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Improving Risk Management in University Research: Identifying Critical Risks with a Digital Twin Approach

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Abstract

University research projects are often characterized by a high level of innovation, which inherently involves uncertainties and risks. This paper addresses these challenges in three steps. Firstly, this paper explores the critical risks, drawing insights from ten different project leaders at the university. The data is qualitatively collected through interviews, highlighting the key challenges in research project management. Secondly, a systematic literature review validates and supplements the interview findings. Thirdly, a digital risk twin based on a Monte-Carlo simulation is developed, incorporating uncertainties, base costs, and time-related risks. This innovative approach enables the visualization of multiple scenarios. The collected data on identified risks during the project and the interview is compared, aiming to validate and enrich the findings. By identifying the most common risks and introducing enhancements by a digital risk twin approach, the research advances the understanding of risk management in university settings. The occurred risks of the project assist in validating the data to develop further strategies for mitigating or avoiding critical risks early. The findings reveal that the most frequent challenges include resource constraints, unexpected research results, and delivery delays. The integration of a digital risk twin to the management of university settings allows for more effective handling of complexity and improved project outcomes.

Keywords
Risk Management, Digital Risk Twin, Critical Risks, University Research Projects, Project Outcome

1. Introduction

The number of large, complex projects managed by universities is increasing in both size and scope (Moore and Shangrew 2011). Most German funding is collected through third-party funding. In 2021, a professor at a German university raised an average of €298,400 in third-party funding. This is 3.8 % more than in 2020 (Statistisches Bundesamt 2024). The German Research Foundation (DFG) is one of the largest funding organizations in Germany. Both individuals and institutions can apply for funding. In total 103 programs and 6.620 projects were approved in 2023. As a result, €3.2 billion in funding was awarded by the DFG (Statistisches Bundesamt 2023).

1.1 Problem Statement

Globalization encourages interdisciplinary work and the integration of people, promoting human cooperation across national boundaries (Boudreaux 2024). This requires an adjustment to the management approach for projects. University research projects, known for their high level of innovation, are accompanied by significant uncertainties and risks. Therefore, they have to deal with this duality: to take risks to be innovative vs. the need to reduce risks to ensure the delivery of the results on time and budget (Ernø-Kjølhede 2000). Current practices in risk management often lack comprehensive tools and methodologies to address the special needs of research management systematically. This can lead to inefficiencies and poorer research outcomes in university research projects. Therefore, knowing and handling the critical and most common risks in university research projects can improve the research outcome. The research question explored in this paper shall be answered:

What critical risks affect university research projects the most, and how can a digital risk twin, incorporating a Monte Carlo simulation, enhance risk management in university research projects by identifying and mitigating critical risks?

1.2 Objectives

The objective of this paper is to provide a deeper understanding and handling of risk management in university settings by:

- Identifying the critical risks through qualitative interviews with ten university project leaders to understand challenges in research project management
- Validating and supplementing these findings through a systematic literature review (section 2.3)
- Developing a digital risk twin, based on a Monte Carlo simulation, incorporates uncertainties, base duration, costs, and risks. This tool displays a systematic approach and visualizes various scenarios.

Therefore, this paper aims to identify the most common risks and to gain a deeper understanding of risk management in university settings. This should improve the outcomes and manage universities more effectively.

2. Theoretical Background

2.1 Definition of Risk Management and its Methodology

Dealing with risks and uncertainties is not a new discipline. More than 4000 years ago the ancient Babylonia expressed their results with certainty, confidence, and authority to read the signs of gods (Covello and Mumpower 1985). Modern risk management focuses more on probability and mathematical models.

According to the International Competence Baseline risk and opportunity management involves identification, assessment, response planning and implementation, and control of risks and opportunities around the projects. It assists decision-makers in making informed choices, prioritizing actions, and distinguishing between alternative courses of action. This management is an ongoing process that takes place throughout the entire project lifecycle. (IPMA 2017)

This means risk management must be considered for identification, assessment, response planning, implementation, and control of risks. Therefore, effective risk management is important for the success of the projects. The ongoing process enables informed decision-making as well as the prioritization of different risks. Risks can be distinguished into threats and opportunities. Applying risk management and its methodology allows adaptation to change and enhances the likelihood of achieving project goals.

