

Repositório ISCTE-IUL

Deposited in *Repositório ISCTE-IUL*:

2026-03-09

Deposited version:

Accepted Version

Peer-review status of attached file:

Peer-reviewed

Citation for published item:

Santos, E. & Trigo, A. (2025). Digital transformation in managing outgoing student applications: Enhancing administrative efficiency in higher education institutions. *International Journal of Business Process Integration and Management*. 12 (1), 78-88

Further information on publisher's website:

10.1504/IJBPIM.2025.144069

Publisher's copyright statement:

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Digital Transformation in Managing Outgoing Student Applications: Enhancing Administrative Efficiency in Higher Education Institutions

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Abstract: Digital transformation is essential for improving the operational processes of organizations and, consequently, their performance. This work presents the prototype of a computer application to support the management of outgoing students' applications in a higher education institution. The key outcomes of this work include the systematization of the process, the establishment of Key Performance Indicators, and the real-time monitoring and traceability of students' applications. From a managerial perspective, this work provides insights for higher education institutions aiming to digitalize and control their processes. Moreover, it offers a practical framework that can be adapted by any industry seeking to implement controlled processes, enabling the collection of data from activities to feed the Key Performance Indicators.

Keywords: Higher Education Institution; Digital Transformation; Business Process Management; Key Performance Indicator; Management Control.

1 Introduction

In today's globalized and fiercely competitive landscape, organizational efficiency is more crucial than ever. Achieving this requires a fundamental reengineering of work processes to boost both efficiency and competitiveness. Central to this effort is ensuring clarity and accessibility of information, which is often hindered by bureaucratic obstacles and manual tasks. The path to accessible information necessitates the dematerialization of existing organizational processes, eliminating reliance on paper-based records, handwritten notes, and cumbersome filing systems.

This transition to digital processes can be realized through the adoption of Information Systems (IS) that digitize, process, and disseminate critical data essential not only for decision-making but also for the organization's survival (González-Gallego et al., 2015; Varajão et al., 2009). By dematerializing processes and embracing digitization, organizations can automate data collection to fuel performance indicators, thus effectively measuring and steering towards organizational goals and objectives. As renowned software engineer Tom DeMarco aptly stated, "You can't control what you can't measure" (DeMarco, 1982), underscoring the importance of data-driven decision-making.

Just like corporations and other organizations, higher educational institutions (HEIs) face growing demands for efficiency, transparency, and agility. To meet these challenges, HEIs must also undergo a fundamental reengineering of their processes by embracing digitalization. HEIs, often burdened by bureaucratic procedures and manual tasks, can greatly benefit from adopting IS that digitize and streamline critical operations. This

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transformation is essential not only for administrative efficiency but also for supporting data-driven decision-making in areas such as student performance, research outcomes, and resource management (Neborsky et al., 2020; Seres et al., 2018). By dematerializing processes and automating data collection, HEI can better align with their educational goals and improve overall institutional performance (Balzer, 2020; Donald Norris et al., 2008; Tanveer & Karim, 2018).

This paper showcases a digital transformation initiative undertaken by the International Relations Office of the Faculty of Economics and Business (IRO-FEB) at the University of Maribor (UM). Specifically, it focuses on the overhaul of the student outgoing application process, previously reliant on paper documentation, Excel files, and email correspondence.

The paper is organized as follows: next section presents a brief literature review on similar projects; section three presents the research and development method; section four presents the results of the research work; and finally, section five explains the utility of the research work for further implementation of similar processes, as well as limitations and highlights for future research.

2 Literature review

When discussing internationalization, it's crucial to distinguish it from globalization. As noted in Altbach & Knight (2007), these concepts are often conflated, but they are distinct albeit related phenomena. In the context of 21st-century higher education, globalization encompasses the processes through which economic, political, and social forces propel higher education to an international level. On the other hand, internationalization pertains to the practices and policies of HEIs within a global framework. Expanding on Knight's definition, as suggested by Ellingboe et al. (1998), internationalization is perceived as a progressive integration of HEIs systems into an international context. This integration demands sustained leadership that is forward-thinking, comprehensive, and collaborative, involving stakeholders in the process. Through such efforts, institutions can adapt their internal dynamics to align with external environments and shifts.

