

# Enhancing Strategic planning course with operational research methods: a case study for IT students

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**Abstract.** *This paper addresses the need to enhance the interdisciplinary skills of information technology students, who traditionally, within their studies, focus mainly on technical courses such as software development, coding, databases, security, and similar. As students advance in their studies, they encounter some interdisciplinary courses, designed to prepare them for future careers that will probably extend beyond coding. The interdisciplinary courses include customer relations, project management, strategic planning, and others. This paper specifically focuses on improving students' strategic thinking abilities, a critical skill often underdeveloped in information technology (IT) curricula. Recognizing the importance of long-term planning for their professional success, the curriculum has been revised to integrate the mathematically oriented Operational Research into the Strategic Planning course, making the two courses more engaging and relevant to market needs. Although the work is still in progress, and the research methodology was limited to standard documentation of attendance, grades, and student feedback, early findings suggest that while improvements are still needed, the changes are moving in the right direction toward better preparing students for the complex challenges they will face in their careers. Therefore, the aim of the paper is to present the modification of the Strategic Planning course with Operational Research, to better prepare students for the needs of the market and motivate them to think more interdisciplinary and out of the box.*

**Keywords.** Strategic planning, Operations research, Operational research

## 1 Introduction

Information technology (IT) students typically follow curriculum that prioritizes acquiring technical knowledge. This approach is driven by the need to equip students with the essential technical skills required in a rapidly evolving computer science field.

As a result, courses that enhance soft skills, such as strategic planning, communication, and critical thinking, are not considered as primary, therefore less courses are dedicated to these fields. The mainly technical focus aims to ensure that IT students are proficient in the core areas of computer science (programming, data structures, algorithms, systems architecture, and similar), which are fundamental competencies that are crucial for their employment and technical problem-solving. However, the increasing complexity of the IT landscape and technology integration into all parts of business and society demands a more holistic approach to education.

In the contemporary job market, employers seek well-rounded professionals who not only possess strong technical skills but also the ability to navigate organizational challenges, work effectively in teams, and contribute to strategic decision-making processes. This shift in employer expectations emphasises the importance of soft skills, which are crucial for leadership roles and adapting to the tech industry's dynamic demands.

Despite the traditional focus on technical skills, there is a growing recognition of the need to balance curricula with courses that develop these essential soft skills. Addressing this gap is important for preparing IT students to meet the economy's and society's current and future demands. By integrating strategic planning and other soft skills into the IT curriculum, educational institutions can produce graduates who are not only technically proficient but also capable of leading and innovating in a digitally transformed world.

An additional motivation to reorganize the curricula resulted from several projects, introduced in the last four years, addressing the customer and end-user aspect of software development, how important it is to include all possible participants, and what additional activities should be conducted. For example, several innovative projects are being undertaken within higher education to enhance inclusivity and accessibility, leveraging technology and strategic curriculum development. These projects aim to address various educational challenges and prepare students for

the evolving demands of the modern economy and society. Some of these projects are:

- *Accessibility in Digital Communication Higher Education Curricula* is a project focusing on educating university teaching and educational staff in the field of communication on how to publish digitally accessible content and create a more inclusive teaching environment. By establishing a unique partnership between higher education institutions, educational organizations, and the private sector, the project aims to incorporate accessibility skills into communication curricula. This initiative prepares students to meet current and future economic and societal needs.
- *Introducing Training on User Testing with People with Disabilities into UX Design and Related Higher Education Programs* is a project, which aims to integrate training on accessible and inclusive user testing involving people with disabilities into UX design and related higher education courses. This project enhances the curriculum and empowers individuals with disabilities by raising awareness of their rights and encouraging active participation in usability testing. It promotes equal partnership between people with disabilities and organizations in both the public and private sectors.
- *Self-Evaluation Tools for e-Inclusion in Higher Education Institutions* is a project which recognizes the dual impact of digitalization on education, both positive and potentially exclusionary. It seeks to improve inclusive digital capabilities within higher education.
- *Enhancing Inclusive Education in Higher Education Institutions with Artificial Intelligence* explores the potential of Artificial Intelligence to advance education for students with diverse learning needs, including those with special needs and disabilities, aiming to address the current gaps in teachers' knowledge, skills, and resources regarding the effective integration of AI in educational processes. By leveraging AI tools, the project seeks to create more inclusive and productive educational environments in higher education institutions.