2.2 Risk Categorization

For this paper, the risks are divided into four groups. Firstly, the risks were categorized into external and internal risks. Secondly, internal risks were divided further into economic performance and organization and management and financial risk categories (Diederichs 2018). Every risk has an impact on time and/or budget. Therefore, the chosen category shall assist in diversifying the risks and enhance the understanding of common risks in the university setting. The risk types are defined as follows:

- External (technological, political-legal…)

- Economic performance (procurement, logistics, technical implementation…)
- Management and organization (organizational structure, personnel, planning…)
- Financial (liquidity, over-indebtedness…)

The origin of risks can be distinguished. This means the risk is categorized after its origin. Still, because of their complexity, risks can overlap sometimes. For example, a regulatory change, which had its origin in external risks, might require an organization to overthink its internal processes or procedures, leading to new internal risks.

2.3. Related Work

A systematic literature review on the most common and/or critical risks in the context of universities was conducted. The used keyword combinations for the search were: "university/higher education" and "risk/risk management". Relevant literature was identified based on the abstracts. If the abstracts were relevant, the full paper was investigated. Further relevant topics from the literature were identified and incorporated. The inclusion criteria for the search were: (1) English language (2) available at the Google Scholar platform (3) publishing year 2000 onward (4) accessible online. The exclusion criteria are defined as follows: (1) the full paper did not focus on at least one risk category defined in section 2.2 (2) the study is not an academic study (3) the white paper.

Some literature focused on PhD students and their research work. Most PhD students and researchers are the main recipients of physical and emotional harm and are being let down by PhD supervisors by failing to manage researchers' risks effectively (Bloor et al. 2010). This in turn can lead to depression and emotional harm to the personnel resources for projects. One paper explored the cybersecurity risks in higher education. This included the most common risks according to data protection, phishing attacks, and the costs of spam emails in academia (Ulven and Wangen 2021). Most of the literature mentions risks related to industry-university relationships (Fernandes et al. 2021, Fulop and Couchman 2006, Harman and Sherwell 2002).

Fernandes et al. (2021) concentrated on a single case study on management risks for industry-university relationships. They identified the ten most critical risks for management. The three most critical management risks referred to in the HR category are the lack of stakeholder commitment and the resignation of key HR during the project lifecycle. Still, some critical risks belonging to quality, management, time, and scope were included in the top ten risks. Fulop and Couchman (2006) focused on university-industry R&D partnerships. The mentioned risks belonged to risks: (1) financial loss (2) relational risks (3) institutional risks. Harman and Sherwall (2002) investigated the university-industry relationship. The most common risks occurred in the context of (1) publications (2) ethical issues about informing patients (3) conflict of interests (4) confidentiality problems for researchers. Less literature was found just for university research projects. This includes no direct focus on the most common, occurred, and critical risks. The investigated literature shall enrich the results of the interview findings.

3. Methodology

3. 1 Method

The chosen method is an expert interview. This methodology helps to collect data efficiently and improve data generation (Bogner et al. 2009). More precisely, the explorative expert interview was chosen to collect facts and information to develop new research objects. The current status quo was to be analyzed. The chosen method is a mixture of standardized and unstandardized interviews to combine the benefits. The discussion guide was sent in advance to the participants. The guide consisted of predefined free-text fields and multiple-choice questions. This was done to avoid misunderstandings and thus make the results more reliable. The aim is to be able to include subjective perceptions so that a more accurate depiction of project management in university research projects is possible.

3.2 Data Collection

Ten project leaders at the University of the Bundeswehr Munich were interviewed. Project leaders were chosen because this is a mandatory position in university research projects, as evidenced by the Federal Ministry of Defense third-party guidelines (BMVg 2018). The professional affiliation was widely varied from engineering, computer science, natural science, health and medicine, media and communication to psychology. The survey sample was chosen randomly. It is only a sample and cannot be considered as an entirety of all. All participants were professors. Every investigated project can be described as complex because of its interests, number of relations, financial volume, and capabilities (Haider and Haider 2012). Just relevant results according to the common and critical risks will be discussed.