From the perspective of student mobility and international programs in higher education, internationalization, as highlighted in Altbach & Knight (2007), presents an array of opportunities for universities and stakeholders. These opportunities include growth through engagement in the international academic and scientific community, enhancing visibility and reputation through recognized rankings and programs, and leveraging the potential of the for-profit higher education sector. Viewed from a European standpoint, the inception of internationalization is delineated by Huisman & Wende (2005). Over the past two decades, the European Union (EU) has played a pivotal role in fostering internationalization within HEIs through economic and political integration efforts. Programs like ERASMUS, established and funded by the EU, facilitate academic exchanges for university students across EU borders. Furthermore, the Bologna process has standardized the academic system, introducing transferable credits known as the European Credit Transfer and Accumulation System (ECTS), ensuring compatibility of degree structures and qualifications among EU higher education students.

As noted by Altinay et al. (2019), the proliferation of students seeking educational experiences abroad is evident, reflecting a shift beyond mere university prestige to a desire for social exchange programs. This surge poses challenges for education systems and

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institutions ill-prepared for the influx of external students. The author suggests that HEIs should reevaluate the fundamentals of internationalization and formulate strategic policies to ensure sustainability and success in the process. Implementing a strategy focused on quality and sustainability presents HEIs with an appealing prospect for foreign students. Internationalization in higher education necessitates ongoing assessment processes for stakeholders, accreditations, and internal quality systems. This assessment, as referenced by Paige (2005), involves a comprehensive approach encompassing defining, selecting, designing, collecting, analysing, interpreting, and utilizing information. This enables institutions to gauge their progress towards achieving goals and objectives effectively.

As Endes (2015) describes the process at Selcuk University (Turkey). One notable finding from their research highlighted the challenges faced by students in the document preparation process. They expressed difficulty and frustration due to insufficient knowledge among departmental coordinators regarding the Erasmus exchange program, resulting in delays and communication issues during document preparation and signature processes. This underscores the complexities associated with paperwork-intensive procedures.

Furthermore, Van Damme (2001) reported similar concerns within ERASMUS/SOCRATES programs, echoing dissatisfaction with excessive paperwork and lengthy application procedures. This highlights a widespread need for streamlined and transparent application and evaluation processes across EU programs.

The University of Warsaw attempted to tackle these challenges by initiating the development of a “software to assist daily activities of the university international relations office” in 2005. This system aimed to manage various tasks such as mobility management for outgoing and incoming students and staff, recruitment, and registration, as outlined in Mincer-daszkiwicz (2005). However, despite these efforts, the university has not achieved complete success. As mentioned, “the process of negotiating learning agreements between students and coordinators from both universities is the most arduous part of the entire procedure”.

Improving business processes (BP) in HEI, particularly through the integration of Information Technology (IT), can significantly enhance overall institutional performance (Alshuaibi A.H., 2023). By streamlining administrative tasks, reducing bureaucratic delays, and automating routine processes, HEI can allocate more resources and time to core academic activities. There are many examples in recent literature of the use of the Business Process Management (BPM) methodology supported by technology to support the BP of HEI, for example in the case of technology transfer process (Doering et al., 2023), in the implementation of the student life cycle, financial management or human resources management (Lamsin & Tangkeko, 2023).

3 Methodology

The undertaken work adhered to the Design Science Research (DSR) methodology, a systematic approach for generating innovative solutions based on empirical evidence (Dumas et al., 2013). The research questions in the DSR methodology can be framed in different domains, and the one presented in this paper is in the domain of “problem solving”, the most common domain in this methodology (Hoang Thuan et al., 2019). As for the typology, the (Hoang Thuan et al., 2019) proposal classifies three different ways of

