MIS Quarterly Executive

# Five Principles of Industrialized Transformation for Successfully Building an Operational Backbone

*To move into the digital age, a globally operating company needs to have in place an operational backbone, but many struggle with achieving this and the associated transformation program. Based on the experience of UPM, a Finnish forest industry company, we describe an industrialized transformation approach that is underpinned by five principles—template-based, business-driven, matrix-organized, tight supplier steering and cascaded planning. The UPM case provides important lessons for transformation leaders seeking to build, expand or develop a value-adding operational backbone.*[1,2]

**Till J. Winkler**
Copenhagen Business School
(Denmark)

**Petteri Kettunen**
UPM
(Finland)

## Resolving the Tensions in Building an Operational Backbone

Any globally operating company that wants to equip itself for the digital age needs a platform for efficient, scalable, reliable and predictable business execution. In short, a globally operating company needs an operational backbone.[3] Operational backbones consist of technological capabilities such as enterprise systems, which in turn enable business capabilities through processes implemented in, and supported by, these systems. Backbone implementation programs aim to achieve operational excellence by ensuring stable core business operations, enabling real-time decision making and allowing firms to leverage their global scale.

Although companies have built and expanded their operational backbones since the late 1990s, few things have proven more difficult for them than to generate value from transforming

SIM WHERE IT LEADERS CONNECT

KELLEY SCHOOL OF BUSINESS INDIANA UNIVERSITY

1 Kristine Dery and Janis Gogan are the accepting senior editors for this article.

2 This research was previously reported in *Proceedings of the Thirty-Seventh International Conference on Information Systems, Dublin, Ireland*, December 2016. We thank the track chairs, associate editor and reviewers of the practice track for their valuable feedback and suggestions on our original submission. The authors also thank all interviewed collaborators and gratefully acknowledge the permission of UPM to publish this research.

3 An operational backbone is one of two technology-enabled assets that are essential to execute a digital strategy. The second is a digital services platform that enables rapid innovation. See Sebastian, I. M., Ross, J. W., Beath, C., Mocker, M., Moloney, K. G. and Fonstad, N. O. "How Big Old Companies Navigate Digital Transformation," *MIS Quarterly Executive* (16:3), September 2017, pp. 197-213.

core business processes and IT systems simultaneously.[4] In practice, only a fraction of businesses today have a value-adding backbone in place and yet, in the world of digital business, such a backbone has never been so critical for building business value.[5] Despite an operational backbone's potential to build value, designing and implementing one is still challenging for globally operating companies. The challenges arise from the effort required to transform core business operations through any new system, which increases exponentially with the number of geographies and sites affected, due to interdependencies, idiosyncrasies, uncertainties and complexity.[6]

The UPM case study described in this article provides insights into how to reduce transformation costs and improve the deliverables. (The research method used to develop this case study is described in the Appendix.) UPM is a global leader in the bio-economy and forest industry. It faced huge market pressures to reduce costs and increase innovation in its paper manufacturing business. UPM responded to these pressures by developing and deploying a seamless operational backbone across all its plants. Having moved to global sales and supply chain systems, UPM then sought to close the remaining gap in its value chain by streamlining the company's core value-generating process and renewing its manufacturing execution systems. After a failed initial transformation program, UPM implemented what it called an *industrialized* approach to building its operational backbone. Having participated in UPM's program, we characterize the industrialized approach as pushing *radical* change at the transformation strategy level while carefully *balancing* several tensions at the program execution level.

After describing UPM, its need for a global backbone and its initial failed transformation attempt, we then describe the five principles of industrialized transformation. We show how these principles help to resolve the tensions commonly found in IT-enabled business transformation programs (see Figure 1).

The framework in Figure 1 draws on prior research and suggests there are three strategic-level and three execution-level tensions that transformation program leaders need to address.

4 Large IT-enabled transformation programs have been found to be 20 times more likely to fail than other business projects. See Flyvbjerg, B. and Budzier, A. "Why Your IT Project May Be Riskier Than You Think," *Harvard Business Review* (89:9), September 2011, pp. 601-603.