4. Findings

All participants were questioned about their highest and most occurred risks. Therefore, they should estimate from their experience the severity level and the probability of occurrence on an example. The example shall be meaningful. For a more detailed assessment of the answers, a point scheme for the likelihood with a scale of 1-5 was chosen (1 = very unlikely; 2 = unlikely, 3 =possible, 4 =likely, 5 = very likely). The point scheme for the severity level was chosen with a 1–5-point scheme (1 = negligible; 2 = minor, 3 =moderate, 4 =significant, 5 = severe). This scheme refers to the risk matrix. A variety of different illustrations regarding terminology, orientation of axes, and a variety of critical zones exits (Peeters and Peng 2015). The color coding of the risk matrix followed the structure of an ESA example (Peeters and Peng 2015). The risk matrix displayed a combination of the severity of the consequences, that occur in a certain accident scenario and its probability (Ni et al. 2010).

The results were put into a five-by-five grid with severity on the x-axis and likelihood on the y-axis. The color scheme is as follows: (1) economic performance risks in grey (2) external risks in blue (3) organization and management in white (4) financial risks in black. The results of the interviews are depicted in Figure 1.

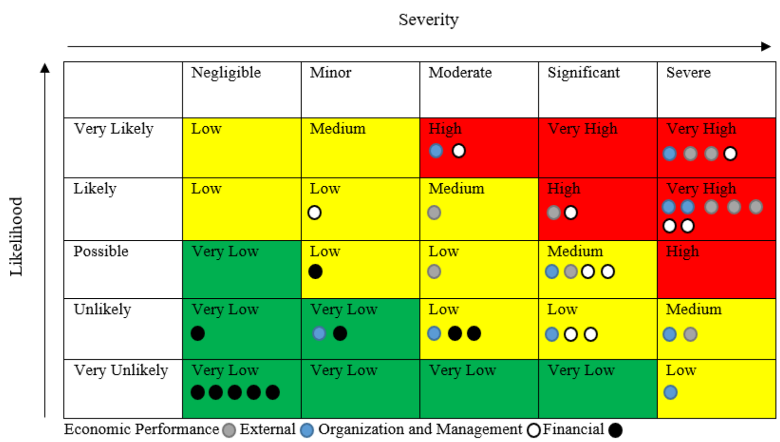

Figure 1. Risk-Matrix

Figure 1 shows that financial risks were rated very low to low. The risks belonging to the organization and management were mostly rated between medium and very high. The economic performance and external risks were rated mostly medium to very high. Therefore, the most impact of important risks for the participants was the economic performance risks. In the second step, the examples are presented that are responsible for the decision of the occurrence and the severity of the risks. If the participants saw no likelihood of occurrence and no impact, no answer was given. The summary is shown in Table 1.

Table 1. Critical Risks

	Answer	**Total Amount**
Economic Performance	Procurement	4
	Logistics	2
	Infrastructure	2
	Technical difficulty	2
External	Delivery delays	4
	Change of government	2
	Regulatory issues	2
	Cooperation with security-critical countries	1
	Data protection	1
Organization and Management	Lack of resources	7
	No processes defined	3
Financial	Image problems	1
	Budget overrun	1
	Project partner not interested in collaboration	1

Most participants stated that economic performance risks occurred the most because of the procurement process. On the one hand, this can be referred to as the elaborate specification, which is needed to ensure all relevant features are included. On the other hand, cost-intensive products must be mandatory tendered. Tendering depending on the price of the product is time intensive. Two people stated that they were facing technical difficulties, which led to high risks.

Research is highly risky due to uncertain procedures or unexpected outcomes. Delivery delays were rated the most for external reasons. Therefore, an external lack of resources or transportation problems can be the reason for this. This can result in higher costs, lower customer satisfaction, or production delays.

For risks according to organization and management, seven out of ten stated that they are afraid of a lack of resources. The mentioned reasons were: (1) Burnout (2) Limited personnel resources (3) Equipment (4) Underperforming employees. Financial risks were identified as image problems, budget overruns, or no collaborations. Because of not adhering to budget and/or time constraints, goals may not be achievable anymore. This can lead to image problems and no further funding. In the worst case, raising funds becomes more difficult as the rejection of stakeholders increases. The findings are enriched by a systematic literature review from section 2.3.