These projects collectively aim to transform higher education by promoting accessibility, inclusivity, and the integration of advanced technological tools, ultimately preparing students for a diverse and dynamic world and were inspirations for creating a new course connected to user experience. However, in addition to the lack of knowledge in the mentioned topics, there are several other areas in which IT students' education could be enhanced. Therefore the

secondary objective of this paper is to evaluate the success of enhancing interdisciplinary knowledge among IT students, primarily focusing on strategic planning course.

One of most significant areas in the interdisciplinary IT domain is strategic decision-making, both short and long term. Strategic thinking skills, which are crucial for effective planning and execution of projects, often need further development. The introduction of decision-making frameworks, as well as operational research into the curriculum, is an important part of our efforts. Although some of the topics are covered in previous years, the students need encouragement to use the formerly gained knowledge in their everyday activities just before their studies are completed. These areas are critical for equipping students with the ability to analyse complex situations, make informed choices, and optimize processes within their future workplaces.

By addressing identified gaps, educational institutions can better prepare IT students to meet the complex demands of the modern workforce. This holistic approach to education will not only improve their technical capabilities but also their strategic and operational competencies, making them more versatile and effective professionals. Accordingly, the paper presents an example of the integration of Operational Research into the Strategic Planning course, with the goal of better preparing students for market demands and fostering interdisciplinary thinking. Since this is an ongoing process, the methodology has been limited to standard documentation of attendance, grades, and student feedback. The initial findings indicate that while significant work remains, the changes implemented are progressing in the right direction.

The paper is organized in the following way: after the introduction, the course design and implementation are presented, followed by the longitudinal case study for IT students from 2020 to 2024 in section 3. The results and short analysis are provided in chapter 4, followed by the discussion in section 5 and conclusion section 6, which includes planned future activities.

## 2 Course Design and Implementation

Strategic Planning is an elective course in the study program Informatics and Data Technologies at the University of Maribor, Faculty of Electrical Engineering and Computer Science (UM FERI), 2nd year of master's study, available for students of modules IT Security And Security Management, Digital Innovation, and Information Systems Management. The course's primary goals include the knowledge from the field of strategic planning in informatics, focusing on their ability to demonstrate, apply, and critically evaluate methodologies, concepts, and best practices of strategic planning in IT.

Strategic planning is generally a systematic approach that organizations use to define their long-term goals and the means to achieve them, encompassing various approaches such as strategic business planning, which focuses on overall organizational objectives and market analysis, and strategic IT planning, which aligns technology initiatives with business strategies to promote efficiency and innovation (Grünig and Kühn, 2015). Key characteristics of strategic planning include its long-term orientation, adaptability, stakeholder involvement, and an iterative nature that encourages continuous improvement (Dixit and Nalebuff, 2010). Understanding the phases of strategic planning involves assessment and analysis, strategy formulation, implementation, monitoring and evaluation, and periodic review and renewal, each of which is essential for ensuring that the strategic plan effectively guides the organization toward its desired future (Dhillon, 2014). All the listed topics were included in the course by default, however the concept of strategic planning has evolved significantly over the past few years, integrating deeper insights and more sophisticated tools to address the dynamic challenges of modern organizations.

