complete only the **blue-highlighted columns, and don't delete any values of the column "Score".**

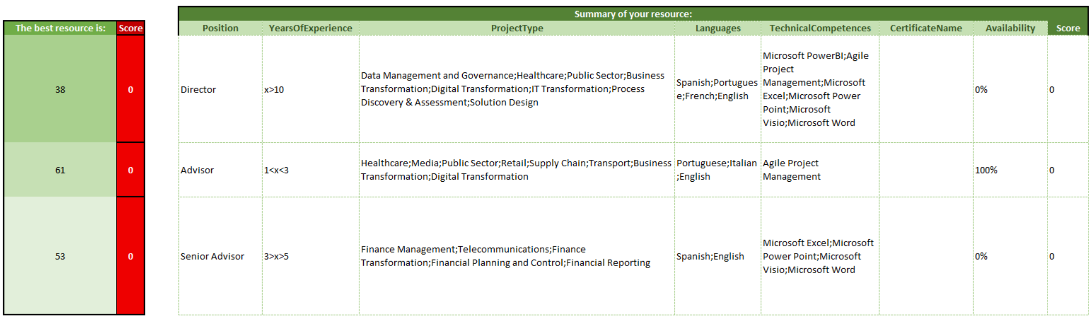
Possible Variables	Definition
Availability	This variable corresponds to the percentage of availability of each resource - projects may require different levels of commitment.
Certificate Name	This variable includes certifications held by the resource (e.g., Alteryx Designer Advanced).
Languages	This variable lists the languages spoken by each resource (e.g., English, French, Arabic).
Position	This variable identifies the position of the resource (e.g., Manager, Director), which correlates with their experience and level of responsibility
TechnicalCompetences	These variable details the technical skills and tools known by the resource (e.g., ALTERYX, SQL).
TravelAvailability	This variable assesses the resource's willingness and ability to travel for project-related tasks.
ProjectType	This variable captures the resource's expertise in specific work areas (e.g., Analytical Processes, Business Process and Framework).
YearsOfExperience	This variable quantifies the duration an employee has worked in relevant roles.

Project Name:	
Number of Variables:	0

For a I want:			
Variables	What you want?	Mandatory?	Score

Calculations	
0	#DIV/0!
0	#DIV/0!
Max Score	0,00

Figure 7. Sheet 2: Criteria Selection & Weight



The best resource is:	Score
38	0
61	0
53	0

Summary of your resource:							
Position	YearsOfExperience	ProjectType	Languages	TechnicalCompetences	CertificateName	Availability	Score
Director	x>10	Data Management and Governance;Healthcare;Public Sector;Business Transformation;Digital Transformation;IT Transformation;Process Discovery & Assessment;Solution Design	Spanish;Portugues e;French;English	Microsoft PowerBI;Agile Project Management;Microsoft Excel;Microsoft Power Point;Microsoft Visio;Microsoft Word		0%	0
Advisor	1<x<3	Healthcare;Media;Public Sector;Retail;Supply Chain;Transport;Business Transformation;Digital Transformation	Portuguese;Italian ;English	Agile Project Management		100%	0
Senior Advisor	3>x>5	Finance Management;Telecommunications;Finance Transformation;Financial Planning and Control;Financial Reporting	Spanish;English	Microsoft Excel;Microsoft Power Point;Microsoft Visio;Microsoft Word		0%	0

Figure 8. Sheet 3: Ranking and Final Selection

For the *"Thesis Project"* example, four variables are considered: Position, Availability, ProjectType, and Languages:

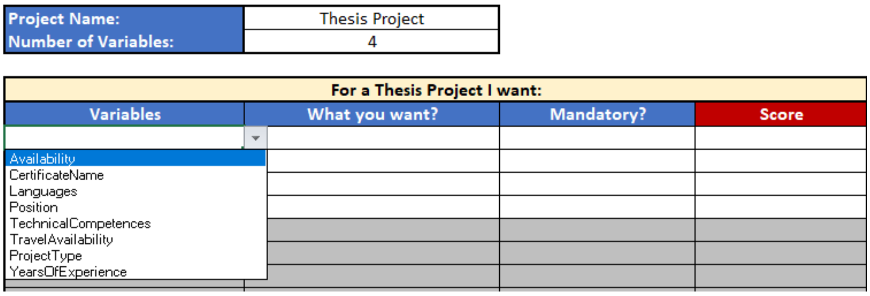


Figure 9. Variables Selection

The model automatically displays the available variables and their possible values once selected. For this example, "Advisor" was chosen for Position, "100%" for Availability, "Digital Transformation" for ProjectType, and "English" for Languages:

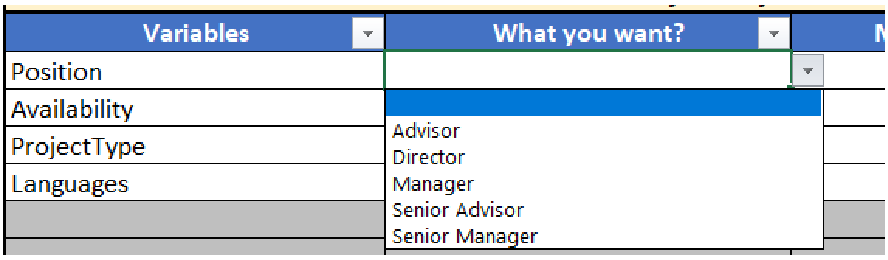


Figure 10. Possible Values Selection

The next step involves defining whether each variable is mandatory or not. In this case, Position and Availability are mandatory, while ProjectType and Languages are non-mandatory:

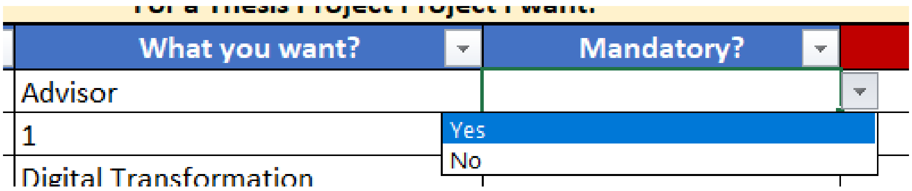
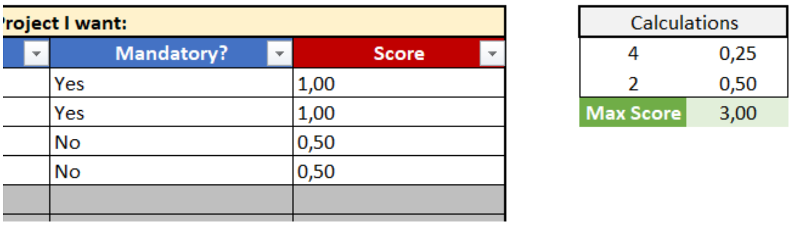


Figure 11. Mandatory Variables Selection

The model then calculates the score for each variable and determines the maximum possible score a resource can achieve based on these selections. Mandatory variables consistently receive a score of 1, while non-mandatory variables are assigned a score of $\frac{1}{number\ of\ non-mandatory\ variables}$:

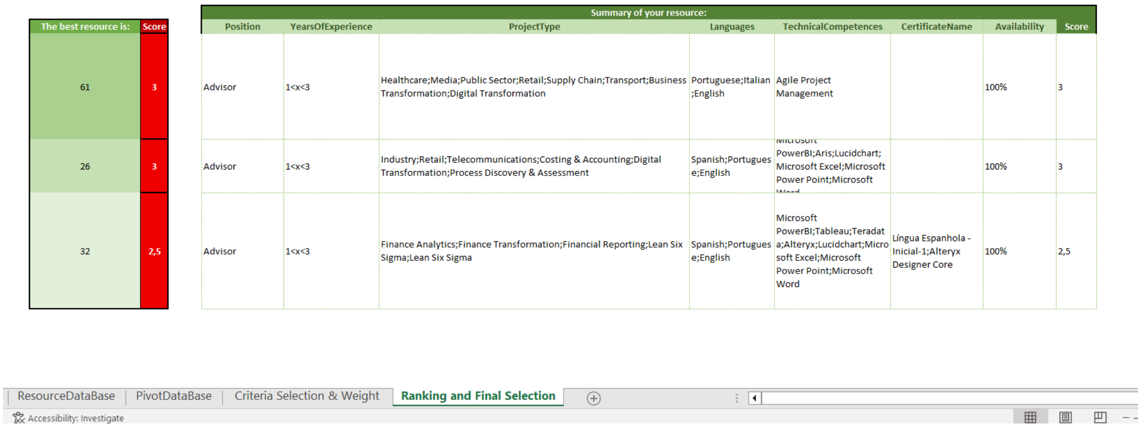


'roject I want:		
	Mandatory?	Score
	Yes	1,00
	Yes	1,00
	No	0,50
	No	0,50

Calculations	
4	0,25
2	0,50
Max Score	3,00

Figure 12. Automatic Score Generation

Once this phase is completed, the next step is to proceed to the *"Ranking and Final Selection"* sheet. Here, the model presents the top three resources in a ranked order and their corresponding characteristics:



The best resource is:	Score
61	3
26	3
32	2,5

Summary of your resource:							
Position	YearsOfExperience	ProjectType	Languages	TechnicalCompetences	CertificateName	Availability	Score
Advisor	1<x<3	Healthcare;Media;Public Sector;Retail;Supply Chain;Transport;Business Transformation;Digital Transformation	Portuguese;Italian ;English	Agile Project Management		100%	3
Advisor	1<x<3	Industry;Retail;Telecommunications;Costing & Accounting;Digital Transformation;Process Discovery & Assessment	Spanish;Portugues e;English	Microsoft PowerBI;Aris;Lucidchart; Microsoft Excel;Microsoft Power Point;Microsoft Word		100%	3
Advisor	1<x<3	Finance Analytics;Finance Transformation;Financial Reporting;Lean Six Sigma;Lean Six Sigma	Spanish;Portugues e;English	Microsoft PowerBI;Tableau;Teradat a;Alteryx;Lucidchart;Micro soft Excel;Microsoft Power Point;Microsoft Word	Língua Espanhola - Inicial-1;Alteryx Designer Core	100%	2,5

Figure 13. Top 3 Ranking display

This allows the user to review the top three candidates and select the one that best fits the project's requirements. In this example, resources 61 and 26 both achieved the maximum possible score and met all the specified criteria. This process empowers users in their decision-making by ensuring that the final selection is based on comprehensive data while also enabling them to make informed choices based on the ranked results. Furthermore, offering more than one option allows decision-makers to draw upon their own experience, considering soft skills and past projects in the selection process.

5.2 EVALUATION

Artefact evaluation can take many forms and can be conducted through various methods, either qualitative or quantitative (Peffers, et al, 2007). For this study, interviews - a qualitative method - have been selected as the evaluation method.

As a result, a SWOT analysis was developed based on three in-depth interviews with a KPMG manager, a KPMG advisor, and a data analyst manager from an international company. This evaluation aimed to thoroughly assess the potential of the proposed automated resource allocation model across consulting firms and other business industries. The extensive experience of the two managers in selecting human resources for projects, combined with the advisor's insights on instances where resource allocation misaligned with prior experience, provided critical perspectives. These insights highlighted the limitations of the current manual processes and underscored the transformative potential of an automated solution. By leveraging these firsthand perspectives, it is expected to understand the model's strengths and weaknesses, the opportunities it presents, and the challenges it may face.