5. Interpretation and supplementing Findings

5.1 Interviews

Correlating Figure 1 and Table 1 shows the weighting of the risks and the given example. Therefore, internal risks, such as procurement, technical difficulty, and infrastructure, as well as a lack of resources, entail high risks. This can influence technical development and implementation. External risks display a high degree of impact on the success of the project. Changes in funding policy or regulatory changes can inhibit the degree of innovation and lead to poorer results. Budget cuts or a lack of personnel depict major challenges for university research projects. Poor process decisions or failure to implement processes for the management can also hinder the progress of the project. Although budget overruns and the time frame do not play an overriding role for project leaders, costs and time delays must be considered to prevent budget overruns and to recognize delays in the schedule early. Stakeholder disaffection can also arise due to quality problems. This can have a negative impact on further funding.

5.2 Comparison between Literature Review and Interviews

Some similarities and differences are notable in comparing the data from the interviews to the related work. The literature review focused more on the financial, management and organizational risks, whereas the interview covered all four risk categories.

Both highlight the significant effect risks can have on project outcomes, whether through quality issues, delays, or conflicts. In detail, both mention risks due to (1) cyber security – e.g. data protection (2) lack of resources – e.g. personnel fluctuation (3) conflicts of interest – e.g. cooperation (4) physical and emotional harm – e.g. PhD students - and (5) institutional challenges according to the infrastructure.

The differences can be summarized as follows: The literature review focuses foremost on the relationship between university-industry projects. Therefore, the focus lies on cooperation and confidential issues, not on technical issues. The interviews include technical issues due to technical difficulties and unexpected results. This led to high risks, which were difficult to predict. Moreover, they faced long and difficult procurement processes through the administration department and the tendering process.

The literature review validated the data and supplemented the interview data. Based on the results of the interviews, supplemented by the literature findings, an approach to prevent budget overruns and time delays is developed. This procedure will integrate a management strategy to involve stakeholders better and enable transparency. This eventually leads to more effective control of the project and the inhabitant risks.

6. Development of a Digital Risk Twin

6.1 Subject of Investigation

A single case study was conducted using an exemplary project at the University of the Bundeswehr in Munich. The chosen project is called: “Establishment of an innovative hybrid for future-orientated Powertrains”. Aiming to develop an innovative vehicle, which combines the advantages of a combustion engine and an electrical engine with less emissions. In further sections, a closer look will be taken at what occurred and which risks were identified in the last two years.

6.2 Method

Complex and major projects involve a high level of uncertainty and long project durations. Therefore, it is important to make accurate forecasts where the project can react to unexpected results, which often occur in research projects. Reasoning in that creating a digital risk twin can improve this approach (Reilly et al. 2023). The scenario analysis was chosen because it is a method that is proven to be suitable for many different risk types (Romeike 2018). This approach aims to depict the future as accurately as possible. Every forecast has inherent uncertainties and imprecisions. For inputting the values, a three-point estimate: minimum, most likely, and maximum is used. It is proven that the reality can be illustrated through a three-point estimate much better than a single deterministic value (Sander 2012). The bandwidth planning enables the aggregation of risks through a Monte Carlo simulation (Gleißner 2016). This enables the simulation of various scenarios and makes the results more meaningful. Value at Risk (VaR) is used to ensure that the expected losses will not exceed a certain budget or time based on a common confidence interval (Culp et al. 2008).

6.3 Program

The program RIAAT is used. This tool enables combining and linking the information from cost management, risk management, and time scheduling in a single software (RISKConsult GmbH 2024). The software is already used and successfully tested in large infrastructure and construction projects. The already developed program can be used because construction and research projects both deal with high uncertainty and complexity (Gross et. al 2024).

6.4 House of Quality

First, the goals and the objectives must be defined. An introductory workshop will be held together with the stakeholders and all interested parties. This will improve the alignment of goals within the team. In the long term, this can have a positive impact on communication and understanding. Establishing the house of quality serves transparently to present the customers' requirements and translate them into technical requirements. The degree of technical difficulty can also be specified, which is also helpful in assessing and prioritizing the risks. Figure 2 depicts an excerpt from the House of Quality.

