

Projects for the Digital Transformation

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Abstract—The management of the digital transformation faces challenges resulting from the specific characteristics of the transformation process. These characteristics can be more or less distinctive and relevant for a particular aspect, e.g., the domain where the transformation takes place. The partitioning of the complex transformation process into manageable work packages can be done with projects which are a proven tool for structuring and managing transformation. In this respect, digital transformation projects (DTP) form a new and specific type of projects and need specific project management methodology, not only for Smart City projects, but also for other types of DTP. Within the Erasmus+ Knowledge Alliance “Projects for the Digital Transformation (ProDiT)” the characteristics of DTP and the respective processes, methods and tools have been investigated, new methods have been developed and evaluated. Furthermore, guidelines, teaching and training materials were developed, and case studies were compiled. This contribution provides an overview of the results and illustrates the findings by giving examples based on the case of a Smart City project which conducts the digital transformation in cities, covering a broad range of relevant aspects.

Keywords—digital transformation project, project management, smart city project

I. INTRODUCTION

The *Digital Transformation (DT)* is in many cases conducted by doing projects, so called *Digital Transformation Projects (DTP)*. The analysis of DT based on the expected results and artefacts [1] and the view of DT as a sequence of DTPs [2]–[3] leads to a deeper understanding of DTP as a specific project class, different from IT projects [4]. A core issue with this view is the inherently continuous and open-ended nature of DT [3] which contradicts with key characteristics of projects in the classical view (e.g., “defined start and end”, “requirements and goals known upfront”, “team has the right competences”). Agile practices (esp. explorative, incremental and reactive approaches) are applied in *Project Management (PM)* in such cases [5], and this is expected to fit to DT and DTP [6], too. In general, DTP are heavily influenced by the driving forces of the VUCA world [7]–[8]: Volatility, Uncertainty, Complexity and Ambiguity, which are causing a dominance of transformational change in such projects. VUCA names “technical” challenges while the BANI (Brittle, Anxious, Non-Linear, Incomprehensible) concept [9] maps them to the issues which affect people, the project environment and the stakeholders. VUCA and BANI take away some of the main pillars for classical project planning, leading to the research question if PM is the right

tool for the management of DT and how it needs to be adapted. Developing Smart Cities is such a complex example of DT while involving many aspects beyond DT, e.g., urban planning, transportation, governance etc. [10]. Nevertheless, DT is a key factor in the development towards smart cities and DTP are a very relevant tool in that context [11]. The following sections will provide an insight into the management of DT with DTP, and into the mapping of this approach on the case of smart city development. Section II will provide a brief overview of the state-of-the-art literature, while Section III will present the ProDiT research project and its methodology, which generated the findings about DTP, presented in Section IV. Section V will illustrate the application of the findings about DTP based on the case of a smart city project. A summary will conclude the results.

II. STATE OF THE ART

A. Agile Project Management and the Management of Digital Transformation Projects

DT is a complex phenomenon which is intensively researched for more than a decade. First, a deeper understanding of the transformation process with its driving factors, its changes, disruptions and barriers, and with the impacts is required [12]. Second, it is relevant to understand in which domain the transformation happens. DT is described as a roadmap or as a DT journey, emphasizing the long-term, continuous and transformational character [13]. This contradicts the episodic character of projects (see above) and raises the question why PM should be applied to DT. Nevertheless, DTP are a very important approach to the management of DT [14] since projects are a successful tool for structuring complex tasks or roadmaps, even if PM methodology needs to be improved for it. It is important to understand that DTP are different from IT projects [15], specifically due to the stronger influence of the VUCA factors, the pace and the scale of change and transformation involved. Success rates of DTP are too low, even compared to IT projects, while the definition of success of DTP or DT is still a research topic in itself [16], putting the focus more on long-term effects and impact of DTP rather than the project execution performance. Along that discussion, there are also different definitions of DT, with the authors leaning to a definition that “digitization” names the technical process of turning analog data (e.g., written documents) into digital data, while “digitalization” means that (existing) processes are automated with digital means. The term “digital transformation” (DT) names a more holistic view on larger leaps beyond existing products, services, processes, business models,

This research is partly funded by the EU Erasmus+ programme within the Knowledge Alliance “Projects for the Digital Transformation - ProDiT” (621745-EPP-1-2020-1-DE-EPPKA2-KA), see <https://prodit-alliance.eu>.

organisations, etc. Nevertheless, a “digitalization” project can be part of DT same as more comprehensive and complex DTP. The deeper understanding of DTP, the types of DTP and their main characteristics is still in its infancy, e.g., a first DTP taxonomy [17] has just recently been described by some of the authors of this contribution. Research is needed for a better understanding and classification of DTP which then can be used to select and tailor PM methods and tools for it. Furthermore, it is necessary to understand where DTP are used and where classical business process management and process improvement may be the better choice [18].