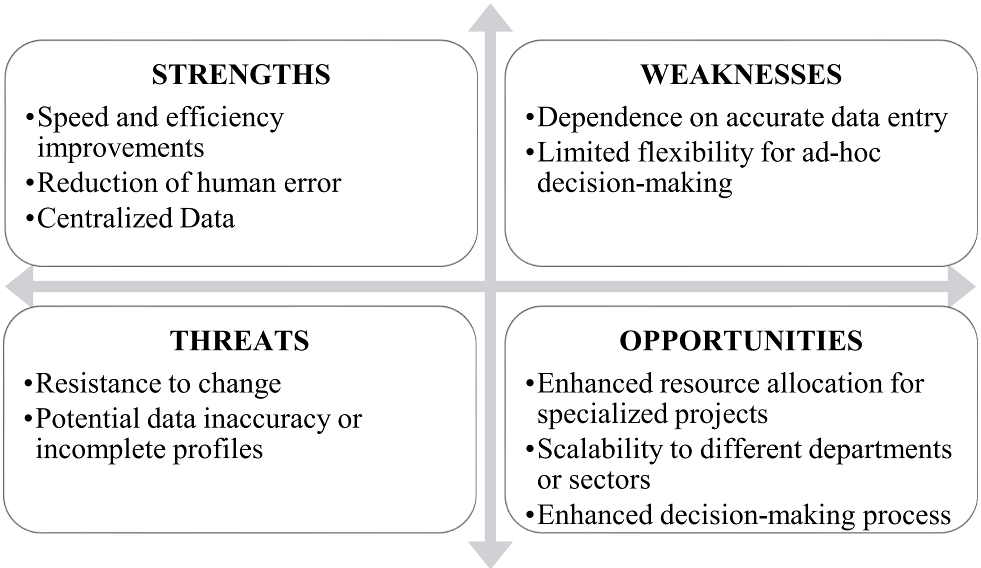


Figure 14. SWOT Analysis

1. STRENGTHS

Speed and efficiency improvements: According to KPMG's manager the automated model "will definitely speed up the selection process", since the actual process "can take a couple of days, because it is an entirely manual process, deciding on which people fit the role, and then checking their availability manually (in a specific tool used to see everyone's allocation)". This model reduces the time taken to select candidates by providing a ranked list based on specific criteria that are crucial, such as "expertise, years of experience (always a requirement for our clients), and availability". It helps streamline the decision-making process, offering a faster alternative to the manual approach.

Reduction of human error: By consolidating information on candidates' past projects, skills, and experience, the model reduces human errors, such as mistakenly selecting someone lacking a crucial skill or experience. As noted by the KPMG manager, "having a way to verify everyone's capabilities and match them to our needs would be a significant improvement", and the KPMG advisor ""I have often received requests asking if I had experience in areas like X, Y, and Z. There have also been instances where I was asked to join a project outside my area of expertise. In such cases, it becomes necessary to collaborate to identify the most suitable people and check their availability."

Centralized data: The model centralizes key information - such as availability, skills, and experience - streamlining the selection process and making it more efficient. As highlighted, "the advantage of having all the information on experience, skills, and availability in one place" greatly enhances accessibility and organization.

2. **WEAKNESSES**

Dependence on accurate data entry: The model's effectiveness relies on the completeness and accuracy of the data input into the system. "It requires some work for us to fill out an accurate and complete database," and missing or incorrect data could compromise the candidate choice.

Limited flexibility for ad-hoc decision-making: While the model enhances efficiency, it may not fully capture the nuanced judgment that managers typically apply in their decision-making processes. Human intervention remains valuable for assessing soft skills, team dynamics, and motivation, as "the model may not completely replace the necessary ad-hoc considerations that are often important in Consulting".

3. **OPPORTUNITIES**

Enhanced resource allocation for specialized projects: The model provides significant value for niche or highly technical projects by quickly identifying candidates with the most relevant skills. As the manager mentioned, "Let's say I have two excellent candidates, but one is a specialist in Data Analytics." The model can easily highlight which candidate best fits the specific project needs while also suggesting alternatives, which may even be useful for another project that's about to begin. This ensures that the right expertise is allocated to the right project efficiently.

Scalability to different departments or sectors: As the model is adaptable, it can be expanded to cater to different project types or even other departments, thus increasing its usefulness across the organization. As the manager mentioned, "Consider we have a model that can identify candidates with the necessary skills; this could be applied not only in our area but across different sectors." This flexibility will enable the organization to utilize the model to meet various resource allocation needs in multiple areas.

4. THREATS

Resistance to change: Managers who are used to making decisions based on personal relationships or manual checks may be hesitant to rely on an automated system.

Potential data inaccuracy or incomplete profiles: If candidate profiles are not well-maintained or updated regularly, the model could provide suboptimal recommendations, which could damage trust in the system.

