Identification and Prioritisation of Digital Transformation Projects Selection Criteria

Ottaviani F.M. [a)], Narbaev T. [a)], Carlin A. [a)] and Ortiz Mendez L. [a)]

a. Dipartimento di Ingegneria Gestionale e della Produzione, Politecnico di Torino, Corso Duca degli Abruzzi, 24 10129 – Torino – Italy
(filippo.ottaviani@polito.it, timur.narbaev@polito.it, antonio.carlin@polito.it, lorena.ortizmendez@polito.it)

Abstract: Digital transformation (DT) initiatives are vital for organisations to remain relevant and competitive amidst a complex and ever-evolving technological landscape. Selecting and evaluating suitable projects is critical for achieving strategic objectives while balancing necessity and feasibility. Despite the extensive literature on project portfolio selection and prioritisation models, there is no consensus on effective critical success factors (CSFs), resulting in poorly selected criteria and overlooking project interdependencies. Therefore, improved selection guidelines are necessary for academic and professional communities. This study addresses the need for such guidelines by conducting a thorough literature review of project portfolio management characteristics and analysing 29 studies to identify DT projects selection and prioritisation criteria. The criteria were grouped into four success dimensions, and the Analytic Hierarchy Process (AHP) method was used to weigh the criteria. Data was also collected from a group of experts in DT projects. The results of this study highlight the importance of considering the people, organisation, project, and uncertainty dimensions, with a focus on people management, collaboration with end-users, top management support, alignment to strategic objectives, and risk management were crucial criteria. The results of this study also suggest using Agile project management for managing DT projects and recommend developing monitoring and controlling capabilities. Overall, this study contributes to both academic and professional communities by providing guidelines for selecting and prioritising DT projects. By considering the success dimensions and CSFs identified in this study, organisations can improve their project selection process and increase the likelihood of successful DT initiatives.

Keywords: Digital Transformation; Portfolio Management; Critical Success Factors

I. INTRODUCTION

Companies from several sectors are adopting digital transformation (DT) initiatives to enhance their business models and improve their operational efficiency and flexibility [1]. Selecting and evaluating DT projects has become critical due to the intricate and evolving technological landscape [2]. Achieving strategic objectives requires optimizing the trade-off between necessity and feasibility, which comes at the cost of several implementation challenges.

Organisations have implemented Project Portfolio Management (PPM) tools to tackle these issues and to balance diverse initiatives toward achieving strategic objectives [3]. PPM impacts several areas, including, but not limited to, strategic alignment, resource balancing, and project selection and prioritisation. However, assessing PPM performance across different industries has shown that the most significant shortcomings are related to selecting the proper number of projects, given scarce resources, and balancing the project portfolio under both short- and long-term perspectives [4].

The literature on project portfolio selection and prioritisation models is extensive. It focuses on identifying criteria that organisations should adopt to prioritise and implement the appropriate project portfolio, addressing the set strategic objectives, thereby generating value for stakeholders. However, these approaches are unsuccessful due to poorly selected criteria and the complex interdependencies among projects [5]. As a result, there is no consensus on the most influential Critical Success Factors (CSFs) for project selection and prioritisation, and selection guidelines require

significant attention from academic and professional communities [6].

This study aims to identify and prioritise a set of CSFs to be considered in a multi-criteria decision-making method to support managers in selecting and prioritising DT initiatives.

The paper is structured as follows. Section II reviews the literature providing models for selecting and prioritising DT projects. Section III explains the approach to identify the CSFs and evaluate their weights, including the literature review process and the use of the Analytic Hierarchy Process (AHP) method. Section IV provides empirical application of the AHP method on the data collected by interviewing 12 professionals. Lastly, Section VI summarises the main findings and limitations of the study and suggests avenues for future research and implementation.

II. LITERATURE REVIEW

Project selection and prioritisation are complex due to their multi-faceted characteristics, the high number of stakeholders involved, the diverse priorities, and definition of success [7]. [8] reported the complexity characteristics that can affect selecting Key Performance Indicators (KPIs) in organisations, such as fundamental criteria, organisational and functional structure, project size, industrial sector, different perspectives among stakeholders, and different stages of the project life cycle. For this reason, an agreement has not been reached yet about which indicators should be considered to select and prioritise projects according to the identified CSFs. Therefore, researchers and professionals must conduct a deeper analysis to clarify this issue [6].