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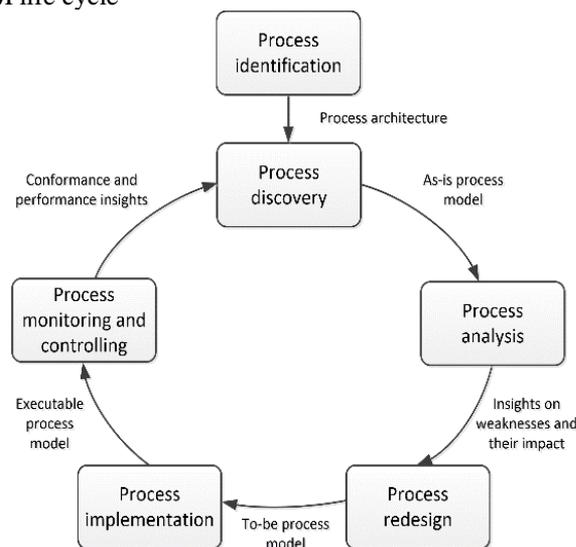
doing research: way of knowing, way of framing and way of designing. The present work is of the third type “way of designing” and the research question (RQ) is as follows:

- *RQ: How can we implement an information system that operationalizes HEI’s needs regarding the student’s outgoing application process, namely the implementation and monitoring of the strategy defined by HEI for the student’s outgoing application process at the operational level?*

From an operational standpoint, and within the framework of the DSR methodology, the Business Process Management (BPM) methodology was employed. BPM serves as a widely utilized approach by various organizations globally to manage and enhance BP through the integration of IS. It forms the foundation for numerous software tools known as Business Process Management Suites (BPMS). These BPMS facilitate the implementation of BPM within organizations, enabling direct data collection from the source and validation for management purposes (Trigo & Belfo, 2013).

To initiate a BPM project within an organization, it is essential to adhere to a structured series of steps known as the “BPM life cycle” as outlined by Horita et al. (2015). The BPM life cycle encompasses several phases, including process identification, process discovery, process analysis, process redesign, process implementation, and ultimately, process monitoring and controlling (Dumas et al., 2013). As the BPM process is inherently geared towards continuous improvement, this life cycle operates in a perpetual manner, with each phase seamlessly transitioning into the next (Figure 1). However, for the sake of clarity, only the initial iteration of this cycle will be presented for demonstration purposes.

Figure 1 BPM life cycle



Source: Dumas et al. (2013).

Thus, following the BPM lifecycle methodology, the digitalization of the student’s outgoing application process was implemented at the IRO-FEB at the UM. The results section details all the results of the different stages of the implementation of the above process according to the BPM life cycle. It is worth highlighting the fact that for the IRO-FEB to monitor and control the process, it was necessary to define Key Performance Indicators (KPIs) and the data collection points for the respective activities, as will be seen

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in the results section, which allows the process to be monitored in real time. In addition to using BPMS to implement the process, a Business Intelligence tool was used to present the visualizations associated with the KPI.

4 Results

This section describes the research work carried out by the researchers, which lasted around three months and aimed to implement an IS that operationalizes HEI's needs regarding the student's outgoing process. Given that this research work followed the BPM methodology, it will be presented in sections that are in accordance with its stages, adding, however, a final section evaluating the prototype built.

4.1 Process identification

In this first stage, the processes of the organization targeted by the reengineering process are identified. In the specific case of this work, only the student's outgoing application process was selected, which is to be dematerialized and all the information about it available in an IS. This implementation may encourage the HEI to apply the same methodology to other processes in the HEI.

