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Digital Transformation Progress Model for Supporting Co-Creation during a Digital Transformation Initiative

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Abstract. Reflecting the IFIP 8.6 theme of “cocreating for context,” this conceptual contribution proposes a model designed to support co-creation within an unfolding context of varying internal and external conditions as a digital transformation (DT) strives to achieve its goals. It proposes a digital transformation progress model (DTPM) that combines a work system perspective with ideas related to DT, including DT initiative, DT success, phases of DT, and tangible and intangible resources for change that affect DT initiatives. The model expresses the combined impact of the favorability of five categories of resources for change at any point in a DT initiative’s trajectory. The categories are momentum, capabilities, forces, drivers and impediments of change, and catalysts of change. Potential uses of the DTPM and follow-on research are discussed briefly.

Keywords: Digital Transformation, Co-creation, Work System Perspective, Resources for Change

1 Digital Transformation as Co-Creating for Context

“Co-creating for context,” the theme of the 2022 IFIP 8.6 conference, emphasizes the increasing diversity, complexity, and uncertainty of context(s) influencing the diffusion of emerging IT. The CFP discusses many possible topics including what is happening “at the precipice of digital transformation.” This paper pursues the topic of digital transformation (DT) as a prime example of “co-creating for context.”

This conceptual contribution proposes a digital transformation progress model (DTPM) for supporting co-creation as a DT initiative unfolds within a context of time-varying internal and external conditions. Traditional project management approaches emphasizing Gantt chart topics would miss many issues and obstacles that could affect the initiative’s trajectory as a co-creation effort within diverse contexts. The DTPM combines project status and momentum information with subjective judgments related to issues and obstacles likely to affect the initiative’s current status, future trajectory, and possible outcomes.

The proposed DTPM assumes that DT occurs through change trajectories in IT-enabled mission-critical work systems (WSs). It assumes that the general phenomenon of DT is not linked to specific emerging technologies such as cloud computing, blockchain, and machine learning. It does not incorporate DT mantras about maintaining visible leadership by top executives, improving digital literacy, and

changing corporate culture, nor does it suggest a normative DT process or assume that DT necessarily involves strategic responses to technology-related disruptions in industry or society.

Goal. This paper proposes a model-based approach for supporting or analyzing co-creation as a DT initiative strives to achieve its goals within the unfolding context of varying internal and external conditions.

Organization. Section 2 summarizes the work system perspective because DT calls for significant changes in mission-critical work systems. Section 3 presents definitions and other ideas related to DT. Section 4 explains how the DTPM links the favorability of five categories of resources for change to a DT initiative's likelihood of successful outcomes throughout its evolving trajectory. Section 5 briefly discusses potential uses of the DTPM. Section 6 identifies limitations and follow-on research.

The DTPM was developed through an iterative process incorporating interests and research experiences related to DT, value co-creation, work systems, implementation case studies, and the resource-based view. Many of this paper's ideas are presented without detailed background explanations that would be expected in a full journal article but would exceed this paper's length limitations.

2 Work System Perspective Underlying the DTPM

Brief background summarizing existing coverage of the work system perspective (WSP) [1, 2, 3] is needed since the DTPM focuses on initiatives related to mission-critical WSs as defined within that perspective. The WSP has been used in teaching (e.g., [4, 5, 6]) and in research articles on various topics, but I am not aware of its use in models for supporting DT.

Definition of work system. A WS is a system in which human participants *and/or* machines perform work (processes and activities) using information, technology, and other resources to produce specific product/services for internal and/or external customers. WSs may be sociotechnical (human participants perform work with help of machines) or totally automated (machine perform all work). ISs, projects, highly focused supply chains, and totally automated WSs can be viewed and analyzed as WSs.

Definition of information system. An IS is a WS whose essential activities are devoted to capturing, storing, retrieving, transmitting, deleting, manipulating, and displaying information. ISs may exist to produce their own product/services or may exist to support other WSs. The notion of essential activities is analogous to the idea of deep structure in representation theory [7].

Work system view of an enterprise. An enterprise (or major business unit or supply chain crossing enterprises) can be viewed as a set of WSs whose operation and interactions maintains the enterprise, determines how it obtains and applies resources, and produces product/services for customers and economic results for the enterprise.

Aspects of a work system that may change during DT. The nine elements of the work system framework (Fig. 1) are viewed as changeable in the course of DT initiatives. The elements of that framework outline a basic understanding of a WS's

form, function, and environment during a period when it is stable enough to retain its identity even though incremental changes may occur. *Processes and activities, participants, information, and technologies* are completely within the WS. *Customers* and *product/services* may be partially inside and partially outside because customers often participate in activities within a WS and because product/services take shape within a WS. *Environment, infrastructure, and strategies* are viewed as outside of the WS even though they have direct effects within a WS and may be affected by a significant DT initiative. “Elements of the WS framework” will be referred to as “WS elements” even though the last three are partially or totally outside and not controllable by a WS.