To define the key components of a project portfolio, [3] suggested analysing three categories of factors: realization factors (i.e., cost, duration, resources, expected deliverables, and complexity), organisation's objective-oriented factors (i.e., positive and negative impacts on strategic objectives, simplicity and visibility of results, and benefits realization timeline), and external factors (i.e., organisation's image, contribution and interdependencies with communities and countries, and resistance to change). Project selection should be based on the degree of alignment with strategic objectives, interdependencies among projects, portfolio process assets, and enterprise factors.

Regarding DT projects, [9] suggested that the success relies on selecting solutions that can aid in choosing and managing multiple DT projects simultaneously. They highlighted the uncertainty around PPM activities in relation to DT projects, as organisations desire portfolio management practices to coordinate multiple digital initiatives while not wanting these methodologies to reduce the creativity and innovativeness of digitalisation through excessively structured processes. However, DT projects require new measures and criteria that better focus on strategic fit, customer alignment, and financial criteria. Current practices have not advanced beyond the initial stages and do not consider the level of interdependencies and synergies among projects.

[10] suggested that successful implementation of DT projects depends on the previous experience of the person in charge of the operational implementation, top management support, involvement of different stakeholders and functions. They also defined a set of measures to monitor, control, and evaluate progress in this fast-changing environment. [11] proposed four levels of critical factors that can impact the cost and time success of information systems development projects, including portfolio-, project-, project manager-, and team-level factors.

[12] proposed a model based on several financial criteria, such as the net present value of energy savings, labour savings, material savings, and the project investment. The model also considers the complex interrelationships among portfolio elements and sets general constraints, such as a budget constraint, a threshold for each type of savings, and dependencies among projects. In their study, [13] emphasised the importance of customer experience and identified four dimensions with corresponding CSFs (CSFs): analytics, business, customer, and digital.

However, [14] focused on the maritime transport industry and analysed a list of CSFs for DT. They highlighted the need for strategic alignment of digitalisation initiatives, a clear vision of the scope and desired results, and investment in leadership roles and team skills training. [15] identified challenges in implementing digitalisation initiatives and proposed corresponding solutions, including the need for data transparency, well-trained teams, and effective communication. [16] proposed a framework for successfully implementing DT projects based on initiatives implemented by ABB, CNH Industrial, and Vodafone companies. They stressed the importance of clear scope and results,

data collection and platforms, and effective people management.

To summarise, earlier studies agree on analysing factors belonging to four categories: organisation, people, project, and uncertainty. However, the literature suggests there is still no agreement on the models and the weights of the CSFs for selecting and prioritising DT projects, given the complexity of the decision-making process and the many stakeholders involved. Considering this, the following research questions are proposed. Firstly, which factors should be considered when selecting and prioritising DT projects? Secondly, what are the most critical factors, following a multi-criteria decision-making method?

III. METHODOLOGY

This section presents the methodology used to perform the study, starting from conducting the initial research for identifying the criteria and ending with analysing and obtaining the results through the AHP method.

A. Academic literature review and criteria identification

The study began by conducting a thorough literature review of PPM characteristics. The PPM literature was collected from Scopus, ASCE, and Google Scholar libraries. After the literature screening phase, 86 articles were selected and reviewed to understand the main goals and usefulness of PPM practices. This was done to support subsequent analyses on CSFs.

Next, the study focused specifically on investigating the criteria and factors proposed in the literature. This resulted in 29 articles deemed valuable for analysing the most relevant criteria to select and prioritise projects. DT projects received particular attention, and academic literature was reviewed for both digitalisation at large and specific criteria for evaluating DT initiatives.

Analysing these articles enabled the identification of the most valuable criteria for selecting DT projects. These criteria were grouped into success dimensions, and a qualitative hierarchy was created based on their prevalence in academic literature. In the next section, a group of experts in DT projects was interrogated to collect data to be used to apply the AHP method.

B. Practical application of the AHP method

The AHP method was selected as a multi-criteria decision method to assign priorities and weights to the criteria identified. The method is structured in two main phases, which comprise the design and evaluation. The design phase aims to create a hierarchy and requires a comprehensive understanding of the subject of interest. Following the design phase, the next step concerns the hierarchy evaluation. The exact steps to perform during the AHP methods are listed by [17], as follows:

1. Creation of the hierarchy by breaking down the problem into decision elements.
2. Collection of data through pairwise comparisons.
3. Perform the "eigenvalue method" to calculate the weights of hierarchy elements.
4. Aggregation of the relative weights resulted in each element to define the priorities for the alternatives.

29 articles were collected to create the hierarchy, while data for the weights was collected through pairwise comparisons using a Google Form survey. Professionals were chosen based on their roles in DT departments, involvement in international projects, location in the European Economic Area, and more than five years of experience in digital-related roles. The AHP scale suggested by [18] was used to express weighted preferences for the first level of success dimensions and the second level composed of criteria.