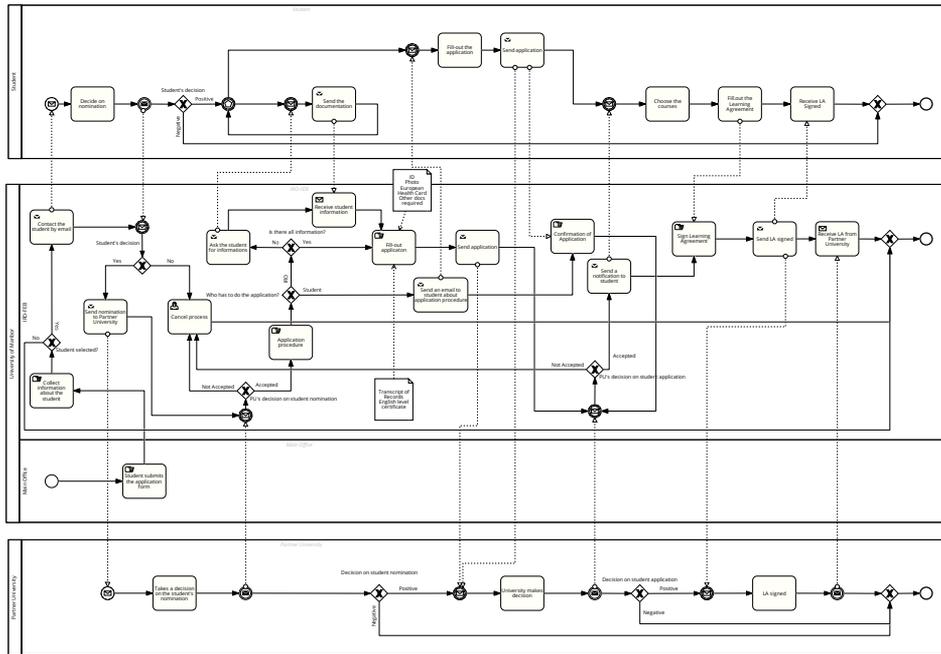
4.2 Process discovery

The student's outgoing process presented in Figure 2 involves three sequential steps: initially, the student submits the application form at UM main office; next, the student undergo a selection process, where based on different factors such as their grades a Partner University (PU) is nominated for he/she to go; finally, if the student accepts his/her nomination the application to a PU is initiated. However, prior to sending this nomination, IRO-FEB must verify the nomination procedure. This involves either consulting the official PU website for the procedure or requesting the current Fact Sheet (leaflet containing all Erasmus exchange program information) via email. Typically, the nomination is transmitted via email with information in the body or attached as a form or file. Subsequently, IRO-FEB awaits the PU's decision. If the PU accepts, the application procedure starts. IRO-FEB meticulously examines the application procedure to ascertain requirements and responsibilities, which may differ among PUs. If IRO-FEB is responsible for submission, all necessary documents are collected, and the process is monitored until the conclusion of the student's exchange program. Throughout this phase, IRO-FEB may request documentation from students or academic departments. Alternatively, if the student is responsible for submission, IRO-FEB guides them via email, providing step-by-step instructions and deadlines, and requesting confirmation of application submission. This stage is critical due to variations in deadlines and procedures among HEIs, which may lead to errors jeopardizing student placement. Upon completion of all application steps, the application is submitted, and the send date is recorded by IRO-FEB. The PU should respond with official confirmation of student acceptance. If the response is negative, the process concludes. Otherwise, the PU prompts the student to select courses and complete the Learning Agreement (LA), an official contract in the ERASMUS+ program. The LA,

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as defined by the (European Commission, 2021), outlines program parameters, participant goals, and requires signatures from the student, IRO-FEB, and PU. Only when IRO-FEB receives the fully signed LA does the process conclude, enabling the student to proceed abroad. The process may be cancelled if the student is not selected by IRO-FEB, the student declines the nomination, the PU rejects the student nomination, or the PU rejects the student application.

Figure 2 Student's outgoing application process diagram (as-is).



Given the size of the diagram, it cannot be divided into parts throughout the document, as this would make it difficult to read. However, the resolution of Figure 2 is good enough for a PDF reader to see all the steps of the process in detail. The same applies to all the following figures presented in this document.

4.3 Process analysis

The process analysis phase in the BPM lifecycle involves the detailed examination of the current business process to identify inefficiencies, bottlenecks and areas for improvement. During this phase, IRO-FEB collaborators were interviewed and observed operating in practice to gain a complete understanding of how the process works in practice. This analysis made it possible to introduce improvements to the process and establish the basis for its redesign and optimization, to achieve greater efficiency, effectiveness and alignment with HEI's objectives. In addition to improvements to the process, it was at this stage that KPIs were also defined to monitor and control the process, an initial requirement of this digital transformation project.