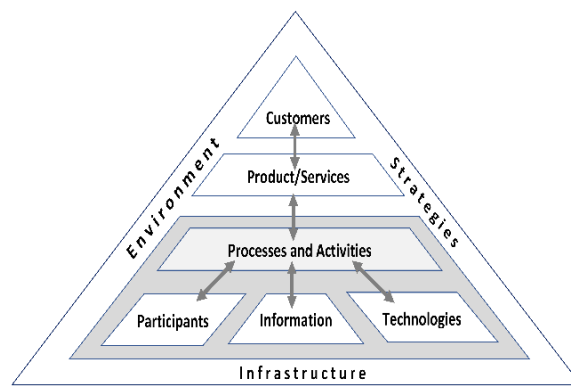


Fig. 1. Work System Framework

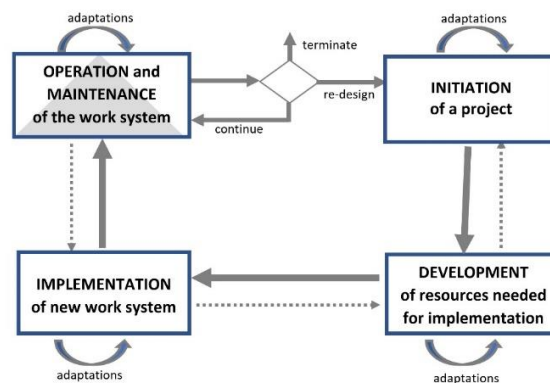


Fig. 2. Work system life cycle model

The WS life cycle model (WSLC – Fig. 2) describes how WSs (including ISs) evolve through iterations of planned change through projects (initiation, development, and implementation phases) and unplanned change (adaptations and workarounds).

Significant changes affect multiple elements of the WS framework, not just technologies. The development phase creates or acquires and then tests software and other resources needed for implementation in the organization. The implementation phase involves changes in work practices. The WSLC's four idealized phases (and their sub-phases) express a waterfall-like approach to identifying things that should happen as a WS evolves iteratively. Key activities and responsibilities remain even if the phases are partially merged in agile approaches and regardless of whether the WS uses homegrown software, commercial application software, or external platforms. Even when development and implementation are partly merged, each iteration determines requirements (at some level of detail), acquires, produces, fixes, tests, and debugs any needed software, decides how to implement WS changes, identifies implementation problems, and trains WS participants.

3 Ideas for Understanding Digital Transformations

The effort to develop a DTPM was motivated by the increasing importance of DT and my unawareness of models that might support DT initiatives more effectively than project management, change management, and IT portfolio management models.

The comprehensive DT literature review in [8] made further review seem redundant. It found 282 DT articles, of which only 28 defined DT. Many definitions had significant shortcomings related to “circularity, unclear concepts, and conflation between the concept and its impacts” (p. 119). [8] defined DT as “a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies.” (p. 118). Later [8, p. 122] expanded on that definition by noting eight “building blocks of the DT process” in the literature: strategic responses, disruptions, use of digital technologies, structural changes, changes in value creation paths, organizational barriers, negative impacts, and positive impacts. This paper recognizes the relevance of those factors, while proposing a model designed to help managers trying to steer a DT initiative.

3.1 Developing the DT Progress Model

Inspection of current DT-related articles and consultant web sites concluded that a useful model of DT needed to start with a clear definition of DT, should support DT initiatives, and ideally should help researchers visualize DT issues. It should go beyond recycling common assertions about management support, experience, adequate resources, realistic scheduling, disruptions, and emerging technologies. Developing a DT model based on the WSP seemed more straightforward than using institutional theory, technological change, strategy analysis, diffusion of innovation, or other approaches because DT necessarily involves changes in work systems.

My initial attempt to imagine a DTPM applied aspects of the WSP including work system theory (WST) and the work system method (WSM), a related systems analysis method designed to help business professionals visualize WSs and collaborate

effectively with IT professionals. The general idea of applying a WS lens to mission-critical WSs seemed plausible but an initial descriptive application of WST and WSM said nothing unique about DT. The next step was trying to describe how DT initiatives call for new extensions or combinations of WS-related understandings in [1, 2, 3, 4]. The search for richer conceptualizations touched on empirical studies [9, 10], views of innovation [11], discussions of forces [12, 13], the resource-based view [14], dynamic capabilities [15], a new framework for describing theoretical perspectives [16] and its application to the WSP[17]. Trial and error iterations in developing the new model included some aspects of design science research but did not use DSR explicitly.

3.2 Definitions Related to DT and DT Initiative

The DTPM builds on definitions from WST and on definitions related to DT.