Agile frameworks, methods and tools are expected to address and solve some of the issues in DTP. It is again important to understand what “agile” means in this context. With respect to DT, it can be understood as organisational agility – the business agility view (BAV) or as agility on PM methodology level – the agile-as-methodology view (AMV) [19]. Mapping this distinction on DTP, BAV addresses the project environment and overlaps with the topic of agile transformation [20]. For organisations, it includes the process view, e.g., in Industry 4.0 or lean, and the people, mindset and culture view [21]. AMV with respect to DTP is very much researched and covered by Agile Project Management (APM) [5], including small scale (e.g., Scrum) and larger scale frameworks (e.g., Scaled Agile Framework – SAFe). Therefore, the agile approach provides a portfolio of methods and tools which fit well to DT and DTP, especially due to the incremental, explorative, lean and flexible characteristics which address the VUCA factors, the pace and the change.

B. Managing with Scenarios and Maturity Models

DT leads into the unknown and DTP are therefore a leap into the unknown. If a project goal or a “to-be-situation” is unknown, it doesn’t mean that it cannot be envisioned and described, e.g., by developing a set of “to-be-scenarios”. Nevertheless, the DT journey from “as-is” to “to-be” is complex, both situations are difficult to grasp and describe, and the path from one to the other is difficult to map out. Therefore, the DT journey is abstracted as an advance from a less digitally transformed status (as-is) to a more digitally transformed, desired status (to-be), raising the digital transformation maturity. *Digital Transformation Maturity Models (DTMM)* [22]-[23] are outlining possible maturity levels with the aim to provide guidance for the assessment of the as-is situation and the description of a future to-be situation. DTMM are either very generic or putting the focus on a very specific type or domain of DT, leading to the need for DTMM taxonomies for selecting the right one for a specific DT journey [24]. DTMM are also used to sketch out the steps during the DT journey, e.g., as a sequence of advancing maturity levels [25]. This isn’t only used for DTP planning, but also for business process improvement [26] and for general DT strategy development [27]. Since maturity models are a typical approach for structuring and planning in PM they can be used as a tool for DTP design [28] and for partitioning the DT journey into DTP portfolios. Doing this effectively and efficiently is another important research topic.

C. The People Perspective of Digital Transformation

DT involves and affects people – individually, in projects and teams, in organisations, as stakeholders, as society – and the people perspective is of very high importance for a successful DT [2][14]. PM emphasizes the people perspective as a major success factor already for many years, e.g., in the Individual Competence Baseline (ICB) [29]. Leadership as

part of the people perspective is a critical success factor in both DT [30] and PM. Transferring people-related methods from PM to DTP is therefore a very relevant research topic, especially since the aspects of BANI, pace and change are very influential for the involved people and therefore for the DTP success. Hence, research puts the focus on the soft factors [31]. Due to the “unknown” aspects of DTP, first research is also done on the hidden competences [32]. DT is not only influenced by the people perspective, but it also changes competence management, e.g., by making digital competence profiles usable and powerful in DT management [33]. In PM, the staffing and team formation in projects is a key success factor which is largely done by the experience of project managers, supported by IT tools for simple skill matching, or based on textual descriptions of individual competences [34]. Describing individual existing competences, required project competences and team competences with competence profiles leads to a large variety of competence descriptions, e.g., captured in a taxonomy of competence models [34]. The digital transformation of competence management, project staffing and team formation can be based on textual descriptions which can be processed by Large Language Models (LLM), leading to insufficient results so far [35]. Competence-based staffing and team formation can also be envisioned based on formal competence descriptions [36]. Furthermore, competence and knowledge are very fluid in DT, leading to a high relevance of learning (for individuals, teams and organisations) as a critical success factor for DT and DTP [37]. Due to the dynamic change, both learning and unlearning [38] are required.