4.3.1 Improvement opportunities

Appendix A of the book “Fundamentals of Business Process Management” by (Dumas et al., 2013) contains a list of 29 possibilities for process improvement, which the authors call heuristics. Although they are not the only ones, they constitute a wide range of options for process improvement and consequent redesign.

In the specific case of the process analysed in this paper, the following improvement opportunities were considered:

- Eliminating manually executed tasks:
 - Student initial form submission;
 - IRO-FEB initial information collection about the student;
 - IRO-FEB application procedure;
 - IRO-FEB fill-out of the application form;
 - IRO-FEB confirmation of application;
 - IRO-FEB sign of the LA.
- Elimination of the tasks of sending and receiving e-mails between the different stakeholders, including them in the IS to be implemented.
- Ensuring comprehensive documentation of all tasks:
 - The upcoming system implementation will comprehensively record all process-related information, commencing from the moment the application form is completed.
 - This data will be logged and readily accessible at any given time for monitoring and control functions.
 - Additionally, an integral aspect of process monitoring, and control involves documenting details concerning individuals engaged in the process.
 - With the new system, it will be feasible to track user interactions, actions taken, and timestamps, thereby mitigating the risk of losing pertinent process-related information, a current issue.
- Incorporating data collection points within tasks to feed the KPIs.

4.3.2 Key Performance Indicators

Monitoring and controlling processes rely heavily on KPIs, making their inclusion imperative in the process redesign. As stated by (Weske, 2007), “each business process contributes to one or more business goals”. To assess the efficacy of business processes and their alignment with organizational objectives, controlling activities are essential. These activities involve determining KPIs for business processes, encompassing technical indicators such as average response time and throughput, as well as domain-specific factors like error rate reduction and cost savings.

Following discussions with the head and staff of IRO-FEB, 14 KPIs were established for process monitoring and control. These KPIs are detailed in Table 1, adhering to the indicator model definition outlined by (Caldeira, 2018), in which each indicator is defined by an identifier, name, description, formula, unit of measurement and visual element with which it is intended to be displayed on the monitoring and control dashboard of the student’s outgoing applications process.

Table 1 Key Performance Indicators for student’s outgoing applications process

Name	Description	Formula	Unit	Visual
State of a specific application (KPI 1)	Tracks the execution percentage of a student's application to determine its progress—whether it's at the beginning, middle, or completed: Step 1: 20% – “Send the nomination to PU”; Step 2: 40% – “Application procedure”; Step 3: 60% – “Application submitted”; Step 4: 80% – “Sign LA”; Step 5: 100% – “Finalized”.	N/A	%	Bar chart
Percentage of applications in step 1 (KPI 2)	Measures the percentage of applications currently in the “Send the nomination to PU” task.	$\frac{\sum \text{appsinstep1}}{\sum \text{apps}} \times 100$	%	Pie chart
Percentage of applications in step 2 (KPI 3)	Measures the percentage of all applications currently in the “Application procedure” task.	$\frac{\sum \text{appsinstep2}}{\sum \text{apps}} \times 100$	%	Pie chart
Percentage of applications in step 3 (KPI 4)	Measures the percentage of all applications currently in “Application submitted” task.	$\frac{\sum \text{appsinstep3}}{\sum \text{apps}} \times 100$	%	Pie chart
Percentage of applications in step 4 (KPI 5)	Measures the percentage of all applications currently in “Sign LA” task.	$\frac{\sum \text{appsinstep4}}{\sum \text{apps}} \times 100$	%	Pie chart
Percentage of active applications (KPI 6)	Measures the percentage of total applications that are incomplete	$\frac{\sum_{i=1}^4 \text{appsinstepi}}{\sum \text{apps}} \times 100$	%	Pie chart
Percentage of completed applications (KPI 7)	Measures the percentage of completed applications.	$\frac{\sum \text{appscompleted}}{\sum \text{apps}} \times 100$	%	Pie chart
Number of completed applications (KPI 8)	Measures the total of completed applications.	$\sum \text{appscompleted}$	No	N/A
Deadline approach for each application (KPI 9)	Measures the number of days left to due date - current date deadline.		No	Bar chart
Percentage of cancelled applications (KPI 10)	Measures the percentage of cancelled applications. A KPI of 0% indicates that all students accepted the nomination and the PU approved their nominations and applications.	$\frac{\sum \text{appscancelled}}{\sum \text{apps}} \times 100$	%	Pie chart
Percentage of cancelled applications by student (KPI 11)	Measures the percentage of cancelled applications by students, i.e., where the student did not accept the nomination.	$\frac{\sum \text{appscancelledby student}}{\sum \text{appscancelled}} \times 100$	%	Pie chart