Definition of DT. Enterprises serve their customers through the operation and interactions of numerous WSs. Accordingly, DT is defined as an enterprise-level transformation which IT-related changes enable strategically significant changes in mission-critical WSs . Thus, DT is neither about the diffusion of IT nor about industrial or societal changes inspired or enabled by IT. DT typically focuses on selected mission-critical WSs, not on the entire enterprise, and not on shared IT infrastructure unless infrastructure changes enable significant changes in mission-critical WSs. DT-related changes during DT initiatives are typically directed toward some combination of major business concerns such as operational excellence, profitability, product/services for customers, and/or the customer experience.

Definition of DT initiative. An identifiable DT initiative involves the initiation, oversight, and management of one or more DT-related projects from inception to completion or abandonment. Applying a project viewpoint to DT initiatives assumes that typical project details such as schedules, dependencies, and resources will be articulated clearly, tracked, and possibly adjusted as conditions change. As with many large projects, DT initiatives may be merged into other projects or may be terminated before achieving their goals.

Time frame for DT. Viewed in project-like terms, a DT initiative has a start date, a set of milestones that help in tracking progress, and a projected date of completion that may be revised.

DT as an adjustable trajectory. The planned trajectory of an ongoing DT effort (including timing, intermediate milestones, intended end points, and human, technical, and financial resources) may be modified during a DT initiative based on its current status and assessments of opportunities, constraints, and other concerns.

Success of a DT initiative. This is described in two ways, both of which recognize that DT initiatives are large, complex projects whose ambitions and scope may change due to opportunities and/or constraints that were not recognized initially. The first view of success describes the extent to which projects in a DT initiative are completed on schedule and absorb an appropriate amount of human, technical, and financial resources in creating or modifying mission-critical WSs in accordance with original or revised transformational visions. The second view of success focuses on

the extent to which new or improved WSs achieve and sustain the transformational vision and eventually are extended. Both views of success call for subjective assessments that may differ between observers.

3.3 Phases of a Digital Transformation

The phases of a DT can be viewed as a 5-phase variation on the WSLC that nonetheless recognizes that iterations and overlaps between phases may occur [11]:

1. **Impetus.** Recognition of enterprise-level challenges that a DT could try to address.
2. **Transformational vision.** The management vision of how those challenges will be addressed and what outcomes will be achieved
3. **Resource acquisition.** The process of creating, obtaining, improving, and/or channeling resources that are needed for DT implementation
4. **Implementation.** Making WS changes needed to achieve the transformational vision
5. **Operation and maintenance.** Operation and support of transformed WSs.

Identifying general phases of DT initiatives distinguishes those initiatives from less specific diffusion of technological innovation or societal change related to innovative technologies. Executing DT initiatives requires that their transformational vision will be translated into projects that acquire and use resources to create or improve mission-critical WSs. A DT initiative without well-defined projects is more like a management exhortation that lacks operational follow-through. The nature and scope of projects within DT initiatives may evolve over time, especially since DT initiatives typically are undertaken in dynamic business contexts where needs and ambitions that launched a DT initiative might be overtaken by events in the surrounding context(s) or might evolve based on experience within the initiative.

3.4 Resources for a Digital Transformation

The idea of “resources for change” has been used in a variety of ways in relation to management, education, law, medicine, social relationships, organizational change, and elsewhere. Many iterations of trying to apply various aspects of the WSP to DT initiatives led to visualizing five types of “resources for change” that contribute to whether and how DT initiatives will achieve their goals. Largely tangible resources for change include (1) momentum toward the transformational vision and (2) capabilities needed to achieve the vision. Intangible resources include (3) forces affecting all or most of a WS, (4) drivers and impediments of change related to specific WS elements, and (5) catalysts affecting the micro-dynamics of DT-related changes. Each of type of resource has many different facets that may have positive, neutral, or negative impacts on current and future progress of projects within the DT initiative. The various facets of the five types of resources for change typically are not totally independent. Most managers probably would ignore that issue if the larger categories helped them identify and collaborate around important concerns.

Momentum toward the Transformational Vision. A specific WS's DT-related momentum is the extent to which its current state and the state of ongoing projects that affect it are consistent with the current schedule and the DT's transformational vision (which both may have been revised). Typical ideas in project management focus on those concerns, which are expressed in project management tools that focus on project status, future milestones, available human, financial, technical, and informational resources, and key dependencies along the critical path to the project's conclusion.

Shared enthusiasm and significant progress toward the goal can be viewed as resources that reinforce shared beliefs that the goal makes sense and is attainable. Conversely, participants in a project that seems adrift may tend to believe that their efforts are pointless and will not pay off for themselves or for the organization.