In this section, we provide an overview of the Strategic Planning course as it was introduced and developed over the years (from 2020 to 2024), encompassing its definition, types, characteristics, and lifecycle phases. The most significant change was connecting the course Strategic Planning with topics from the field of operational research (a course that existed on its own until 2022 but was reorganized and its topics were integrated into the courses of Optimisation of Business Processes and Strategic Planning). Because operational research plays a critical role in strategic planning by providing quantitative analysis and decision-making frameworks that help organizations optimize their resources and achieve their long-term objectives, such as applying statistical and mathematical models to analyse complex data, enabling organizations to make informed decisions based on empirical evidence rather than intuition alone. Using operational research techniques, organizations can identify the most efficient ways to allocate resources, such as time, money, and personnel. This ensures that strategic initiatives are executed effectively and in a sustainable manner. Moreover, operational research methods allow organizations to simulate scenarios and assess potential outcomes. This capability is crucial for strategic planning, as it enables decision-makers to evaluate risks and opportunities associated with various strategies before implementation. Operational research equips organizations with tools and methodologies, such as linear programming, simulation, and queuing theory, to address complex problems systematically. This structured approach facilitates the identification of optimal solutions in strategic planning. Operational research also provides metrics and analytical

techniques to evaluate the effectiveness of strategic initiatives. By monitoring key performance indicators, organizations can adjust their strategies based on real-time data, ensuring alignment with overall objectives. In summary, operational research is essential in strategic planning, allowing organizations to make data-driven decisions, optimize resources, analyze scenarios, and solve complex problems. By integrating operational research into their strategic frameworks, organizations can enhance their agility, improve performance, and achieve sustainable success in a competitive landscape (Hillier and Lieberman, 2010).

As the course Strategic Planning did not initially incorporate operational research methods, they were gradually incorporated into the course over four years. The following list documents topics that were covered each year for the course Strategic Planning (the topics were based on various literature from the field of strategic planning (Cassidy, 2016), (Peppard and Ward, 2016) and (Dobbs and Dobbs, 2016) and (Rumelt, 2012) as well from the field of operational research (Hillier and Lieberman, 2010)):

- *Introduction to Strategic Planning* (2020, 2021, 2022, and 2023), including the main definition of strategic planning, specifics of strategic business planning and strategic planning in information technology, presentation of the characteristics of strategic planning, and understanding the phases/lifecycle of strategic planning.
- *The importance of strategic elements* (Mission, Vision, Values, Goals) (2020, 2021, 2022, and 2023), including the definition of the organization's principal goal, fundamental values, and motives for product existence.
- *Strategic Planning in Informatics* (2020, 2021, 2022, and 2023), including analysis of IT strategic planning and connection to the global strategic plan, linking factors of strategic planning within the organizational and information domain, emphasizing the importance of adapting the strategy to information systems development.
- *Environmental Analysis* (2020, 2021, 2022, and 2023), including understanding the importance of environmental analysis, use of different methods and approaches to strategic planning, and the evaluation of the suitability of methods in specific contexts.
- *Management of strategic planning* (2021, 2022, and 2023), including performance monitoring, performance measurement, evaluation, operational research analytics, scenario planning, and risk management, as well as continuous improvement.
- *Enhancing strategic plans with operations research* (2022, 2023), including application of linear programming for strategic planning activities, optimal resource distribution approaches, and forecasting and prediction.

- *Strategic decision-making technique* (2022, 2023), including what-if analysis of strategic decisions, sensitivity analysis within strategic scenarios and holistic decision-making and optimal strategy selection with operational research.
- *Game theory and strategic games* (2023), including understanding the application of the mathematical framework to analyze the interactions of rational individuals in strategic situations, Application of Nash equilibrium, and negotiation in strategic decision-making.
- *Case studies and practical applications* (2020, 2021, 2022, and 2023), including case study analysis and critical evaluation, lessons learned from strategic failures, and best practices in strategic planning.
- *Emerging trends in strategic planning* (2020, 2021, 2022, and 2023) depend on each year, including agile and adaptive strategies, purpose-driven strategies, Gartner and Innovations overviews.

As additional topics were added, students' success and their attitude towards the course were monitored over four years based on their grade, attendance and feedback. We should note that the elective course does not include large number of students, therefore the small groups within courses enabled a personalized approach to adapting the course according to the needs and interests of students.