D. Sustainable Digital Transformation

Project Success, the relevant Project Success Factors and the assessment based on Project Success Criteria are highly important and intensively researched topics for PM [39], and consequently for DTP, which are done for a purpose and goal within the DT journey. Consequently, doing DTP effectively and efficiently is an important research topic, too. For DT, the contribution of DTP to the overall transformation (DT journey) is relevant, as described by the linkage of project success to outcomes and impact [39]. Impact orientation is the foundation of sustainable project management [40] which used tools like the sustainable project management canvas [40] for a project planning with a focus on achieving desired impacts and avoiding undesirable impacts. Impacts are structured by the sustainability dimensions: people, planet, profit, leading to social, ecological and economic sustainability. An important tool for sustainable project planning and control is result-based management (RBM). There is a remaining research gap on the (sustainable) result-based management of “wicked problems” [41], which describe a more holistic view on challenging project tasks than VUCA or BANI. It is important to align the whole DT journey to sustainability aspects, leading to a Digital Sustainability Canvas (DSC) [42] as an assessment tool for DT and DTP.

E. Digital Transformation Towards Smart Cities

The development of Smart Cities involves many aspects of a DT journey. Therefore, smart city projects share various aspects of DTP. Case studies of smart city initiatives are used for research about DT [11], especially with the view on organisational or societal transformation, emphasizing the people view which is in effect not a project-internal people view (e.g., on the project team) but a view on the project environment as a citizen view, focussing the smart city

initiative and projects on the quality of life (QoL) of citizens. This leads to participative approaches where citizens are not only considered as stakeholders in the project but involved as co-producers of the smart city. Smart cities deploy a Systems-of-Systems (SoS) view which addresses both the distributed, parallel and diverse objectives aspect of such projects and the people view [43]. Therefore, DT in smart cities is one of the most complex and challenging environments for DTP.

III. RESEARCH DESIGN AND METHODOLOGY

The research presented in this contribution is largely based on the outcomes of the Erasmus+ Knowledge Alliance “*Projects for the Digital Transformation (ProDiT)*” which was conducted from 01/2021 to 12/2024. The project consortium consists of 5 European universities (Fachhochschule Dortmund as grant holder, KU Leuven, Kaunas University of Technology (KTU), University of the Basque Country (UPV/EHU), and Norwegian University of Science and Technology (NTNU)), 13 companies, and 3 professional associations: International Project Management Association (IPMA/AEIPRO), IEEE Technology and Engineering Management Society (TEMS), and the Society of Environmental Management of the Basque Government (IHOBE). The company partners are a mix of large, medium, and small companies in the field of DT, two startup incubators, and a deep-tech network. The aim of ProDiT was to develop novel methods and tools for *Digital Transformation Project Management (DTPM)*, to test and evaluate them, to develop teaching and training materials based on the findings, and to test and evaluate them in pilot teaching within the Master’s programmes of the “European Partnership for Project and Innovation Management (EuroPIM)”, the partnership of the 5 ProDiT universities (see above).

Since the research design of ProDiT was based on the development of novel methods and tools as main research artefacts, their test in real scenarios (the problem space) and the establishment of a knowledge base for DTP, the Design Science Research (DSR) paradigm [44] was applied as the overarching research methodology and approach. The development of the methods and tools was based on real company case studies, applying case research and case-based validation to a large extent [45]. Conducting systematic literature reviews, research questions (RQ) were defined which got then investigated with case research, interviews and (explorative) focus groups, using a concurrent mixed methods approach with data triangulation [46]. For the validation, experiments and project simulations were used along with surveys and (confirmative) focus groups.

ProDiT addresses the following research questions (RQ):

- RQ1: What is a Digital Transformation Project (DTP) and what characteristics make it unique and different from other types of projects? Can these characteristics be structured in a classification scheme or taxonomy?
- RQ2: Which are the main challenges to project management processes, methods and tools created by these specifics of DTP? Where is an extension of the state of the art in project management needed and why are current practices insufficient?
- RQ3: Which new or adapted processes, methods and tools are needed for successful DTP management and how do they look like? Is this sufficient for a management of DT which achieves the desired impact?

The research activities were guided by the aim to design new or adapted processes, methods and tools according to RQ3. Such new artefacts are researched and developed with the design science research (DSR) method [44]. This includes the deductive and inductive analysis of the problem spaces identified in RQ1 and RQ2 and the solution design according to RQ3. Within the ProDiT project, the research was conducted in iteration cycles (according to DSR) in cooperation with the partners and based on their cases which allowed a combination of scientific deductive and inductive research with a continuous transfer of results into practical applications and educational activities. In a summary, the following research plan was executed:

Systematic literature reviews were conducted on RQ1, followed by more focused integrative literature reviews for building classification schemes and taxonomies [47] since it was found that DTPs are not well-defined in the state of the art yet. To provide definitions and classifications for DTP is the groundwork for further work which was then validated with case studies and focus groups, using qualitative methods.