Capabilities Needed to Achieve the Transformational Vision. DT requires a combination of appropriate software development and implementation capabilities, financial capabilities (adequate budget and financial systems and flexibility) and trustworthy leadership and organizational change capabilities (e.g., dynamic capabilities defined in [15] as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments"). Low levels of capabilities of any of those types imply that a DT initiative likely requires additional inputs of energy, time, money, personnel, and/or technical resources.

Management responses to inadequate capabilities are often more difficult than simply acquiring additional staffing or funding. For example, inadequate technical capabilities call for bringing new people into the project, which is often difficult because time spent bringing new project participants up to speed is time not spent on completing ongoing tasks [18].

Forces Affecting a Work System as a Whole. The idea of forces and force fields as discussed by Lewin [12] is not common in the IS field even though it has been used to describe a struggle between driving and restraining forces, e.g., in software development firms [19]. Also, Porter's five forces model [13] is used widely to describe business competition. The idea of thinking about forces in relation to the WSP originally came from an extended analogy with physics [16] and was discussed in [17].

Fig. 3 identifies five types of forces that may have positive or negative impacts on DT-related changes in a WS.

- **Cohesive forces** tend to hold WSs together, e.g., incentives, goals, controls, alignment. Five alignment arrows within the work system framework (Fig. 1) highlight typical paths for cohesive forces.
- **Innovative forces** aligned with the transformational vision propel the progress of DT initiatives because they support coordination and maintain direction.
- **Disruptive forces** tend to impede DT initiatives by dissipating energy and sometimes degrading WSs significantly. e.g., internal misalignments, discontent, poor management, design flaws. Those issues mirror the idea of entropy from physics, i.e., a generalized type of disruptive force that increases disorder.

- **Inertial forces** impede progress by dissipating energy and resisting planned or unplanned changes in WS operation. Organizational inertia is cited frequently a key challenge in overcoming resistance to change, e.g., in organizational behavior, general management, and systems dynamics, where the related phenomenon is called policy resistance ([20, pp. 5-12]).
- **Forces at a distance** (analogous to gravity) may propel or impede progress toward DT goals. These forces stem from broad phenomena related to economics, competition, regulation, demographics, and technological change. Such forces may not be apparent to participants in mission-critical WS that have operated adequately for years but are not aligned with a DT initiative's requirements or goals.

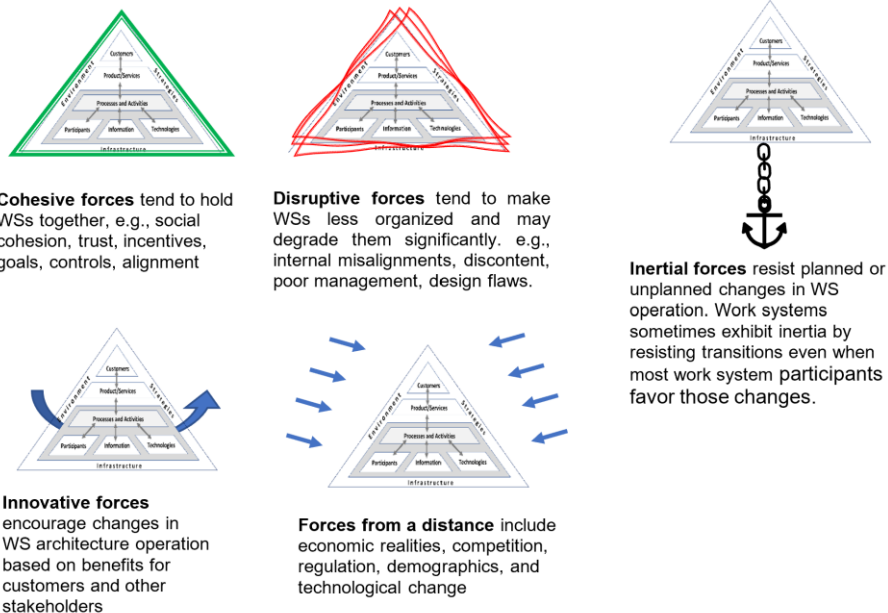


Fig. 3. Five types of forces that may affect a DT initiative

Drivers and Impediments Related to WS Elements. In contrast with forces in Fig. 3 that apply to an entire WS, many drivers or impediments of change are related to individual WS elements [11] and sometimes are reminiscent of some of the factors in UTAUT [21,22]. Fig. 4 shows typical examples of such factors, all of which are expressed so they can be drivers or impediments for DT. For example, low customer satisfaction could be a driver of DT while high customer satisfaction might impede DT by making the need for change less evident. Similarly, the motivation and ambitions of WS participants might have positive or negative impacts depending on how well the DT initiative is aligned with those motivations and ambitions.

Many factors in the IS literature on post-adoption behavior can be viewed as drivers or impediments related to WS elements. The drivers and impediments in Fig.