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Percentage of cancelled application by PU in where the PU did not accept the nomination (KPI 12)	Measures the percentage of cancelled applications by PU, i.e., student nomination.	$\frac{\sum \text{appscanceledbyPUinnomination}}{\sum \text{appscancelled}} \times 100$	%	Pie chart
Percentage of cancelled application by PU in where the PU did not accept the application (KPI 13)	Measures the percentage of cancelled applications by PU, i.e., student application.	$\frac{\sum \text{appscanceledbyPUinapplication}}{\sum \text{appscancelled}} \times 100$	%	Pie chart
Total number of applications (KPI 14)	Measures the number of total applications.	$\sum \text{apps}$	No	N/A

Below is a brief description of the variables used in the indicators defined in table 1:

- *apps*, outgoing student application cases
- *appsinstep1*, outgoing student application cases in step 1 of the process
- *appsinstep2*, outgoing student application cases in step 2 of the process
- *appsinstep3*, outgoing student application cases in step 3 of the process
- *appsinstep4*, outgoing student application cases in step 4 of the process
- *appsinstepi*, outgoing student application cases in step i of the process
- *appscompleted*, outgoing student application cases completed
- *duedate*, deadline for outgoing student application case
- *currentdate*, current date of the outgoing student application case
- *appscancelled*, outgoing student applications cases cancelled
- *appscancelledbystudent*, outgoing student applications cases cancelled by the student
- *appscanceledbyPUinnomination*, outgoing student applications cases canceled by PU in nomination
- *appscanceledbyPUinapplication*, outgoing student applications cases cancelled by PU in application

This work of identifying opportunities for improvement and defining KPIs was carried out by the researcher together with IRO-FEB staff.

4.4 Process redesign

Following the process analysis, which involved characterizing the student's outgoing application process, identifying improvement opportunities, and defining KPI, all necessary information for redesigning the existing process has been gathered.

In the description of the process redesign (see Figure 4), two situations stand out in: 1) the elimination of manual tasks and tasks carried out with external applications such as email clients, which in the implementation phase will be implemented in the IS based on a BPMS, forcing and centralizing all the information in one place and no longer requiring the use of paper, email clients and/or Excel files, among other types of documents; 2) the inclusion of KPIs in the tasks carried out, as can be seen in Figure 3, where it is possible to see the data collections points feeding KPIs 1, 2, 10, 11, 12, and 13.

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The to-be diagram (Figure 4) displays all designated points for data collection to support various KPIs (Table 1).

4.5 Process implementation

Due to the fact of not having authorization to post images of the BPMS application screen, these images were not posted. Nevertheless, data models, forms, email templates and other resources were defined for the implementation of the IS to support the “outgoing student’s application” process. The BPMS used is a type of low-code development platform that greatly facilitates the development of such systems (Dumas et al., 2013; Trigo & Belfo, 2013).

4.6 Process monitoring and control

Due to space constraints, only the most significant KPI will be presented to emphasize the importance of process monitoring. To illustrate this, data from 48 real cases of outgoing student processes from the 2021/2022 academic year, extracted on 31/05/2021, have been used.