For RQ2 and RQ3, relevant clusters of challenges were developed based on literature work. The relevance was again confirmed with qualitative methods in focus groups and interviews with industry partners. Specific case studies for the clusters are developed.

For the 3 clusters, solutions were developed based on the analysis and adaptation of existing methodology from the literature reviews, mainly from PM and agile methods. These solutions adapt and use maturity models, competence models, and sustainability canvas for DTPs. Again, results were validated based on qualitative research.

The results of the research are to a larger extent already published (see Table I) but not yet compiled into an overview or framework with a holistic description and analysis. The first aim of this paper is to provide such a holistic overview in the form of a framework for DTP management. The second aim is to apply the framework to the case of a Smart City project to make it understandable and plausible.

IV. FINDINGS ON DIGITAL TRANSFORMATION PROJECTS

According to the research results of ProDiT, the planning and management of a DTP follows a generic pattern, forming a framework of 8 phases which can be outlined as follows:

1. The type of DT and the DT journey are analysed.
2. The DT journey is partitioned into DTP, e.g., based on a DTMM, and the type of DTP is determined.
3. DTP methods and tools are selected accordingly.
4. Starting point, goal and main project phases of DTP are defined, supported by DTMM.
5. The goals of DTP are assessed with a sustainability analysis and linked to the goals of the DT journey and the intended impacts.
6. The team for DTP is formed, considering the available competences and the ability to learn.
7. DTP is conducted in an incremental, agile way, applying lean principles.
8. Result-based management (RBM) links the project progress with the contribution to the impacts.

According to the conceptual model developed by ProDiT, DTPM must consider 4 views on DTP: the project view, the people view, the organisational view, and the impact view (see Fig. 1):

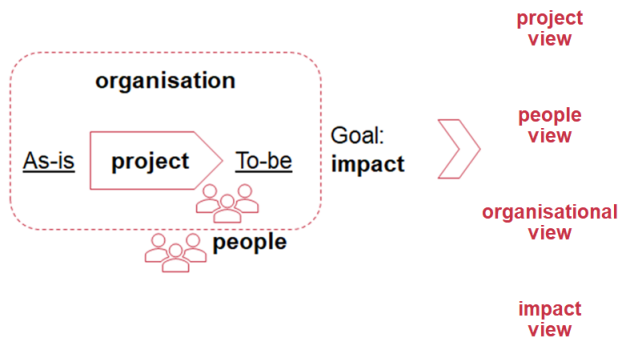


Fig. 1. Formulation of 4 views on DTPs (own illustration by ProDiT).

The 8 DTP phases are linked to the (partly published, see references to the own publications of the authors, based on ProDiT results) DTPM methodology and the respective views (see Fig. 1) in the following table:

TABLE I. DTP PHASES AND APPLICATION OF METHODS AND TOOLS

<i>DTP phase</i>	<i>DTPM methods</i>
1. DT journey analysis (organisational view)	- Analysis of the type of DT based on DT taxonomies [24] - Determination of the relevant DT domains, the resulting digital units, the VUCA aspects, the pace and level of transformational change [17]
2. DT journey partitioning into DTPs (from organisational view to project view)	- Development of a DT journey or DT strategy, e.g., based on scenario techniques - Assessment of the DT journey, and structuring, e.g., by using Digital Transformation Maturity Models (DTMM) - Partitioning of the DT journey into steps which are conducted in a sequence of DTPs <i>The forming of the DT journey and the (optimal) partitioning into DTPs are identified as areas for further research by the ProDiT team.</i>
3. DTP type and methods selection (project view)	- Assessment of the DTP type based on a DTP taxonomy [17], developed in ProDiT by applying methods from [47] - Assessment of Critical Success Factors of DTP - Selection of methods and tools for DTPM
4. DTP design and planning with DTMM (project view)	The following steps are based on the DTMM guideline [28]: - Selection of relevant DTMMs based on a DTMM taxonomy - Assessment of the “as-is” situation and selection of the current maturity level - Formulation of a “to-be” situation based on scenarios
5. DTP sustainability analysis (impact view)	(see phase 2) and more advanced maturity levels - Structuring of DTP based on intermediate maturity levels - Assessment of the sustainability of DT and DTP by using the Digital Sustainability Canvas (DSC) [42] - Assessment of Critical Sustainability Factors based on the DSC analysis - Life-cycle Analysis (LCA) of DT and DTP
6. DTP team forming (people view)	- Competence-based staffing and team formation, e.g., using LLM [35] and the competence framework [36] - Analysis of soft factors [31] - Consideration of hidden competences [32] - Analysis of the DTP’s absorptive capacity [37] and the learning aspects within DTP [38]
7. Agile DTPM (linking the 4 views)	- Application of an agile PM framework (e.g., Scrum) on DTP level - Embedding into an agile framework (e.g., SAFe) on DT journey level - Definition of increments, using lean principles, e.g., minimum viable product (MVP) - Linking product increments (output level) of DTP to the outcome and impact level of the DT journey, e.g., with BizDevOps [48] <i>The agile management of DTP and the link between DT journey and DTP are identified as areas for further research by ProDiT.</i>
8. RBM for DTP (impact view)	- Linking of the output level of DTP with the outcome/ impact level of the DT journey by developing cause-and-effect networks within a result-based logic or logical framework - Developing success criteria and performance indicators based on the result-based logic - Application of RBM for controlling and DTPM <i>Since DT and DTP (of a certain complexity) are considered “wicked problems”, the application of RBM is another open research topic.</i>