Professionals were selected based on the following criteria:

- Job title: Head of department, Project Manager, or Consultant in the digital transformation department of organizations.
- Experience: More than 5 years of experience in a digital-related role.
- Location: Located in the European Economic Area.
- Project involvement: Involved in international projects in large organizations.
- Leadership: Held leadership and decision-making positions in digital departments and projects.

The results were calculated using the Excel model created by. The model employed the linear 1 to 9 AHP scale and calculated priorities using the row geometric mean method. Consistency indices were calculated for each participant based on the principal eigenvalue λ_{max}, with consistency ratio calculated using the Alonson/Lamata linear fit.

The model aggregated the priorities obtained from different participant sheets in the summary sheet, using the weighted geometric mean of the matrices'

elements $a_{ij(k)}$. The weight of each decision-maker was set to 1, and the consolidated matrix C was calculated. The consensus indicator, using Shannon alpha and beta entropy, was also calculated to determine the level of agreement among participants' preferences.

IV. Results

C. Identified Criteria

The identification of criteria was based on 29 screened articles, which addressed the selection and prioritisation problem in PPM covering different years, industries and actors' perspectives. Firstly, for each article, the CSFs suggested were investigated as a base for the subsequent aggregation. Secondly, the elements suggested were merged and compared to identify the shared CSFs can act as criteria in project selection. Finally, the criteria shared by at least five sources in academic literature (more than 15% of the total 29 sources used) were included in the final list used for the hierarchy of the AHP method.

After conducting the analysis, 16 criteria were identified to cover various project aspects, presented in Table I. These criteria were suggested and validated by experts' judgments and previous literature analyses and are easily identifiable along with their corresponding sources.

TABLE I. Identified CSFs

ID	CSF
1	Adequacy of initial risk assessment
2	Alignment to strategic objectives
3	Capability of monitoring and controlling the project
4	Client involvement and satisfaction
5	Dependency on external factors
6	Financing requirements
7	Interdependencies with other projects
8	Organisation's functions involved
9	Project Manager expertise and experience
10	Readiness of required technology
11	Size and complexity
12	Stakeholders' involvement and motivation
13	Team skills and experience
14	Top Management Support
15	Urgency and timings
16	Value creation

D. Success dimensions and hierarchy design

The main objective of identifying the 16 criteria was to develop a successful portfolio of DT projects. These criteria cover various aspects of PPM success and can be organized into a hierarchy that consists of four dimensions contributing to portfolio success. It is important to note that these dimensions consider not only specific aspects of individual project evaluation but also encompass strategic objectives and organisation-wide benefits. Thus, the four success dimensions are identified as follows:

1. *Organisation*: factors related to organisational characteristics, structure, and capabilities.
2. *People*: factors impacting people management, from a skills point of view to stakeholders and client management.
3. *Project*: factors that describe the project-specific characteristics to evaluate not only the overall impact at the portfolio level but also the effectiveness of each project.
4. *Uncertainty*: factors investigating the risk management side of portfolio and project management, taking into consideration the external impact and the internal capabilities of monitoring and controlling the project.

The four dimensions and respective CSFs are summarized in Table II.

TABLE II. CSFs hierarchy

Dimension	CSF ID
Organisation	2, 8, 10, 14
People	4, 9, 12, 13
Project	6, 7, 11, 15, 16
Uncertainty	1, 3, 5

Table III lists, for each CSF, its respective scale.

TABLE III. CSFs scales

ID	Scale
1	1: Risk register not clearly defined/uncomplete 3: Qualitative risk analysis 5: Quantitative risk analysis
2	1: Not aligned 3: Aligned with ~50% of strategic objectives 5: Covering all strategic objectives
3	1: Uncomplete KPIs and low feasibility preparation of controlling actions 3: Complete KPIs but low feasibility of controlling actions 5: Complete KPIs and high feasibility of controlling actions
4	1: Client is only consulted during the first and final stages 3: Periodical consultation 5: Continuously involved
5	1: Low exposure 3: Medium exposure 5: High exposure
6	1: <5% of budget allocated to DT projects 3: ~10-30% of budget allocated 5: >40% of budget allocated
7	1: <10% of resources are shared with other projects 3: <50% of resources are shared with other projects 5: 100% of resources are shared with other projects
8	1: Internal to one function 3: Collaboration between only two functions 5: Cross-functional project
9	1: First DT project as PM 3: 1-3 years of experience 5: >5 years of experience
10	1: Technology to develop from scratch 3: Technology developed and ready to launch the pilot 5: Technology already implemented in current practices
11	1: Sequential phases 3: Simultaneous and overlapping phases 5: Simultaneous and overlapping phases with multiple relationships
12	1: Unclear benefits and no incentive schemes