Figure 5 Countries of destination

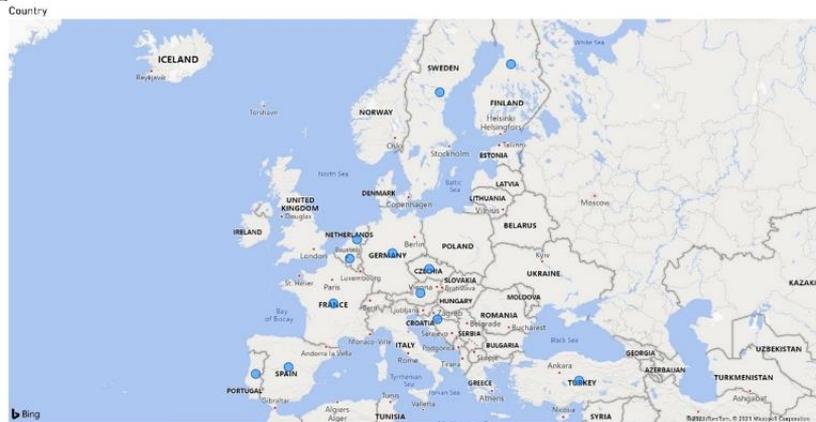


Figure 5 provides a clear visualization of the distribution of students by destination. The outgoing students are observed to be dispersed across twelve countries, including Portugal, Spain, France, Germany, Netherlands, Croatia, Turkey, Sweden, Finland, Austria, Belgium, and the Czech Republic.

In Figure 6, an overview of applications for the winter semester is depicted, highlighting three significant categories based on previously described KPI: percentage of active applications (KPI 6), percentage of cancelled applications (KPI 10), and percentage of completed applications (KPI 7).

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Figure 6 Overview of applications for winter semester of 2021/2022
Overview of applications

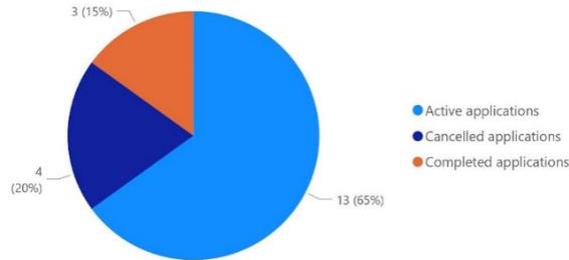


Figure 7 illustrates the distribution of application statuses as percentages. This matrix corresponds to KPI 1. Among the applications, three have been completed, achieving a 100% status. Additionally, one application is at 80% completion, two are at 60%, six are at 40%, and three are at 0%, indicating that the students have not yet accepted the nomination from IRO-FEB. This graph in particular is very important because it allows the IRO-FEB to see the state in which all instances of the student's outgoing process are in, allowing IRO-FEB to quickly identify the most critical cases so that the IRO-FEB can take action.

Figure 7 State of applications by case

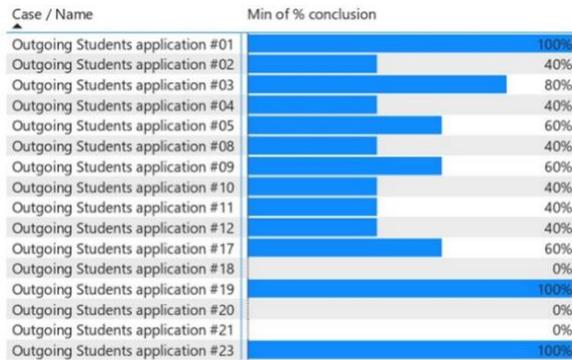
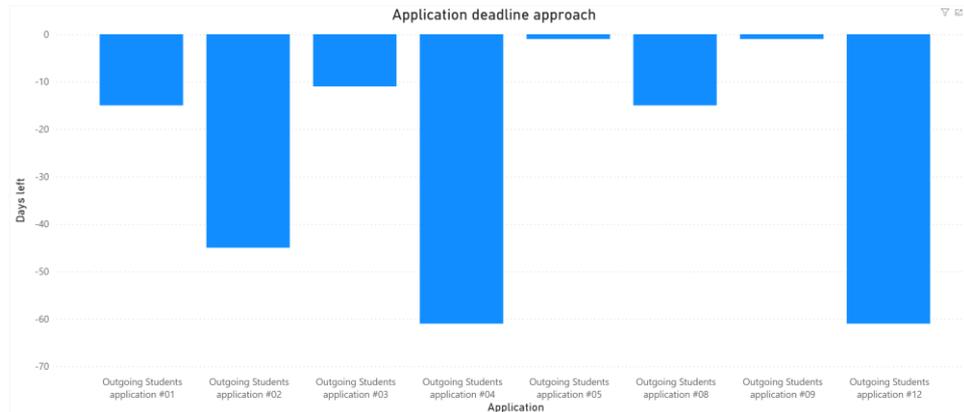