5 A survey of 171 globally operating companies found that 32% had no operational backbone, 40% had one under construction, and 28% had a value-adding operational backbone in place. See Ross, J. W., Sebastian, I. M. and Jha, L. and the Technology Advantage Practice of The Boston Consulting Group *Designing Digital Organizations—Summary of Survey Findings*, MIT CISR Working Paper No. 415, February 2017.

6 Transformation program complexity increases with the number of sites affected, their variety, the dynamics over time and the planned scope of business and IT changes. For more information, see Ribbers, P. M. A. and Schoo, K.-C. "Program Management and Complexity of ERP Implementations," *Engineering Management Journal* (14:2), 2002, pp. 45-52.

**Figure 1: Tensions in IT-enabled Business Transformation Programs**

| *Dimensions* | Tensions to Resolve | | |
|---|---|---|---|
| **Transformation Strategy** | | | |
| *Business process change* | Process standardization | vs. | Process differentiation |
| *IT architecture change* | IT replacement | vs. | IT integration |
| *Ownership of change* | Business driven | vs. | IT driven |
| **Program Execution** | | | |
| *Program governance* | Program control | vs. | Project autonomy |
| *Supplier relationship* | Contractual governance | vs. | Relational governance |
| *Program scheduling* | Schedule stability | vs. | Schedule flexibility |

For each of these six dimensions,[7] leaders need to make an informed decision on how to position their program management approach.[8] When setting out to resolve each tension, leaders have two options: they can push toward one of the extremes or find a way to reconcile (i.e., balance) the extremes.

UPM's global manufacturing execution systems program was guided by the following five principles:

- Principle 1: *template-based*
- Principle 2: *business-driven*
- Principle 3: *matrix-organized*
- Principle 4: *tight supplier steering*
- Principle 5: *cascaded planning techniques*

This article explains why the first two principles represent *radical* change strategies and how the latter three principles implement *balanced* execution mechanisms. In the UPM case, each principle was effective at specific stages of the transformation program.

The five principles offer important lessons for program leaders who need to build and perfect operational backbones within transformation journeys that are not perfectly predictable from the outset.

## Background to UPM's Paper Manufacturing Business

As a manufacturer of paper and wood products, UPM has a long tradition in the forest industry. The company, which is listed as UPM-Kymmene Corporation on NASDAQ's Helsinki stock exchange, originated from the merger in 1996 of Kymmene Corporation and United Paper Mills. The merged company grew rapidly, primarily by acquiring European and other competitors. In 2008, when the new global manufacturing execution systems program started, the company employed 25,000 people on six continents. Despite turnover growth, by 2017 UPM employed about 20% fewer people.

The global paper manufacturing business faced challenging market conditions in the first decade of the 21st century. Global demand for paper decreased in European and North American markets, giving rise to the dual challenges of overcapacity and fierce price competition. UPM's merger history supported successful business expansion and was also a strategic necessity for reducing market overcapacity, and for replacing legacy capacity with modern and more sustainable facilities where needed. The company also had to downsize to profitably meet customer demand and to ensure efficient use of its remaining production capacity.

At the beginning of the new millennium, UPM's paper business, with headquarters in Helsinki, comprised 21 production sites (paper mills), with varied machine configurations. Each site originally functioned as an independent entity. Seeking a global operating model and sustainable profitability, the company reduced production capacity and attempted to consolidate support functions, such as administration, IT and supply chain. In 2004, a reorganization of the IT function was started. By 2008, supply chain management was a global business function. This, along with newly implemented ERP systems, provided a first operational backbone to support the global sales, marketing and supply chain business functions.

## The Need for a Global Backbone for Manufacturing

UPM leaders identified the need to close the remaining "gap" in the global value chain by extending the first operational backbone to manufacturing—the company's core value-generating process that links upstream supply chain activities with downstream marketing and sales. Thus arose the need to unify UPM's manufacturing executing systems (MESs). An MES forms a layer that sits between the global ERP system and local process control systems at

7 Five of these dimensions are covered by the theory of IT transformation program ambidexterity, as described in Gregory, R. W., Keil, M., Muntermann, J. and Mähring, M. "Paradoxes and the Nature of Ambidexterity in IT Transformation Programs," *Information Systems Research* (26:1), 2015, pp. 57-80. For a description of the supplier relationship dimension, see, for example, Huber, T. L., Fischer, T. A., Dibbern, J. and Hirschheim, R. "A process model of complementarity and substitution of contractual and relational governance in IS outsourcing," *Journal of Management Information Systems* (30:3), December 2013, pp. 81-114.