In conclusion, this SWOT analysis, grounded in real-world insights from a KPMG manager, highlights the considerable advantages of the proposed automated model, particularly in terms of time savings, error reduction, and centralized data management. While the current process has room for improvement, the model offers a practical solution to many of the challenges identified. For instance, a recent use case involved the need for a person who spoke French for a presentation, leading the team to ask group by group if anyone could assist. This scenario could be avoided with the model in place, allowing for faster identification of qualified candidates. However, the model's success depends heavily on accurate data entry and the continued involvement of human judgment for more nuanced decision-making. The manager's feedback emphasizes that while the model could significantly streamline the resource selection process, it should act as a complement rather than a replacement for current practices, ensuring a balanced approach to optimizing resource allocation.

5.3 COMMUNICATION

The dissemination of results is a crucial component in DSR, ensuring that the contributions generated by the research can be understood and applied by various audiences. To maximize the impact of this work, I will communicate the results and contributions clearly and accessible through a formal thesis defense, where the developed model and its applicability in different contexts can be discussed, and considering practical demonstrations of the resource allocation model to KPMG, allowing stakeholders to see firsthand how it can optimize candidate selection processes.

VI. Analysis and Discussion of Results

This chapter addresses three key areas: a summary of the research findings, a reflection on the practical implications of the results achieved, and a comparison with the literature.

The primary goal of this study was to develop an automated resource allocation model to improve the Resource Allocation process, which was successfully achieved. The model, implemented in Excel, allows for the efficient selection of candidates based on predefined project requirements and criteria, reducing the time required to manually assess employee suitability for projects. Through the automation of this process, the model ensures consistency and accuracy in selecting the most appropriate candidate, minimizing human error and subjective bias.

In practical applications, the model demonstrated its capacity to handle different selection scenarios by dynamically adjusting to the weighted criteria and generating a ranking of candidates. Interviews with experienced professionals in resource allocation affirmed the model's potential for practical use, recognizing its ability to streamline the selection process and improve decision-making outcomes. Notably, the model's capability to dynamically manage mandatory and optional criteria has been particularly well-received, significantly improving the traditional manual process.

Comparison of the Proposed Model with Literature Review Approaches

The literature presents various models to improve resource allocation, each with distinct features. Comparing the model proposed by Kara et al. (2023), which uses methods to weight criteria, the automated model developed in this study offers greater user control, enabling decision-makers to prioritize the most relevant criteria to each project and receive multiple ranked options. This flexibility empowers users to consider technical skills and other important factors like prior project experience. In addition, as emphasized by Grigore et al. (2020), resource allocation significantly impacts product delivery, highlighting the necessity for dedicated and systematic processes to improve its effectiveness**.** Furthermore, unlike the more rigid approaches like Çelikbilek's (2018) model, which relies on AHP, the Excel-based model in this study can adjust to evolving project requirements, ensuring a more adaptable application. The Excel-based model can adjust to evolving project requirements, ensuring a more adaptable application, as Bibi et al. (2021) noted, who underscore the importance of dynamic resource allocation in real-world project environments.

By automating the resource allocation process, the model also addresses the human error and subjectivity issues that often arise in traditional methods. This aligns with the findings of Maritan & Lee (2017), who observe that while conventional methodologies are still widely used, they often fall short of meeting the complex needs of organizations in dynamic project environments.

In summary, the model addresses several limitations identified in the literature by enhancing decision-making autonomy and resource allocation process adaptability. This leads to improved efficiency and a better alignment with the dynamic needs of real-world projects.

VII. Conclusion

In conclusion, this study successfully addressed the challenge of optimizing the Resource Allocation process by proposing an automated model that enhances efficiency and effectiveness. The main research question posed at the outset - *Can the development of an automated model improve the efficiency of Resource Allocation Processes?* - has been answered through the creation of an automated resource allocation tool and trough the SWOT analysis made. This tool simplifies the selection process, making it more accurate and reducing the time and effort required to match the right personnel to project needs.

The following table illustrates a comparison between the actual resource allocation process and the proposed automated model, addressing the objectives defined for this study. Each key aspect of the process is observed, demonstrating how the new model enhances resource allocation by tackling the limitations of the current method.