Technical requirements/ customer needs		1. Basic concept	2. Fuel tank volume	3. Use of liquid or gaseous fuels	4. Drive performance	5. Battery capacity	6.Manufacturing and production costs of the components	7. Vehicle fuel consumption	8. Regulation
		0	↑	↓	↑	↑	↓	↓	0
1.Suitable for everyday, family and vacation use	5	9	0	1	1	3	1	3	1
2. High overall range	4	1	9	9	1	9	1	9	0
3. Fast charging	5	1	9	9	9	9	1	0	0
4. Appropriate mileage	4	0	0	0	9	3	1	3	0
5. High electric range without combustion engine	2	3	0	0	3	9	9	9	1
6. Low purchase costs	4	3	3	3	3	9	9	1	3
7. Low operating costs	4	1	3	3	3	1	1	9	1
8. No entry restrictions in environmental zones/ enjoy regulatory benefits	5	0	3	3	0	9	0	3	9
Technical level of Difficulty		1	1	1	4	5	4	4	4
Target Values		B/C-Segment; SUV	40 l	Bioethanol; Methanol	120 kW peak; 80 kW	15-20 kwh netto	Manufacturing costs comparable to current series	160 Wh/km; ca. 43 %	EU7 (ff.), Co2 Specifications EU
Importance Rating	absolute	76	165	165	160	241	116	166	108
	relative	6,35%	13,78%	13,78%	13,37%	20,13%	9,69%	13,87%	9,02%

Figure 2. House of Quality

Eight different customer and technical requirements were defined. Most important according to the customer, is the suitability for everyday use as well as usage for vacation. The least important aspect for the customers' needs was a long electric range without the support of the combustion engine. In terms of the technical target values, the implementation of the battery capacity was rated as the most difficult. The easiest to implement was chosen based on the basic concept, tank volume size, and the used fuel.

6.5 Work Breakdown Structure

The work breakdown structure (WBS) is drawn up based on the objectives. The WBS contains base costs, uncertainty, and relevant risks. Base costs are defined as costs, which will always occur. The three-point estimation is supplemented with distribution functions. Base costs and the associated uncertainties are stated in euros. An example is depicted in Figure 3.

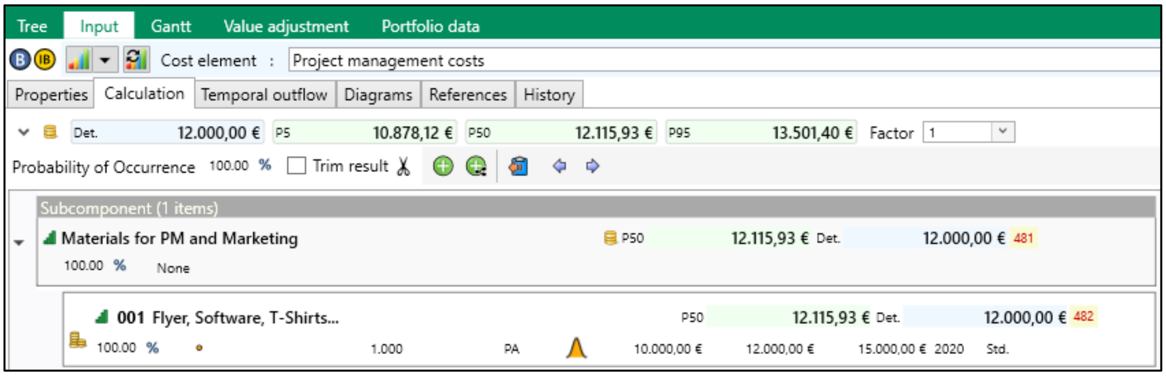

Figure 3. Excerpt of the Base Costs

6.6 Risk Register

After establishing the general structure, the risk register was set up. Based on the results of sections 5.1 and 5.2, a risk questionnaire was developed, which assists the risk identification process through specific questions. Moreover, to strengthen the identification process, the Delphi method was used, which is recognized for research (Häder 2014). The risk register includes all identified risks, unknown risks, and time-delayed risks. Time-delayed risks are risks, which have an impact on the project duration. This can be an additional cost for personnel because of the longer project duration. Unknown risks are charged for risks that have not been identified. The risks included can have a time and/or cost impact. All risks are integrated through a three-point estimate with a distribution function. The different risk categories, as defined in section 2.2 are included by different colored icons. An example of the risk register is shown in Figure 4.