8 Program management is the coordination of multiple interdependent projects that transform business processes and IT systems with the aim of achieving one common transformation goal. See Fonstad, N. O. and Robertson, D. "Transforming a Company, Project by Project: The IT Engagement Model," *MIS Quarterly Executive* (5:1), March 2006, pp. 1-14.

each production site. They enable high degrees of automation and integration and are critical for UPM's business. Users of an MES have to be very well trained, because a break in production at just one paper mill (caused, for example, by a system failure), could cost the company up to 50,000 Euros ($61,600)[9] per hour.

In 2001, before the initial global MES (GMES) transformation attempt but after various mergers and acquisitions, the company operated more than 10 different MESs, with varying degrees of functionality, at its 21 production sites. These MESs were customized installations from three different vendors. Each mill paid for its MES, which was supported by dedicated local IT personnel. These customized systems were expensive to maintain and support, and incompatible with the vision of a global operating model for the business and IT.

UPM's leadership team hoped that a series of projects to harmonize the MESs would give the company a competitive edge through more centralized production planning, better production capacity utilization, consolidation of software licenses and streamlined upgrade and release management cycles. In short, this initiative aimed to achieve operational excellence in UPM's paper manufacturing business and to establish a platform for further growth.

## The Failed Initial Transformation Attempt

Having identified the need for a global backbone for manufacturing, in 2002, the company launched its initial GMES initiative, under leadership of the IT organization and in close partnership with an international systems supplier. The goal of the program was to implement a single standard MES at all UPM paper mills, starting with rollouts at 16 production sites over a tentative timeframe of three years. The new system was based on mills' presumed requirements and would use advanced manufacturing and automation technologies.

By the end of 2002, a supplier had been selected, and a small IT team was assigned the responsibility to manage the global standard solution, incorporate new development ideas and support the local implementation projects. The plan was for the mills to independently control their local rollout projects and their budgets. However, the first GMES pilot rollout, which started in 2004, encountered many challenges, and by 2008, only four other rollouts had been accomplished. Delays were caused by several challenges with the chosen approach, relating to failures to resolve the tensions described in Figure 1.

First, UPM management had assumed that, once a sufficient number of paper mills had implemented an improved MES solution, it would evolve into a standardized global solution for all mills. However, even though the mills used similar paper production processes, the first rollouts showed that each mill had a tendency to interfere with the global standard development and pursued local ways of working.[10] The mills expressed *very different local business process needs, which conflicted with the intended global standard solution* (Tension 1 in Figure 1). Some mills retained some legacy systems, and eventually all five mills customized their MES to a significant extent, which caused *development and integration efforts* (Tension 2 in Figure 1) that delayed project completion, made application management difficult and undermined the overall business case.

Second, as per Tension 3 in Figure 1, the rollouts had *mixed business and IT ownership*. They were led by global IT but controlled and paid for locally by the mills. As a consequence of not resolving this tension, the initial transformation program generated limited commitment to the goal of implementing harmonized manufacturing processes. For example, one mill ordered an enhancement to the standard system functionality that subsequently proved to be redundant. In practice, the IT team was unable to argue against the mills' alleged business needs, and over time, the team was relegated to an intermediary role of merely

9 Currency conversion rate as of April 2018.

10 The strong desire to adapt systems locally is consistent with change management research that argues for minimizing "misfits" that do not fit local ways of working. See, for example, Markus, M. L. "Technochange management: using IT to drive organizational change," *Journal of Information Technology* (19:1), March 2004, pp. 4-20.

conveying requests from the mills to the systems supplier.[11]