4 include many factors that go beyond the variables that appear in the most widely cited IS theories (e.g., TAM, UTAUT) that focus mostly on determinants of technology acceptance and use rather than on IT-enabled changes in mission-critical WSs.

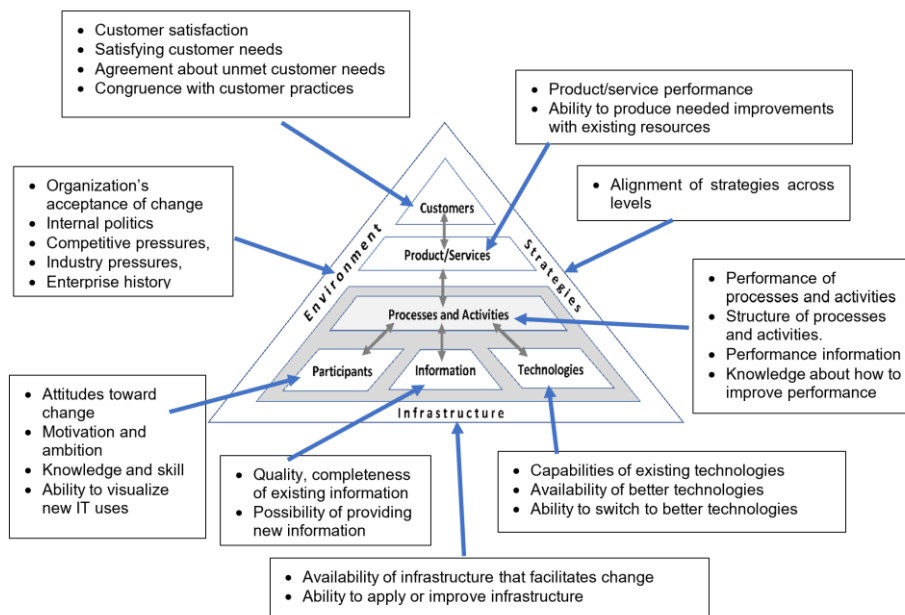


Fig. 4. Drivers and impediments related to elements of the work system framework

Some of the factors in Fig. 4 overlap somewhat with forces in Fig. 3. For example, Fig. 3's *forces from a distance* include competition, and Figure 4's factors related to the WS element *environment* include competitive pressure. That type of overlap is not surprising since forces that affect an entire WS necessarily involve factors that affect one or more of its elements. For current purposes, thinking separately about forces affecting an entire WS and factors related to specific WS elements is a potentially useful for visualizing a DT initiative's status and prognosis.

Catalysts Affecting the Micro-dynamics of DT. Consideration of micro-dynamics of DT is needed because day-to-day activities often reflect expressed or unexpressed beliefs that may support or resist a DT initiative. Micro-dynamics can be described in terms of three catalysts, *needing*, *understanding*, and *liking*, that affect the cooperation vs. resistance of WS participants and other stakeholders [11]. The verb forms *needing*, *understanding*, and *liking* are used instead of psychological terms such as affective or rational because they express ideas more directly in relation to innovation, adoption, and adaptation in organizational settings. Positive perceptions related to *needing*, *understanding*, and *liking* tend to be positive for DT, although with some exceptions.

- **Needing.** This is the extent to which individuals or groups perceive that they need an innovation for achieving their own goals. Greater perceived need usually leads to greater support of an innovation.
- **Understanding.** This is the extent to which individuals or groups understand how an innovation can (or cannot) be applied and how and why it might (or might not) be beneficial. Greater understanding may or may not be associated with acceptance or rejection of an innovation. The simplest cases are when people accept or reject an innovation because they understand its genuine benefits or shortcomings. In other cases, people who understand an innovation's beneficial impact for an enterprise might reject it due to conflicts with personal or group goals or interests. (Remember the Luddites.) Similarly, people who misunderstand an innovation might accept it because they cannot foresee its negative implications for them or their group.
- **Liking.** This is the extent to which individuals or groups like an innovation. It is easier to implement innovations that are liked. Implementation efforts tend to be more painful and costly in time and effort when innovations are disliked.

Issues related to micro-dynamics may reveal problems that are obstacles to achieving DT benefits. Various forms of resistance ranging from benign neglect to low-level sabotage could determine whether the DT initiative will be embraced and implemented fully, especially when WS participants, managers, and other stakeholders have conflicting perceptions and beliefs about whether a DT initiative will improve work conditions, will require different skills, or might cause layoffs.

3.5 Resource Favorability

Google Scholar found no instances of papers that contained both *resource favorability* and *digital transformation* even though it found some instances of *resource favorability* in relation to mineral resource projects and several other topics.