Table 3. Comparison of Resource Allocation Processes: Actual vs. Automated Model

Aspect	Actual Process	Automated Model Process
Reduction of manual effort	High manual involvement in gathering and verifying skills, availability, and project fit, requiring highly human input.	Significant reduction in manual effort, as the system automates much of the data gathering and matching processes.
Speed	Time-consuming manual processes involving checking availability, skills, and informal feedback from colleagues or managers. In more complex cases, the process can take days.	Automation allows the quick generation of a list of suitable candidates based on predefined criteria, reducing the time spent on selection. Additionally, since companies often have a database of employees, data consolidation is simplified.
Accuracy	Relies on informal knowledge, potentially leading to human error when matching candidates to project needs.	Centralized and up-to-date data reduces human error, ensuring more accurate matches. The system automatically updates when new information is input.
Efficiency	Requires significant time and effort to manually check resource availability and match candidates.	Streamlined by automating the selection process, making it quicker and more efficient to identify the right candidate for each project.
Flexibility	Flexibility is limited, as any changes in project requirements require new manual checks and additional consultations with employees or managers.	The system allows dynamic adjustment of criteria and weights, adapting to specific project needs without increasing the time or effort involved.

As so, the model presented in this thesis successfully achieves the primary goal of simplifying and making the Resource Allocation process more efficient and supporting more accurate decision-making. By automating the evaluation of key criteria, the model eliminates much of the manual effort currently involved in resource selection. Additionally, the model's automated ranking of candidates offers a structured approach, ensuring that decisions are based on data-driven insights while allowing managers to make informed final choices.

The model addresses Specific Objective 1 by providing a structured framework that enhances decision-making. The process of defining project-specific criteria and weighting them accordingly ensures the relevance and accuracy of resource selection, streamlining the overall process. In terms of Specific Objective 2, the model clearly demonstrates a reduce on the manual effort on identifying suitable candidates, as evidenced by the faster matching process. A real-world use case during the thesis work showed that an automated system could immediately match candidates for a project requiring French-speaking skills, avoiding time-consuming manual searches across teams.

Practical and Theoretical Implications

The practical implications of this study are considerable. From a business perspective, the model offers an effective tool that can be adapted to various types of projects, ensuring that resource allocation is both efficient and aligned with project needs.

Theoretically, the study contributes to the body of knowledge on Resource Allocation by offering a concrete example of how an automated model can be applied to streamline decision-making processes. The integration of specific criteria weighting and score calculation addresses gaps in existing resource allocation models, which often lack the flexibility or precision needed for complex project environments.

Limitations of the Study

Despite the model's strengths, some limitations were identified throughout the implementation phase.

One issue is that when selecting a quantitative variable, such as availability percentage (e.g., 80%), the user might expect it to encompass values above 80%. The model currently interprets the input strictly, selecting only those resources that meet the exact percentage. To address this, the model allows users to select multiple availability ranges, such as 80%, 90%, or 100%, which offer more flexibility and accuracy in the selection process.

Another limitation arises when no resource meets a mandatory criterion. While this could be seen as a shortfall, the model's true benefit lies in its capacity to empower the decision-maker. Even if no resource fully satisfies all the mandatory criteria, the model provides a list of the best available candidates, enabling the user to make an informed decision. This flexibility gives decision-makers the discretion to consider alternative candidates that may be a better fit for the project despite not meeting every requirement. The system encourages thoughtful human intervention, ensuring that final decisions remain aligned with project objectives.

Suggestions for Future Research

Based on the results of this study, future research and development are suggested:

1. **Transition to Web-based Platform:** While the current model was developed using Excel, a potential next step would be to transition to a more scalable, web-based platform (Costa, 2007). Such a platform could provide greater flexibility, enhance user interaction, and enable seamless integration with existing project management systems. Replicating the logic used in the Excel model on a web platform would ensure consistent functionality, while offering the advantage of real-time data updates and integration with enterprise software, such as SAP or other resource management tools.
2. **Enhanced User Feedback Mechanisms:** Future developments could focus on improving user feedback within the model. For example, when an exact match for mandatory criteria is not found, the system could offer alternative suggestions or detailed explanations on why certain criteria were not met. This would give users more context, helping them make informed decisions and giving them more insight into the model's operation. Enhanced feedback would not only improve the decision-making process but also increase user confidence in the model's recommendations.