Third, when it became obvious that the mills both controlled their project budgets and *autonomously decided on additional local requirements* (Tension 4 in Figure 1), the systems supplier started to exploit this situation by implementing (and charging for) more enhancements than were initially specified, despite the presumed existence of a global standard. As a striking example, different interfaces to the same global sales and logistics systems were implemented at different sites. In this *misunderstood supplier partnership model* (Tension 5 in Figure 1), code quality and adherence to specifications of the systems supplied to the mills were not always adequate.[12] Some software releases had to go back to the development stage, jeopardizing project schedules. The overall program was forced to provide *flexibility to adjust the schedule* (Tension 6 in Figure 1), and other planned rollouts were postponed.

In 2007, UPM and the supplier agreed on a project to bring all five mills where the MESs had been rolled out to a similar technological level and to correct the software deficiencies. However, after spending millions of Euros and implementing five different versions of a supposedly standardized software product, UPM leaders realized that the locally optimized versions constrained global support and would not help the firm to achieve a global manufacturing capability. Around the same time, new economic drivers, such as the Euro crisis and Russian timber trade restrictions, further challenged UPM's business performance. But these difficult economic factors did have a silver lining because they sharpened UPM leaders' attention on the need to fundamentally redesign the transformation approach.

In 2008, UPM decided to move forward with a new GMES initiative, with a new program organization and different staff. Alternative systems suppliers were evaluated, and external resources were hired to help build stronger capabilities in the new program organization. The new team created a plan to turn around the failed GMES initiative using an *industrialized* transformation approach.

## Applying the Five Industrialized Transformation Principles at UPM

The five key principles of UPM's turnaround strategy are depicted in Figure 2 and described below. Our decision to adopt UPM's label of *industrialized transformation* to collectively describe the five principles is consistent with prior work that advocates the application of industrial principles (e.g., prefabrication, serial production and automation) to IT.[13] When applied to an IT-enabled transformation program, the word "industrialized" implies the reuse of standard concepts, procedures and IT solution templates in each local rollout project; this is a key principle of the industrialized approach. At the time of the turnaround, all key stakeholders at UPM instantly understood the metaphor of industrialized transformation because it clearly resonated with the company's process industry context.

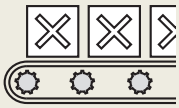
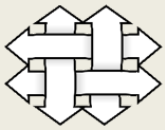
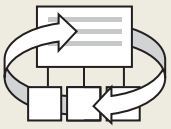
For each of the five principles, we first describe the principle and then characterize it in terms of one of the known tensions in IT-enabled transformation programs (see Figure 1). We then highlight the principle's application in UPM's new GMES program, contrasting the outcome with the earlier failed GMES approach (see Figure 2). We explain how the principle was operationalized during the project (through key mechanisms such as relevant governance bodies, processes, roles and methods). Selected quotes from our interviews highlight how the principle helped UPM overcome challenges at specific times during the transformation program.

11 Mixed IT project ownership at UPM resonates with the much-quoted need to "blend business and IT interests" that has been argued in more recent IT transformation research. See, for example, Gregory, R. W., Keil, M., Muntermann, J. and Mähring, M., op. cit., 2015.

12 UPM's initial partnership understanding of the supplier relationship is in accordance with studies suggesting that such partnership views are associated with successful IT sourcing outcomes. See, for example, Lacity, M. C., Khan, S., Yan, A. and Willcocks, L. P. "A Review of the IT Outsourcing Empirical Literature and Future Research Directions," *Journal of Information Technology* (25:4), December 2010, pp. 395-433.

13 See, for example, Zarnekow, R., Brenner, W. and Pilgram, U. *Integrated Information Management: Applying Successful Industrial Concepts in IT*, Springer, 2006.