The DTPM uses *resource favorability* to summarize the extent to which specific resources or groups of resources for change at any point during a DT initiative's trajectory seem likely to contribute positively (or negatively) to likely success for specific WSs. The favorability of those resources can be explained based on examples, described qualitatively based on subjective perceptions, or rated numerically in various ways. Numerical favorability ratings afford aggregation of otherwise incommensurate factors, although meaningful aggregations require careful attention to the relative importance of different resources and to dependencies and other relationships.

Resource favorability is perceived differently for the five different types of resources for change in Fig. 3. Favorability perceptions related to momentum might be based on information in a project scorecard, e.g., progress vs. plan, critical path to completion, and so on. Favorability related to capabilities might be expressed similarly based on likely availability of human and technical resources. Favorability related to forces, WS-specific drivers/impediments, and WS catalysts might be understood most effectively through narrative evidence obtained through surveys, interviews, management meetings, or other information collection. Stories and

examples often would be important, e.g., when a DT initiative's momentum might seem favorable until a key vendor loses technical experts, leading to the management challenge of finding and evaluating alternatives quickly. A different approach would express resource favorability using numerical scales that summarize situations without collecting a lot of detailed information.

For current purposes, a favorability rating for the current state of any specific resource is a point on a continuous dimension going from extremely unfavorable to extremely favorable for the successful completion of the DT initiative. Perceptions on that type of scale could be collected by using a slider that makes it unnecessary to focus on numerical distinctions (e.g., 4.6 vs. 5.2 out of 7) that might not matter when aggregated perceptions of multiple individuals. Table 2 will illustrate how the slider could use colors such as red for unfavorable, yellow for neutral, green for favorable, and slider inputs from people providing favorability ratings could be converted to numerical scores. Data about the current or past favorability of different resources could be weighted in a variety of ways and combined numerically.

4 Digital Transformation Progress Model

The proposed DTPM is designed to facilitate efforts to monitor a DT initiative and make decisions that try to maximize its chances of success. Those decisions should consider positive and negative aspects of the five types of resources for change that often are relevant to the continuing progress of a DT initiative. Throughout the DT initiative, the relevant information ranges from largely objective (e.g., the degree of completion of a specific step in a project or the availability of specific IT resources) through highly subjective (e.g., the level of anger and resistance among stakeholders who might be affected adversely). It could also include the level of threat from external factors such as likely changes in governmental regulations or likely product announcements by competitors. In effect, a DTPM should relate a plethora of diverse information to possible outcomes of the DT initiative based on the current situation at any point during the initiative's lifecycle.

The DTPM is based on the favorability of resources for change. Fig. 5 represents the DTPM as it might be applied to an entire DT initiative or might be applied separately to mission-critical WSs considered individually. Fig. 5 represents the following verbal statement of the model:

The favorability of five categories of resources for change for WSs targeted by the DT initiative contribute individually and in combination to the likelihood of the initiative's eventual degree of completion and business success. The categories are momentum, capabilities, forces affecting the WSs, drivers and impediments related to WS elements, and catalysts of change. Each category includes resources for change whose state can be described at any time during a DT initiative and can be compared to an ideal state relative to the progress of the DT initiative. The state and favorability of important resources for change typically vary over time as the DT initiative unfolds due to adjustment in projects within the DT initiative and ongoing changes in the targeted WSs and in the surrounding environment.

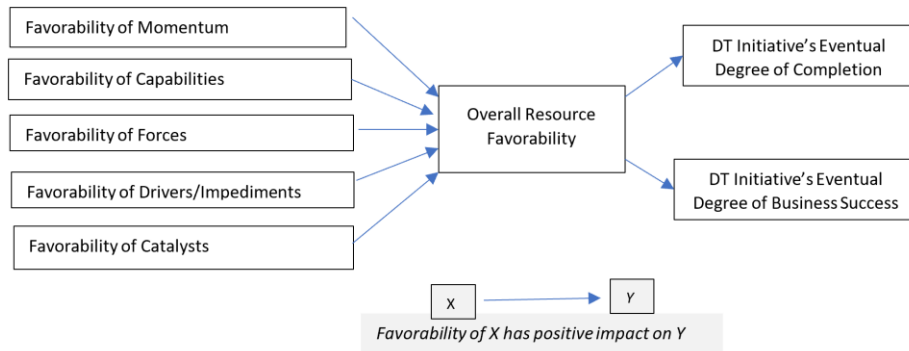


Fig. 5. Digital Transformation Progress Model

Factors that contribute to the five categories of resources for change are not shown in Fig. 5 because each category involves many factors mentioned earlier.