	3: Clear benefits but no incentive schemes 5: Clear benefits are clear and shared and incentive schemes
13	1: First experience in DT projects and necessary trainings on new technology 3: Cumulated experience but in need of training 5: Solid experience
14	1: Not followed by top management actors 3: Sponsored 5: Sponsored and monitored periodically
15	1: <3 months 3: <1 year 5: other
16	1: Payback Period < 6 months 3: Payback Period < 2 years 5: other

E. Data Collection

To perform the data collection step of the AHP method, professionals were involved to express judgements regarding the pairwise comparisons needed by this procedure. In total, 56 experts were contacted for the study based on the criteria mentioned in the Methodology section. 12 of these specialists gave comprehensive answers, enabling the use of the AHP technique computations. This response rate was 21% overall. The study's key goal of obtaining responses from a wide range of industries was effectively met, ensuring a thorough representation of viewpoints for the study.

The survey was developed using the Google Forms platform, chosen to streamline the judgment process. It began by presenting a detailed overview of the project's scope, providing a clear understanding of the analysis and the purpose behind the participants' responses. This initial description aimed to ensure that the experts had a comprehensive understanding of the work before proceeding with their judgments and answers. Secondly, a description of the success dimensions was reported to clarify the hierarchy structure and the grouping of the different criteria. In this way, professionals were able to express judgements in the pairwise comparisons between the main four dimensions, using the 1 to 9 scale proposed by [18].

Then, within each dimension, the proposed criteria were defined to clarify their meaning for the experts. Again, the pairwise comparison was enabled to express consistent and clear judgements.

To select experienced professionals focused on DT, the criteria listed in the methodology section were applied. The screening process aimed to identify managers with decision-making roles in digitalization projects, prioritising professionals with the titles of "Head of Digitalization", "Digital Project Manager", and "Consultant in DT". Additionally, only professionals with more than five years of experience in DT roles were contacted, along with broader industry experience. Experts from companies with international projects were selected to ensure a more global perspective. 56 experts were contacted using this process, and 12 responded with complete information, enabling the AHP method calculations. This resulted in a response rate of 21%.

F. Results

Table IV provides the weights of the four success dimensions, standard deviation (Std), and rank. Results show an overall consistency ratio of 5.4% respecting the threshold of 10% generally admitted in theory. The consensus indicator was moderate and particularly at a level of 52.7%. The People dimension is the most impactful dimension (weight of 57.8%) following the experts opinion. The error interval is the highest but is not overlapping the other dimensions. Organisation and Project dimensions have slightly different weights, but the error intervals overlap, and it is impossible to define a real priority between them. Finally, the last dimension is Uncertainty, with a weight of 8.4%.

TABLE IV. DIMENSIONS WEIGHTS AND RANKS

Dimension	Weight	Std	Rank
People	.578	.234	1
Organisation	.185	.065	2
Project	.152	.043	3
Uncertainty	.084	.014	4

Table V provides the weights of the individual CSFs, and their respective rank.

TABLE V. CSFS WEIGHTS AND RANKS

Dimension	CSF ID	Weight	Rank
People	4	0.238	1
People	13	0.134	2
People	12	0.118	3
People	9	0.088	4
Organisation	14	0.081	5
Project	16	0.073	6
Organisation	2	0.037	7
Organisation	8	0.034	8
Uncertainty	3	0.034	9
Organisation	10	0.033	10
Project	6	0.026	11
Uncertainty	1	0.026	12
Uncertainty	5	0.025	13
Project	7	0.019	14
Project	15	0.018	15
Project	11	0.016	16

V. DISCUSSIONS

The following sections analyse the results obtained for each success dimension and compare them with previous research to highlight differences and confirm important insights of portfolio management practices in the DT context. The success dimensions

are listed by decrescent order of assigned weight resulted from the AHP method.

G. People success dimension

The study's results highlight the importance of considering the People dimension, and particularly the involvement and satisfaction of clients, in the selection and prioritisation of DT projects. This emphasises the importance of collaboration with end-users and the need to involve them throughout the entire project life. The study also shows that people management is a critical success factor for DT projects, with a focus on the expertise, skills, and experience of the project manager and team.