Figure 4. Excerpt of the Risk Register

Figure 4 depicts the influence of the introduced methodology on different risk categories. Management and methodology have an exemplary impact on the lack of resources and the introduction of a new project management methodology. The contract negations have an impact on the financial risks because it is not sure how much the test vehicle will affect the budget. The technical infrastructure has an impact on the economic performance risks caused by system failures and insufficient maintenance.

6.7 Project Plan

The project plan is drawn up. Firstly, the base duration and the dependencies are established. Milestones are set. For every milestone, a target date was set. This shows the deviation from the completion date to the target date. Secondly, uncertainties are integrated through different distribution functions. Thirdly, the current relevant risks are linked to the WBS and the project plan. In dark blue, the base duration is displayed, and in red the additional time-related risks are illustrated. Additionally, the red marked line shows the critical path in the project plan. Figure 5 shows this.

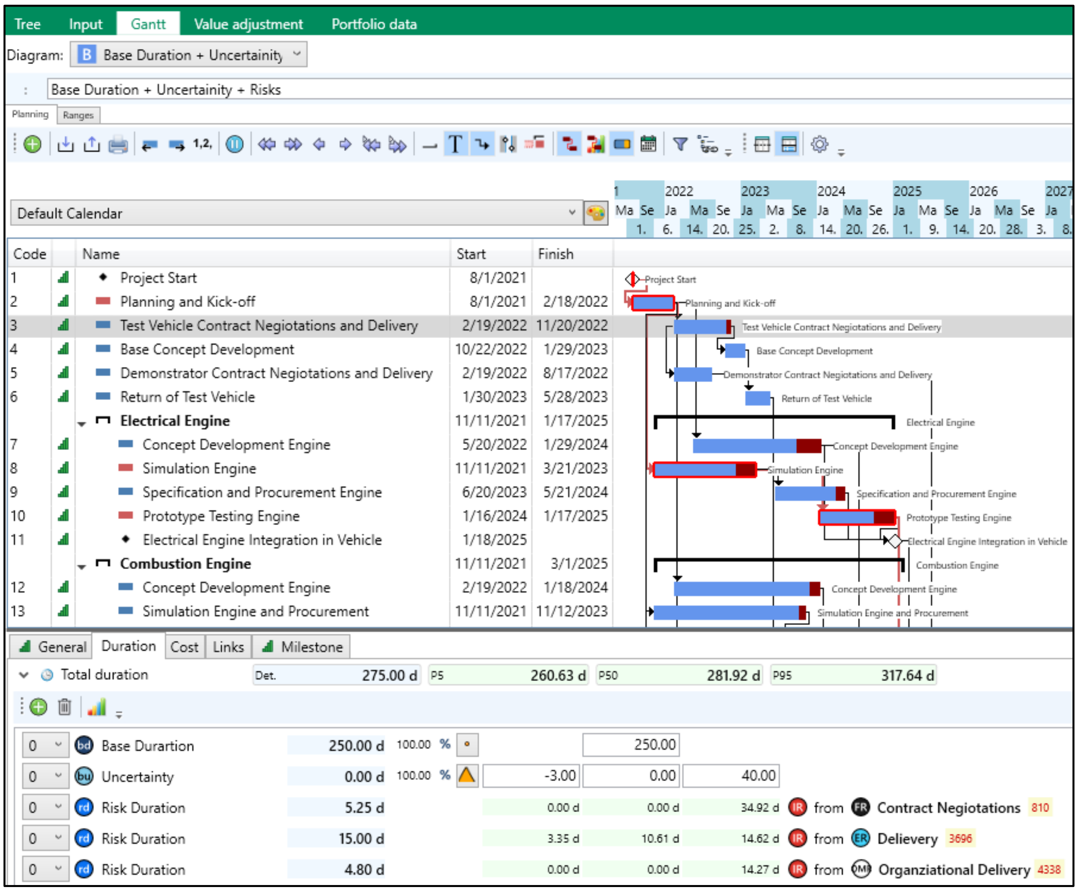

Figure 5. Project Plan including Base Duration, Uncertainty, and Risks

The risk duration of the risk is connected to the project plan. According to the probability of occurrence, the distribution function is included. After establishing the general structure, the Monte Carlo simulation can be conducted. This means different scenarios can be presented. Outputting different dashboards, which can display the results in more descriptive. In the next section, the results are summarized according to the identified risks and the risks that occurred over two years.

7. Results of the Digital Risk Twin

7.1 Identified Risks

For this project, 49 relevant risks were identified from the beginning of the project. Six risks were identified as external risks, nine as management and organization risks, eight as financial risks, and 26 as economic performance risks. Additionally, two risks for project delay cost are defined. The delay costs result from an extended project duration. These relate to fixed costs that lead to more costs. An example of this is the payment of wages. One general budget for unknown risks was given. The severity level is incorporated with the likelihood. The different percentages are converted to the 1–5-point scheme. The severity level is determined by the experts in combination with the impact in days and costs from the simulation.

Table 2. Risk Identification

Risk Category	Risk Identification				
	very high	high	medium	low	very low
Economic Performance	1	10	10	5	0
Organization and Management	0	5	2	1	1
External	1	2	2	1	0
Financial	0	1	1	5	1