A subjective understanding of how and why the DT initiative is in good shape or has significant challenges typically should be more useful to executive and managers than a point prediction of the probability of success or a numerical probability distribution for a given level of goal achievement. Executives and managers who already have access to typical project management tools would not look to the DTPM to provide the same information. A more likely use of the DTPM is as a basis for sense making and discussion leading to further off-line discussion and executive action if needed, i.e., action beyond typical project management decisions such as modification of short-term plans based on current status, dependencies, available resources, and the current critical path to completion.

4.1 Comparison with UTAUT

The widely cited UTAUT (the Unified Theory of Acceptance and Use of Technology) [21, 22] provides a useful point of comparison even though technology acceptance and use differs greatly from DT. A diagrammatic representation of conclusions from a recent meta-analysis of research related to UTAUT [22, p. 39] said that use behavior is affected directly or indirectly (via behavioral intention) by:

- seven independent variables from UTAUT2 (performance expectancy, effort expectancy, social influence, price value, hedonic motivation, facilitating conditions, habit)
- four extensions (technology compatibility, user education, personal innovativeness, and costs of technology)
- effects of four types of moderating variables (individual characteristics, national culture, type of technology, and controls).

Those variables are related to some but not all aspects of the DTPM's five types of resources for change. Several of those variables address momentum and capabilities, the two DTPM types of resources for change that are directly related to project management. Since UTAUT variables operate primarily at an individual level, they do not address forces that affect WSs as a whole. On the other hand, some UTAUT variables touch on topics that the DTPM expresses differently in its other categories.

An additional point for comparison concerns usage. The extensive meta-analysis in [22] shows that UTAUT is designed for testing the validity of hypothesized relationships between specific variables and technology use, a question primarily of interest to academic researchers. In contrast, the DTPM is designed to support DT initiatives that involve much more than whether specific technologies will be used.

5 Potential Uses of the DT Progress Model

The concepts built into the DTPM provide an organized way to visualize a DT initiative, to anticipate and identify issues as a DT initiative unfolds, and to evaluate approaches for dealing with those issues. The DTPM assumes that DT achieves goals by creating or changing mission-critical WSs and that the likelihood of success is related to the favorability of five categories of resources for change.

The DTPM affords three potential types of use that will be discussed next. The first is as a framework for visualizing aspects of an ongoing DT initiative. The second is as an organizing principle for narrative DT project reports. The third is as an organizing principle for quantitative DT project reports that combine favorability ratings that would be tailored to situation-specific conditions and would be collected and combined based on user preferences.

5.1 DTPM as a Framework for Visualizing Aspects of an Ongoing DT Initiative

When viewed as a framework outlining a mental model, the DTPM encourages executives to think about the DT as an integrated enterprise initiative that can be divided into a set of projects directed at creating or improving mission-critical WSs. The current status of each project is a starting point for considering favorable and unfavorable aspects of five categories of issues that may call for executive decisions and action.

5.2 DTPM as an Organizing Principle for Narrative DT Project Reports

Table 1 shows a hypothetical example of the type of information in a DTSM-based executive summary for an ongoing DT initiative. Table 1 assumes that the DT initiative involves two mission-critical work systems (WS1 and WS2) and that a brief summary statement might mention several issues for each category of resource favorability for each WS. Additional information would be available as backup.

Table 1. Imagined narrative summary from an executive information system for an imagined DT initiative involving two mission-critical work systems (WS1 and WS2)

WS	Category	Summary of major observations
WS1	Momentum	<ul style="list-style-type: none"> Project is several weeks ahead of schedule. Given excellent progress and high commitment, probably should not redeploy anyone until the milestone that will be completed in one month
	Capabilities	<ul style="list-style-type: none"> Two technical experts left to join a competitor. We need to replace them as quickly to make sure that technical design is done properly. The timing is bad because the technical experts were in the middle of producing a revision of the underlying architecture.
	Forces	<ul style="list-style-type: none"> A database startup firm has produced a new product that might help us expedite programming. Evaluation requires several weeks of research, which seems worth the possible one week slip in the schedule.
	Drivers and Impediments for WS elements	<ul style="list-style-type: none"> Some customers have noticed that our interactions with them are not nearly as frequent or friendly as interactions from our main competitor. Most work system participants are quite satisfied with the existing software.
	Catalysts	<ul style="list-style-type: none"> Spirits are generally fine.
WS2	Momentum	<ul style="list-style-type: none"> Major strike at a supplier of a supplier. No immediate resolution. This could be a very serious problem due to dependency on our supplier. Otherwise the project is moving as expected.
	Capabilities	<ul style="list-style-type: none"> Adequate resources, could use several other change agents but these can be filled in later.
	Forces	<ul style="list-style-type: none"> Inertia is turning into a big deal. Many staff members have little appetite for this type of project, especially since a significant software upgrade last year proved more difficult than expected. Discontent is running high, partly because of disagreements between three key managers.
	Drivers and Impediments for WS elements	<ul style="list-style-type: none"> Most WS participants believe that the existing information is quite sufficient for performing their responsibilities well. Customers also seem reasonably satisfied with our product/services. Their main concern is cost.
	Catalysts	<ul style="list-style-type: none"> Many long-time supervisors are quite disgruntled about the scope of change that will be required in their work practices. Many say that these changes were dumped on them with no warning or discussion.