The attention to people interactions and collaborative iteration is a strong characteristic of the Agile project management model, which has been found to be suitable for managing the uncertainty of DT projects and better involving end-users in the development process. The study suggests that Agile project management can be an important tool for managing projects at both the single and portfolio level, addressing the needs for client involvement and the uncertainty affecting DT projects.

H. Organisation success dimension

The results of the study indicate that the Organisation success dimension is the second most important category of criteria in the overall ranking, with Top Management Support being the most weighted criterion. The literature supports the importance of Top Management Support, as it has been identified as a critical success factor in portfolio management in various studies. However, the other criteria in this dimension, such as Alignment to strategic objectives and Involvement of different functions, are also crucial to ensure the efficiency of portfolio management practices.

Interestingly, the readiness of required technology criterion is not strongly differentiated in importance within the Organisation success dimension. This finding contradicts recent literature, highlighting the importance of technology readiness in DT projects. However, the study's results suggest that professionals may not view technology readiness as crucial in ensuring organisational success in the context of portfolio management.

I. Project success dimension

Overall, while project-specific characteristics remain necessary for evaluating projects at the project management level, they become less important when assessing projects at the portfolio level. The professionals' judgement emphasises the importance of maximizing value creation and financial evaluation of DT projects, while downplaying the significance of complexity and interdependencies between projects. However, it is important to note that the importance of these factors may vary depending on the specific context and industry, and it is essential to consider a range of criteria when evaluating projects for portfolio management.

J. Uncertainty success dimension

Although risk management was assigned a lower weight in this study, it remains a critical component for the success of DT projects. Developing a set of KPIs aligned with the organisation strategic objectives that can efficiently measure and monitor the progress of DT projects is essential.

Decision makers should pay attention to this success dimension and invest in developing strong monitoring and controlling capabilities within their organisations. Standardizing the inclusion of risk management best practices in their activities is also crucial to ensure the success of DT projects.

K. Managerial implications

Thanks to the criteria identified and the corresponding weights assigned through the AHP method, it is possible to create a solid set of criteria to select and prioritise DT projects. Decision makers can exploit the designed structure and the resulted data, to analyse project from each criterion perspective. Projects can be assigned points using ordinal scales for each criterion (as proposed during the identification of criteria). Then the point assigned should be multiplied by the weight of the corresponding criterion to obtain a set of weighted points for each project. Finally, the sum of the weighted point for each project will determine the importance of the project itself.

Decision makers and managers can also decide to not use all the criteria proposed according to the specific situation or needs of the organisation. In this study, it is possible to notice that the project-specific criteria included in the Project success dimension have a lower assigned weight when evaluated at portfolio level. A possible application that can be useful to differentiate these criteria from the other is to exclude them from the general prioritisation process when using the AHP method. Decision makers can use in the AHP model only the other three success dimensions (Organisation, People, Uncertainty) to evaluate the benefit caused by each specific project to the organisation. After this phase, each project can be investigated and

plotted in a two-dimensional analysis, comparing the benefit to one project-specific characteristic, like costs, timings, or complexity.

VI. CONCLUSIONS

Project selection and prioritisation are crucial in PPM as they impact the strategic success of an organisation. The dynamic and ever-changing environment of DT requires the support of a model to aid the decision-making process of management in creating a successful portfolio. CSFs can be identified to generate criteria for project selection. The research investigates the solutions proposed in the literature, including both CSFs and decision-making models. Through this analysis, a set of effective CSFs is identified, representing all the characteristics affecting DT portfolio management. The AHP method is used to create a hierarchy of elements and assign weights to different CSFs. The resulting model aligns with several aspects highlighted in previous literature and is useful for practical managerial application.

This study highlights the strategic importance of PPM for business success. The main findings consist of the identified CSFs and their ranking. Specifically, the People dimension (top four CSFs) is followed by the Organisation dimension, Uncertainty, and Project as last. Furthermore, this study provides insights for implementing a model to support managers in their decision-making process when evaluating and creating a portfolio of projects. These findings serve as a basis for an automated system to prioritise the pipeline of projects.

However, the study does not come without limitations. Firstly, the list of criteria may vary depending on the specific business environment. Second, the weights of the criteria may be biased due to the limited number of experts involved in the study. Third, the study does not consider the specific needs of different industries.

Future research could explore the following avenues: customizing criteria for DT project selection to specific business environments, employing more robust weighting mechanisms, exploring industry-specific needs, assessing the long-term impact of DT projects on organizational performance, integrating stakeholder perspectives, creating a dynamic criteria framework, conducting comparative studies, and undertaking case studies.

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