As shown with Table I, the findings of ProDiT are a basis for the development of a comprehensive methodology for DTPM, hence supporting the management of DT with DTP. Certain aspects (see Table I, open research topics and demand for further research) require more in depth research on the framework and the adaptation of the methods and tools.

V. SMART CITY PROJECT AS CASE STUDY FOR A DTP

The project case study for testing the application of the DTP framework (see Fig. 1 and Table I) is a smart city project in the field of city logistic, improving the impact (sustainability) of parcel delivery in cities. It puts the focus on the development of novel digital services and technical solutions for a large logistics warehouse while taking into consideration relevant aspects of the development of smart cities [48]. In brief, the outline of DTP is as follows:

- Logistic warehouses are the place where delivery vans are loaded with parcels, start their delivery journey and return to. They are traffic hot spots.
- Delivery vans are converted to battery electric vehicles (BEV) to become more sustainable.
- Charging of the battery is done while being at the warehouse, making it a large charging station.
- While delivery vans are at the warehouse, the charging can be controlled, e.g., the current can be lowered and increased, the charging can start and stop, and ultimately, the charging can be reversed, feeding energy back into the grid (connection point).
- The smart grid can therefore use the logistics warehouse as a smart battery, using it for supplying and sourcing energy. This is fast enough for grid stabilisation and the logistics warehouse can provide a Battery as a Service (BaaS) business model to the grid. Photovoltaics (PV) on the roof of the warehouse and 2nd use batteries from the vans can be included.
- Route planning of the delivery vans must be synchronized with the BaaS requirements, and with the logistics planning, and with the traffic management in a smart city, e.g., reducing congestions due to parked delivery vans. In addition, customers value short delivery times which require optimized routes.

The development and operation of such a smart logistics warehouse is a Systems-of-Systems (SoS) project [43], covering several interrelated technical and socio-economic systems while delivering a positive ecological, social (QoL) and economic impact. It is affected by the VUCA factors, and it involves large scale change. Within DTP, an agile systems engineering process for such smart city projects was developed and evaluated [48] (see Fig. 2).

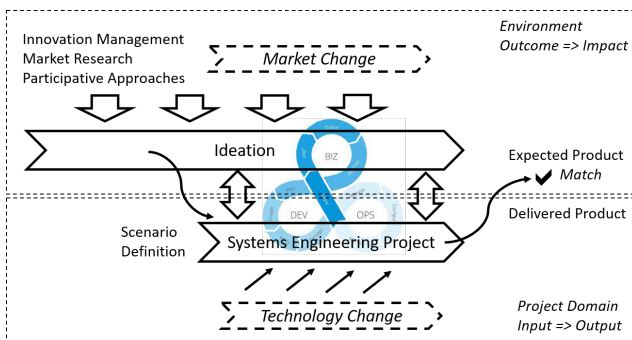


Fig. 2. To-be-process for complex systems engineering projects [48].