This study opens doors for future research, particularly in exploring more scalable model implementations in different platforms. Moving beyond Excel, transitioning to a web-based solution could further increase the model's adaptability, usability, and integration with broader project management systems. In this regard, the work presented provides a strong foundation for continued innovation in optimizing Resource Allocation processes, theoretically and practically contributing to the field.

VIII. References

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IX. Appendices

Appendix 1. Considered Variable and Possible Values

Variable	**Type**	**Possible Values**
Availability	Quantitative	0%<x<100%
Certificate_Name	Qualitative	A2 Level, Language Craft Institute; Alteryx Designer Advanced; Alteryx Designer Core; C1 IELTS; Cambridge English: Advanced (CAE); Cambridge English: First (FCE); Cambridge English: Proficiency (CPE); CCNA Routing and Switching; Certificado curso Intermédio 2 (B2); Cisco Certified Network Associate (CCNA); Functional Basis for SAP S/4 HANA; Língua Espanhola - Inicial-1; MS Excel Expert Certificate; Recovery of SQL DB; TCF
Language	Qualitative	Arabic; English; French; German; Italian; Portuguese; Spanish
Position	Qualitative	Advisor; Senior Advisor; Manager; Senior Manager; Director
Project_Type	Qualitative	Analytical Process; Appointment/Scheduling Services; Associate in Project Management; Banking; Business Analytics; Business Process Framework; Business; Transformation; Costing & Accounting; Data Management and Governance; Digital Transformation; Ecommerce; Education; Energy & Renewables; Finance Analytics; Finance Management; Finance Transformation; Financial Analysis; Financial Modelling; Financial Planning and Control; Financial Reporting; Functional/Technical Specifications; GAP Analysis; Healthcare
Technical_Competences	Qualitative	Agile Project Management; Alteryx; Aris; Bloomberg; Cisco Systems; Confluence; Google Cloud Platform; IBM Cognos Analytics; ISO; Lucidchart; Microsoft Excel; Microsoft Forms; Microsoft Power Point; Microsoft PowerBI; Microsoft Visio; Microsoft Word; Mongo Db
Travel_Availability	Ordinal	Yes; No
Years_of_Experience	Quantitative	1<x<3; 3<x<5; 5<x<7; 7<x<10; x>10

Appendix 2. Questions made on the interviews:

Current Process

1) How do you currently go about selecting human resources for projects? Are there any tools or systems you use to aid in the selection process, or is it primarily manual?
2) How long does it usually take to complete the resource selection for a new project?
3) What factors do you consider most important when selecting resources for a project (e.g., experience, availability, specific skill sets)?
4) How is feedback handled if someone feels they were misallocated to a project?
5) Could you describe a situation where resource allocation went particularly well or badly? What factors contributed to that outcome?

Challenges

6) What are the biggest challenges you face when selecting the right people for a project?
7) How do you handle situations where multiple candidates meet the project requirements?
8) How often do project requirements change during the selection process, and how does that affect your decision-making?

Time and Efficiency

9) On average, how much time do you spend comparing candidates for a project?
10) Are there any tasks in the selection process that feel particularly time-consuming or repetitive?

Accuracy and Precision

11) Do you feel confident that the current process always results in the best possible match between a candidate and a project?
12) Do you think an automated model would help reduce human error in the selection process and make more precise matches?
13) Have you ever been selected for a project where you didn't have the required experience?
14) What is the process to determine whether a resource meets the necessary requirements?

Model Advantages

15) If a model could automatically rank candidates based on their skills, availability, and other factors, how do you think that would impact your process?
16) Do you believe an automated tool that provides a ranked list of the top candidates for each project would help save time and make the process more efficient?
17) When you reviewed the model, what were the three key benefits you identified, and how do you think it could improve the Resource Allocation process? What do you think that can be better?