5.3 DTPM as an Organizing Principle for Quantitative DT Project Reports

Table 2 illustrates one of many possible formats for a numerically oriented favorability report showing favorability ratings for the five categories of resources for change. It uses sliding scales to represent a continuum of possibilities from very unfavorable to very favorable for different issues. That type of report could help executives visualize the current state and direction of change for a DT initiative and

could encourage them to inquire further about specific issues. Table 2 presents two types of information: 1) The left side shows the most recent three weeks of favorability ratings related to the five categories of resources. 2) The right side shows current favorability ratings for selected resources for change within each category. Many versions of this type of report and other reports based on the same kinds of information could be produced. For example, using the blue slider to illustrate progress across 3 weeks is just an illustrative example. Some executives might prefer 2 week or 4 week histories. Nothing is sacred about the different types of resources that are listed for each category. Executives involved in specific DT initiatives might be more interested in other types of resources for each category and might prefer other formats for reporting.

Table 2. Imagined quantitative summary from a project management system – including current favorability for types of resources and changes over 3 weeks for resource categories)

Category and 3 week history of category favorability	Resources (within the category)	Resource Favorability (current)
	Projected completion date	
	Progress in last two weeks	
	Cost vs. budget	
	Staff availability	
	Technical capabilities	
	Vendor availability	
	Dynamic capabilities	
	Cohesive forces	
	Disruptive forces	
	Innovative forces	
	Inertia	
	Forces from a distance	
	Customers	
	Product/services	
	Processes and activities	
	Participants	
	Information	
	Technologies	
	Understanding	
	Liking	
	Needing	

6 Conclusion

The DTSM represents a new way to visualize digital transformation, a major area of practice and research. Its diverse facets include many business and societal issues that extend beyond traditional technology acceptance and use research topics. The new approach treats DT as a strategic initiative focusing on IT-enabled creation or improvement of mission-critical WSs. The DTSM incorporates many ideas that executives and managers should consider as DT initiatives unfold and that IS researchers might incorporate into research related to both IT adoption and DT.

The DTSM fits within the conference theme of “co-creating for context” because DT is a major IT-related type of co-creation involving rich interactions between local, corporate, and broader economic contexts. The DTSM’s five categories of resource favorability cover that spectrum selectively, with momentum and capabilities focusing on project issues while forces, drivers and impediments, and catalysts of change focusing on internal and external issues related to the WSs being created or improved.

This conceptual contribution does not provide empirical verification of its intended value and is limited to defining, combining, and illustrating its central ideas. Also, the overall approach was developed in a highly iterative way that did not follow an established methodology such as design science research because a simple iterative approach based on personal knowledge and experience seemed adequate for proposing a unique model. A full journal paper would explain the central ideas more fully, but would still leave a number of questions in the following areas:

Assumptions about DT. The literature review in [8] demonstrated the substantial difficulty in defining DT. The DTSM is based on definitions of DT and DT initiative that focus more on IT-enabled organizational change than on the idea of disruption or the use of emerging technologies. Some researchers probably would not prefer that approach, especially if they are concerned about differentiating DT from IT-enabled organizational change (e.g., [23]).

Completeness of the DTSM. The DTSM organizes many ideas that are relevant to DT, but surely might be specified in more detailed way, perhaps making it more like the results of the meta-analysis of UTAUT research mentioned earlier [22, p. 39]. That level of detail was the product of many research efforts by many researchers. The DTSM might be specified in more detail in the future, but it is not obvious that a more detailed presentation would actually be more useful, as implied by a comment by Wittgenstein [24] cited in closing a paper [25] about the elusive definition of information: “Is it even always an advantage to replace an indistinct picture by a sharp one? Isn’t the indistinct one often exactly what we need?”

Usability of the DTSM. This paper mentioned the DTSM’s potential for organizing mental models and for generating two types of reports that might support DT initiatives. Testing those proposed uses might lead to insights about how to use the existing DTSM effectively and how to improve it.

Follow-on research. Case studies, survey research, or even careful coding of a sample of existing DT case studies might validate the idea that the favorability of multiple resources for change can be linked to the success of DT initiatives. Action

research and action design research might demonstrate the extent to which executives can use these ideas. Study of project management tools might find ways to add DTPM-related information to existing approaches for large, consequential projects. More direct evidence of the DTSM's value requires research projects involving researchers and organizations willing to try using the DTSM while pursuing DT initiatives.

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