Figure 8 displays the remaining days until the application deadlines for active applications only (KPI 9). Outgoing student applications #04 and #12 indicate approximately 60 days remaining until the deadline, set for July 31, 2021. Conversely, outgoing student applications #05 and #09 have only 1 day remaining to complete their applications. Like the previous one, this chart also allows IRO-FEB employees to see which applications are at risk and to take the necessary action.

Figure 8 Deadline approach (days left) for applications



4.7 Evaluation of the developed prototype

Although there aren't many cases to validate the use of the prototype, the fact is that in the cases in which it was used, it was possible to verify that the IS behaved as expected, allowing IRO-FEB not only to deal with each case at an operational level, but also to monitor the execution of all the cases from the dashboards implemented in the analytical tool, fed with data from the operational process. Until now, there was nothing in the IRO-FEB that allowed this systematization of information. In addition to this, it has also allowed the entire process to be dematerialized, so that IRO-FEB employees no longer have to search through paper, excel files or emails for the information needed to monitor and control the entire process, which was the initial aim of this research project. We believe that the answer to the research question (*How can we implement an information system that operationalizes HEI's needs regarding the student's outgoing application process, namely the implementation and monitoring of the strategy defined by HEI for the student's outgoing application process at the operational level?*) is positive: yes, it was possible to improve the process through the use of the BPM methodology and associated life cycle, which is one way of implementing digital transformation in organizations (Fischer et al., 2020).

The testing of the prototype revealed less successful aspects that will be addressed in future iterations, such as the need to change the process to create alert mechanisms for cases in progress and to improve the analytical application, since it has already been understood that with many cases it is difficult to read some values. Another issue that also merits further reflection, not only from a technical point of view but also from a management point of view, is the definition of new KPIs and associated targets that will make it possible to measure the performance of the entire outgoing process of Erasmus students, with or without an application, by comparison with these targets and performances from previous years. However, the process re-engineering and support prototype can be considered a success and the BPM methodology, and associated technologies can be used for other processes.

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5 Conclusion

Upon completion of the efforts to establish a management information system for overseeing outgoing student applications in IRO-FEB, encompassing process implementation in a BPMS and subsequent monitoring and control via Power BI, several noteworthy reflections and prospects emerge.

Aligned with the project's initial motivations and objectives, the developed management control tool offers three primary benefits to IRO-FEB. Firstly, it optimizes the outgoing process by digitizing and dematerializing it, eliminating the need for paper documents, folders, and email notifications, thus potentially reducing time and resource expenditures. Secondly, it ensures easy access to data, particularly crucial in the current remote work landscape precipitated by the ongoing pandemic, enabling seamless workflow continuation from diverse locations. Lastly, it provides intuitive reports and dashboards for monitoring and controlling outgoing student applications. While the management control tool is currently in prototype form, tested with real data, the subsequent phase involves deploying the tool and providing training to IRO-FEB staff for its daily utilization. Future enhancements include extending the tool to encompass other exchange programs and accommodating later applications, which are exceptions to standard deadlines. Moreover, beyond serving as a tool for control and KPI measurement, the accumulated data over two or three years could potentially unveil insights and raise questions. For instance, discrepancies in application patterns among certain countries could prompt exploration into underlying cultural, political, or economic factors influencing such trends. This tool's potential extrapolation to other faculties within the University of Maribor could yield valuable insights into outgoing student applications on a broader scale.

Lastly, it's essential to acknowledge that this work is part of a broader research endeavour aimed at developing artifacts that bridge the gap between organizational strategy and operational processes. This endeavour aims to implement defined objectives and KPIs at the process level and subsequently monitor and control their execution using data gathered from these processes.

Acknowledgements

The authors would like to thank mag. Sanja Kocijan of the IRO-FEB office for making this project possible.

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