### 3 Case Study: Implementation of the Strategic Planning course for IT Students from 2020 to 2024

In addition to evolving course content, the teaching and learning approaches underwent significant transformations over the four years. By implementing a variety of instructional strategies, the program improved student engagement and learning outcomes. The overall assessment method was simple and combined participation in labs and lectures with a final grade, allowing for a general evaluation of student performance. The teaching approach evolved significantly from student year 2020/2021 to 2023/2024, adapting to enhance student engagement and deepen understanding of strategic planning concepts.

In 2020/21, the educational framework was primarily centered on a standard curriculum that included traditional lectures and laboratory sessions, providing foundational knowledge but offering limited opportunities for interactive learning. This model laid the groundwork for more dynamic pedagogical strategies. However, the approach was upgraded the following year.

In 2021/22, the introduction of the flipped classroom model created a shift in teaching methodology.

Students were encouraged to engage with instructional content outside the classroom through reading materials, allowing class time to be devoted to discussions, problem-solving, and collaborative activities. This approach fostered a more active learning environment, empowering students to take greater ownership of their education.

The following year, in 2022/23, the curriculum further advanced by integrating active strategic planning development within the classroom. Students participated in real-time strategic planning exercises, working collaboratively to apply theoretical concepts to practical scenarios. This experimental learning approach not only enhanced their understanding of strategic planning but also developed skills such as teamwork, critical thinking, and effective communication.

In 2023/24, the focus expanded to include specialized topics related to decision models and operational research. This year emphasized the importance of analytical frameworks and quantitative methods in strategic planning, equipping students with tools to make informed decisions in complex scenarios. By incorporating these elements, the learning approach not only addressed theoretical aspects of strategic planning but also provided practical insights into operational efficiency and effective decision-making processes, ultimately preparing students for the complex challenges of the modern business landscape, requiring ability of interdisciplinary and interdisciplinary thinking and advanced soft skills.

### 4 Results and analysis

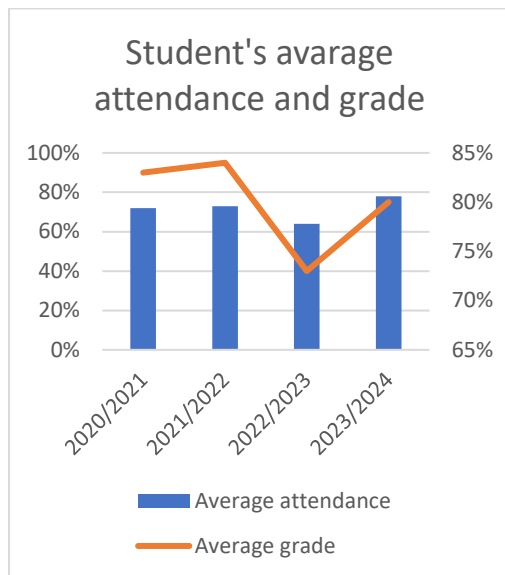
As the course content gradually changed during the 4 years, the teaching methods also changed to get as much collaboration and focus from the students as possible. As no additional survey was conducted, we documented the average grade, attendance rate, and students' general evaluation. The results are presented in Table 1. By focusing on attendance as a key metric, the analysis highlighted the relationship between student participation and academic success, informing future decisions regarding curriculum enhancements.

**Table 1.** Student's statistics

Year	Number of students	Average attendance	Average grade
2020/2021	25	72%	83%
2021/2022	27	73%	84%
2022/2023	24	64%	73%
2023/2024	24	78%	80%

With the exception of the generation of the year 2022/2023, the average attendance slowly increased, while the grade slowly decreased over the 4 years.

Although the additional topics did not create more learning material (as existing topics were shortened and the overall amount of work remained the same), the introduction of operational research resulted in higher attendance, but a lower grade (Fig. 1), documenting the increasing difficulty of the topic or lack of knowledge in fields, which should already be understood by the students, however the existing knowledge was not always well incorporated into new topics.