The 8 phases for DTPM applied to the smart logistics warehouse project can be projected as follows:

1. Within phase 1, the type of DT would be determined by using DT taxonomies [1],[13]: in the case study, there are innovation projects for new digital products and services, digital business model development projects, regulatory innovation projects, citizen involvement projects, and organisational change projects included.
2. Phase 2 would design the DT journey, e.g., by using DTMMs [24]-[25] and Smart City Maturity Models (SCMM) [49]. The DT journey gets partitioned into DTP according to the findings in phase 1 which are scheduled in incremental stages according to the maturity levels and prioritized.
3. In phase 3, DTP are analysed according to the DTP taxonomy [24] and methodology is selected and tailored, e.g., for the agile systems engineering project, for the organisational change projects, or the citizen participation project.
4. In phase 4, the DTMM guideline [28] is used to define the as-is and to-be situation, steps in between, and the relevant project tasks, e.g., by using a Smart City Maturity Model (SCMM) [49].
5. For the systems engineering project, for example, a continuous DT approach and a methodology from Advanced & Agile Systems Engineering (ASE) [48] was selected and successfully applied.
6. In phase 6, a competence-based team formation approach [34]-[35] for the ASE team can be applied. The people view includes developing the competences of people and learning [37]-[38], since the novel design of the logistics and energy management processes requires new competences.
7. While executing the project (phase 7), a combination of a continuous, incremental requirements engineering (RE), a BizDevOps pattern for project-environment interaction, and an agile Scrum approach for the development tasks can be used (see Fig. 2) [48].
8. For the sustainability assessment, DTP can be analysed with the DSC [42]. RBM can be used to align the project outputs with the desired impacts.

As the example of the smart city case study demonstrates, the management approach for DTP (see Table I) can be applied to it and supports the most success critical aspects. This mapping of the phases to a real project does not validate the approach, but it illustrates its use and makes the process of application plausible. Further research is needed on detailing the DTPM methodology, close existing gaps and validate it both with case studies and experiments, and with expert reviews, e.g., in focus groups or interviews.

VI. CONCLUSION AND OUTLOOK

The main goal of this contribution is to provide an overview of the results of the ProDiT project and to organize and structure them in a generic framework for DTPM. A second goal is to illustrate the findings and their application, and to make them plausible by giving examples based on the case of a Smart City project, here the establishment of new use cases and the enhancement of the existing use cases of a logistics warehouse by applying digital technologies. This contributes to the digital transformation of city logistics.

The overview of the DTPM framework shows where existing gaps in the methodology have been closed by the ProDiT project, especially in the understanding of the different types of DTP, the use of DTMM as a planning tool for the design of DTPs, the implications of competence management and the focus on the people view, and the sustainable management of DTP. As mentioned above, the specific contributions are partly published, some more are about to be published. The integration into the overall framework of DTPM in a project management handbook is still an open topic and planned to be covered by ProDiT.

Finally, the framework shows where further research is needed. Partitioning a continuous DT journey in an efficient and effective way into DTP is not yet researched. This is expected to be challenging due to the VUCA aspects of DT which inhibits a full overview and understanding of the DT journey right at the beginning. Novel, agile ways of DTP portfolio management will be required for this. Furthermore, linking a DTP after the start to the continuing change within the overall DT journey is challenging since common project planning rules expect to have all requirements available right from the start. That's by nature not the case in DT. A major challenge for DTPM is the "wicked problem" nature of DT and DTP from a certain level of complexity and scale upwards. Cause-and-effect networks are becoming fluid, multi-causal, and out of reach of the project management. VUCA leads to difficulties in the development of goals and indicators for RBM and project controlling. It requires further research on the application of management methods on wicked problems in general, also in other domains than DT.

Another goal of ProDiT – apart from extending the scientific state of the art on DT, DTP and DTPM – is teaching students and professionals, delivering the competences for the management of DT. ProDiT has developed project-based didactic formats and a selection of teaching materials. The EuroPIM university partnership runs several relevant Master's programmes where the material is used and evaluated. Other users from academic institutions and companies are invited to use the material, to adapt and modify it, and to help to disseminate it.

As a conclusion, ProDiT gives good reasons to believe that projects are a useful tool for managing the digital transformation. It also leaves doubt if DTPM will ever reach a maturity level where DTP become a routine task with a guaranteed success rate. Same as for other "tricky" project types, it might not be the goal to make them 100% successful and to make DT fully manageable and controllable. Instead, DTP could be the best tool at hand to manage DT, while requiring a lot of experience, competence and attention to be applied successfully. If this is the ambition, making DTPM better is a reasonable effort and a valid field for future research. The ProDiT partners are open for cooperation in this field and will continue with their efforts.

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