**Figure 2: UPM's Five Principles of Industrialized Transformation**

| Dimension | Initial GMES Challenges | Industrialized Principles | Tension Resolution Strategy and Key Mechanisms |
|---|---|---|---|
| ***Business processes*** <br> ***IT architecture*** | Middle way of locally differentiated processes and IT solutions | 1. Template-based  | *Standardize* business processes and concurrently *replace* legacy IT systems: <br>• Upfront investment into capability building <br>• Reusable management concepts <br>• Business process blueprints <br>• Technology solution standard |
| ***Ownership of change*** | Ineffective ownership between global IT and local businesses | 2. Business-driven  | Emphasize *business ownership* over IT ownership: <br>• High profile business sponsor <br>• Major business representation in steering committee <br>• Business process owner network <br>• "Push" instead of "pull" requirements management |
| ***Program governance*** | Highly autonomous projects with limited program-level control | 3. Matrix-organized  | *Combine* program control with autonomy of projects and streams: <br>• Comprehensive program management office (PMO) <br>• Matrix of projects and cross-functional streams <br>• Liaison roles and stakeholder networks <br>• Mutual deliverable quality review process |
| ***Supplier relationship*** | Misunderstood partnership model resulting in extra costs and inferior quality | 4. Tight supplier steering  | *Exercise both* strict contractual and relational governance with the supplier: <br>• Regular and separated supplier steering meetings <br>• Contact points and clear escalation procedures <br>• Zero-tolerance deliverables and milestones <br>• Joint lessons-learned sessions after rollouts |
| ***Program scheduling*** | High project flexibility jeopardizing the overall program timeframe | 5. Cascaded planning  | *Balance* program stability with project and stream flexibility: <br>• Fix schedule for overall milestones <br>• Rolling-wave planning for detailed activities <br>• High level of parallel rollouts within clusters <br>• Local project responsibility with aligned schedules |

## Principle 1: Template-based

Following a template-based approach means that changes in each entity (for UPM, each production site) should follow exactly the same pattern. Templates (or patterns) are needed for the IT solution, the business processes that are transformed, the project management approach and all other activities necessary to make each local rollout project a success. The template-based principle emphasizes reusability of concepts and replicability of work steps at each entity affected by an operational backbone

implementation program. Each type of template has a defined owner within the global program organization, and deviations from a template are allowed only if approved by the template owner.

This principle requires significant upfront investment in time and resources to generate and detail the templates. However, the initial investment should pay off later when rollouts are executed at multiple sites sequentially, almost as if on a conveyor belt. A template-based approach represents an extreme strategy[14] for resolving the first two tensions shown in Figure 1 because it aims to *standardize* business processes globally and concurrently *replace* IT systems across all production sites.

This extreme strategy was necessary at UPM because only through strict business process harmonization and IT standardization could the company build a backbone that would enable it to further exploit its scale. Compared to the earlier GMES program, however, operationalizing the template-based principle required a huge shift in thinking, Instead of starting with a vendor solution as a global standard and continuously "drifting" by making more and more local enhancements, this principle demanded an upfront investment in specifying a company-wide template for each target business process and sub-process (business blueprint) and only then building a technical solution (solution template). The principle also ensured that local rollouts would proceed in a highly replicable manner, with similar timelines, work packages, roles and responsibilities. This had not been the case in the earlier failed GMES attempt.

The new GMES program was designed to run through four major stages: ramp-up, pilot, rollouts and program ramp-down (see Figure 3). One full year was dedicated to the ramp-up stage, during which the program organization built the required capabilities and developed the necessary templates. At first, the new program personnel were concerned about the high demands of program planning and the volume of work that lay ahead—there would be rollouts at 15 production sites. The template-based principle was crucial for managing program members' concerns and getting the program up to speed. A program member who joined toward the end of the ramp-up stage recalled:

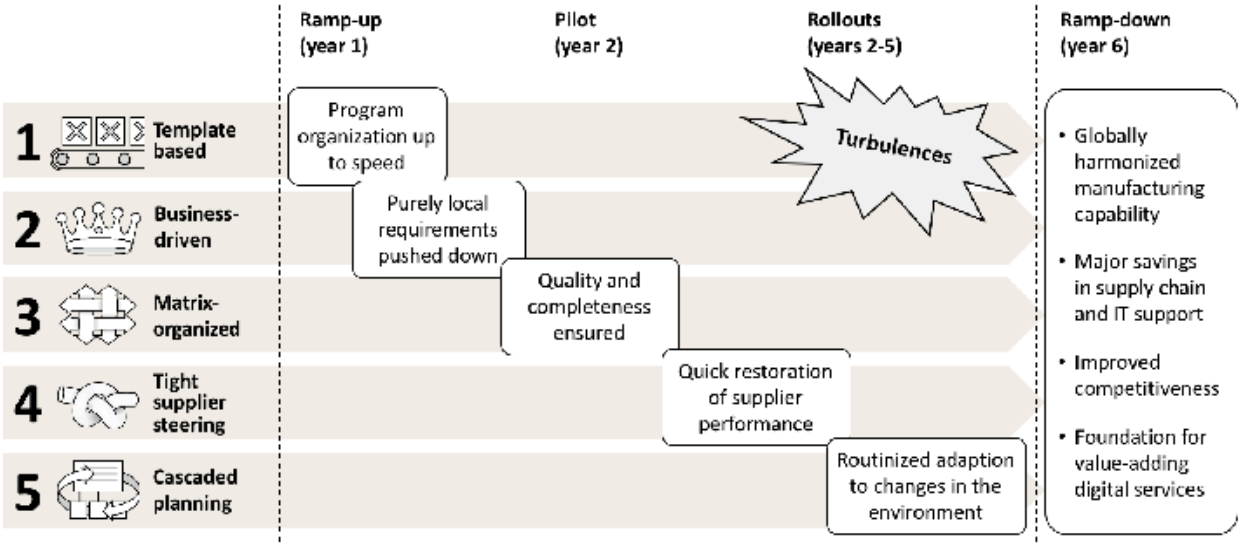
> *"I did not feel any concerns among the team. It was already like a well-oiled machine when I joined."*

## Principle 2: Business-driven

A business-driven operational backbone implementation ensures business ownership of decisions, across all levels of the program. A high-profile business executive serves as sponsor, to ensure top management backing for tough decisions. Leaders from all affected business

14 We use the term "extreme strategy" to indicate the need to choose one or the other of the extremes of the first three tensions shown in Figure 1.

**Figure 3: UPM's GMES Timeline and Benefits of the Five Principles**



areas are also appointed to a steering committee, together with key IT leaders such as the CIO. Moreover, a business process owner network needs to be established at the program level. This requires the appointment of a chief business process owner who can rely on the specialized expertise of multiple process and sub-process owners distributed across the organization. Again, this principle is an extreme strategy for resolving Tension 3 in Figure 1 because it *emphasizes business over IT ownership.*

At UPM, this "push" principle—driving change through global business leaders—was diametrically opposed to the "pull" approach of the earlier failed GMES program. The plan to transform UPM's core operations required clear ownership by global, not local, business stakeholders. All stakeholders needed to understand that the GMES was not merely a systems implementation project initiated by IT; it was a corporate-wide effort to accomplish a seamless operational backbone. Stakeholders also needed to understand that this global approach might be viewed critically on some dimensions by local mill managers and employees.

UPM appointed a high-profile divisional president as the program sponsor and chair of the program steering committee, which included senior leaders from manufacturing, mill representatives, supply chain, corporate controller's office and IT. While the initial GMES program had been run by the IT organization, the director of the new program reported directly to the chair of the steering committee. In addition, a global business process owner (BPO) with broad experience in paper manufacturing was appointed as head of the business processes project. The global BPO's first task was to establish a network of process owners with specific expertise for all manufacturing sub-processes (mill order handling, production planning, raw materials, etc.).