**Figure 1. Relationship between student's average attendance and grade.**

There was a positive 0.69 correlation between attendance and grades, indicating the higher the attendance, the higher the grade. An additional note is that not all students completed the course:

- In 2020/2021, 6 students (24%) were unsuccessful,
- In 2021/2022, 2 students (7%) were unsuccessful,
- In 2022/2023, 4 students (17%) were unsuccessful,
- In 2023/2024, 4 students (17%) were unsuccessful.

Each year, after all obligations within a course are completed, the students evaluate the course including the professor and the assistant (each study module separately). The following grades were provided on a scale from -2 to +2:

- 2020/2021 - Students grade 1.6 and 1.71 for different modules,
- 2021/2022 - Students grade 1.8, 1.88 and 1.5 for different modules,
- 2022/2023 - Students grade 1.5 for all modules,
- 2023/2024 - Students grade N/A, as the results are available by the end of the year.

Based on the student survey, the course grade decreased, having a peak in 2021/2022, when the flipped classroom technique was introduced for the first time. Note that the typical average grade at the University of Maribor level for all courses was 1.45 in 2020/2021, 1.48 in 2021/2022, and 1.46 in 2022/2023.

## 5 Discussion

The results highlight the success of students in the Strategic Planning course following the COVID situation. The aim was to create a more engaging subject that appeals to IT students and fills gaps in the knowledge they may have missed in previous years of study. However, since operational research played a significant role in the previous years of study, we aimed to integrate this existing knowledge into the revised program. The main included themes of operational research, which were included, are optimizing cost/profit using linear programming, solving transportation and production problems to maximize resource efficiency and minimize waste, conducting sensitivity and what-if analyses, applying the critical path method to find the most optimal solution and pay attention to critical ones, and exploring game theory. These topics were incorporated to establish a stronger connection with strategic planning.

As mentioned in the beginning of the paper, these topics, along with others, were part of a different course and some were not included in Strategic Planning. However, following curriculum changes that incorporated Operational Research into Strategic Planning, several of existing topics were integrated, promoting interdisciplinary thinking and connecting diverse areas of knowledge. Although student's grades did not increase significantly and even dropped slightly in the 2022/23 academic year, both interest and comments in the form of unorganized qualitative data displayed progress. Students were more engaged and felt that the strategic plans were more relevant to their activities. Student satisfaction with the inclusion of Operational Research in the course increased, particularly as they gained a better understanding of how soft skills and their work in the economic field are connected to mathematical knowledge and algorithmic thinking.

## 6 Conclusion

The paper addresses the systematic reorganization process of the course Strategic Planning, adapted for IT students. The data reveals a general trend of variability in both average attendance and grades. Attendance peaked in the 2023/2024 academic year at 78%, while the highest average grade was achieved in 2021/2022 with 84%. The students' grades in relation to their

individual performance metrics show some variation across the years. The data highlights the need for consistent monitoring of both attendance and grades to better understand and enhance student outcomes in the course.

The future work will address the challenges in strategic planning in higher education institutions and bridge the gap between current computer science programs and the evolving needs of the private sector. The methodology will be further refined in future research. For now, the findings are primarily relevant to one faculty with a specific set of students. Only after conducting additional research in the coming academic years will enable us to offer broader guidelines applicable to similar programs. The overarching objective is to incorporate strategic planning skills into higher education curricula, equipping future developers with the necessary knowledge to meet economic (Carvalho, 2024) and societal (Pacios, 2024) demands. One of the future aims will be identification of the gap by conducting an assessment to pinpoint the disparity between current computer science programs and future requirements related to strategic planning and optimization activities in software development. Among other activities, we plan to investigate existing tools as well as develop recommendations and best practices in the field of strategic planning for IT professionals. Other similar case studies will be taken into consideration as well (Arevalo-Ascanio et. all 2024).

The research is in its early stages, with limited data currently available. This paper serves as a preliminary investigation into how to improve the long-term study program, beginning with the course of strategic planning. Data collection will be expanded in the coming year through an extended survey including both qualitative and quantitative data.

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