As Table 2 shows, most of the risks were identified for the categories of economic and performance. These risks are predominately classified as high or medium. Many of these risks apply to the technical difficulty of research work implementation. This is a key feature of research projects. Even a failure can lead to a result and be counted as a success. Numerous of these risks classified as high can be traced back to unexpected results, which led to innovative approaches to the research hypothesis. This in turn promoted the restructuring of the components and methodological approaches. In terms of organization and management, five of the nine risks were classified as high. The main reasons for this were a lack of resources in terms of personnel and materials. However, fewer external risks were considered as high in terms of severity. This is because many of the risks identified here are attributable to delivery delays. These external risks cannot be influenced.

7.2 Results of Risks Occurred

Approximately 47 % of the identified risks have occurred until now. Most of the risks were identified in the project and integrated into the project management strategy and the project plan. Their predicted time delays and actual costs were detected close to reality due to the digital risk twin in the simulation. Therefore, the forecast of the simulation made the results more reliable and gave from the beginning a better understanding. Some of the risks that occurred, which were unexpected, were referred to as paradoxical results and technical difficulties. The project is not yet finished, but in total most of the occurred risks are associated with the development of the research object and the organization and management, both 35 % of the total occurred risks. According to the digital risk twin, impacts on the schedule related to economic performance were rated the highest, followed by external risks. The loss due to external risks related to time delays was rated higher despite numerous risks related to management and organization. In Figure 6 an excerpt of the results is summarized.

Risk Category	Risks Identified	Risks Occurred
Economic Performance	26	8
Organization and Management	9	8
External	6	5
Financial	8	2
Total	49	23

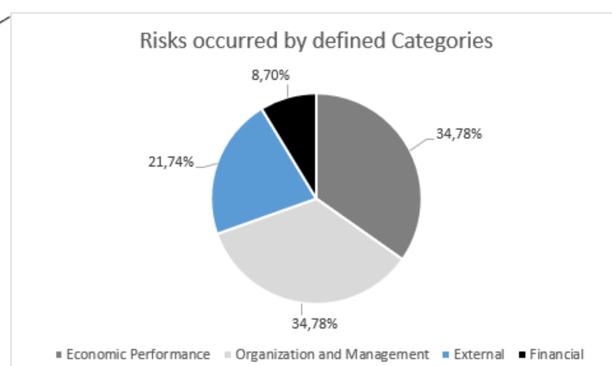

Figure 6. Identified and Occurred Risks

8. Validation of the collected Data – practical and theoretical

Comparing the collected data from the theoretical literature review and the practical studies (interviews, single case study) the most critical risks are practical, referring to economic and performance, theoretical to management and organization. According to the literature review, mostly the management risks and the relationship between the university-industry interaction were investigated. Therefore, it must be considered that detailed data was not available for all categories, and therefore only limited information was available for the theoretical results. Most practical risks occurred through (1) delivery delays (2) resource constraints (3) unexpected research results, and (4) internal procurement processes. The risks had foremost a high impact on time constraints, which affected the goal achievement and the quality of the project. The digital risk twin generated additional data by using a Monte Carlo simulation for risk analysis and mitigation strategies. Based on the data, the risk questionnaire was further developed to ensure that it includes critical risks for the identification process in university risk management.

9. Summary

In summary, the paper investigated university research projects' inherent risks and uncertainties. Firstly, the insights from ten project leaders were gained. This data was collected qualitatively through expert interviews and provided insights into critical risks in research project management. Secondly, a systematic literature review supplemented the findings qualitatively by exploring prior studies on risk management in similar contexts. This ensures that the data is supported by established knowledge. Thirdly, based on a digital risk twin, a single case study on innovative powertrain development was conducted. The digital risk twin enabled the simulation of various scenarios and visualized the potential project outcomes. This allowed a comparison between the theoretical risks (from the literature) and actual risks (from interviews and project data).

10. Conclusion

As a result of these findings, research projects often face uncertainties and risks arising from resource constraints, unexpected research results, and delivery delays. This means a flexible and adaptive framework is necessary to approach risk management more strategically. To reduce critical risks, the integration of qualitative and quantitative methods is necessary, ensuring practical applicability and theoretical validation. This improves the project outcome and eventually the achievement of the project goals. Moreover, risks should not only be considered in isolation but also aggregated. This in turn, ensures that the impact on the overall project plan and budget is realistic and calculable. Therefore, a digital risk twin can be seen as an innovative method to connect these risks efficiently and promote accurate predictions of the results.

10.1 Actionable Recommendations for Project Managers at University Research Projects

The detailed findings represent a guide for project managers to mitigate or avoid critical risks early in the research process. The integration of a digital risk twin approach into the project planning, analysis, and monitoring process can improve informed decision-making, resource allocation, and transparency for project managers. To ensure flexibility in the research process, interim goals shall be integrated into the project plan. This improves the frequent validation of research results and enables flexible changes to be made. By regularly carrying out workshops and meetings with the stakeholders, a risk questionnaire based on the most critical risks (identified in this paper) for university research projects can be used to review the top critical risks and detect new potential risks. Moreover, a flexible resource allocation shall be integrated to respond to unexpected research results without seriously impacting the project delivery. In addition, from the beginning of the project, based on the top critical risks, a buffer (impacts on time and/or budget) for unknown risks may be integrated into the project plan. This ensures a proactive reaction to requirement changes and improves the long-term risk management strategy. Furthermore, continuous and effective communication with stakeholders, including project partners and the university administration, is important. To align with the objectives, the project managers need to provide constant feedback on risk assessments, changes, and new challenges. This enhances the detection of delivery delays and personal or material shortcuts early, which enhances project planning and the risk identification process.

10.2 Practical Recommendations for Industry-University Partnerships

These findings are not just relevant for university research projects, but also for Industry 4.0. By implementing a digital risk twin, efficiency can be enhanced, which reduces costs and risks. This in turn makes the supply chain more robust, which is important for technological development processes. Moreover, flexible and proactive risk management supports changes and ensures long-term competitiveness. By involving all interested parties through cloud-based technologies, real-time simulations, coordination, and communication are possible. This means transparency and the decision-making process can be improved because everyone has the same information. This in fact can reduce, on the one hand, external delivery delays for research projects and, on the other hand, improve the transfer of theoretical to practical knowledge for industrial projects. Still, the introduction of new technologies in the supply chain may face cultural barriers and resistance from employees, management, and administration at universities who like the traditional way of working. Therefore, providing training is important for the successful implementation of the procedure.

10.3 Future Work

This paper represented a step towards a comprehensive understanding, which is important for the management of the research project. However, in its current form, it serves as a support for further studies, such as investigations of other universities worldwide. This paper, therefore, makes an important contribution to project outcomes and the success of research project management.

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