During the ramp-up stage, the business processes project had to start just about from scratch, under great time pressure. A functional business blueprint needed to be created, based on analyses of five representative mills' business processes. Here, and later in the program, the business-driven principle was necessary to minimize numerous requests from mills for local requirements. Such requests were only accepted if they were deemed also to provide value at other sites. Even some enhancements that were implemented at one or more of the four existing GMES mills had to be dismantled. The global BPO recalled:

> *"If I think about our steering committee, it was a clear enabler. We didn't have any difficulties in the business processes team, because we had a clear mandate. For example, [one mill] had a huge amount of production recalls, which we were not able to deliver in GMES. Then, the message was clearly given to them: that's the new way of working, and this was also understood in the field."*

Although the one-year ramp-up stage involved a long and laborious planning exercise, the template-based and business-driven principles helped the program team to build necessary capabilities and paved the way for the forthcoming rollouts. A mill representative on the GMES steering committee commented:

> *"I was positively impressed by the rollout concepts. For the first time, it seems that technical engineering-like planning was applied and will be followed like initially planned."*

## Principle 3: Matrix-organized

A matrix organization structure is supposed to stimulate collaboration and avoid silos by managing individuals through more than one reporting line.[15] In the context of building an operational backbone and a business transformation program, "matrix" refers to a program organization where cross-collaboration between different projects and work streams is facilitated and gaps of responsibility are avoided through "close-meshed" responsibilities. The larger the program, the higher the uncertainty is about dependencies between different program activities. A matrix program organization ensures completeness by locating key responsibilities at the "intersection" of two roles. For example, rollouts may run as autonomous projects but also

15 See Galbraith, J. "Matrix Organization Designs: How to Combine Functional and Project Forms," *Business Horizons* (14:1), February 1971, pp. 29-40.

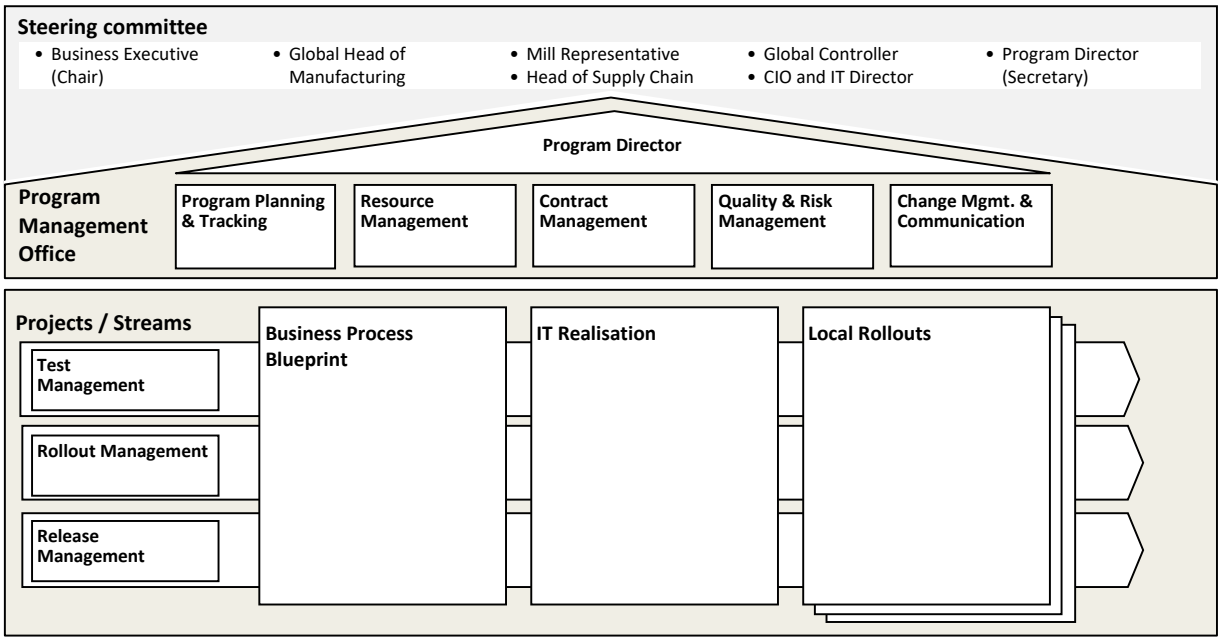
compete for global resources. In this situation, a cross-project rollout manager can work closely with different local project managers, yet also coordinate across the projects, to help align overall resource constraints and schedules. Thus, a matrix program organizational structure helps to balance the program governance tension at the project level between overall *program control* and *autonomous task execution* (Tension 4 in Figure 1).

As shown in Figure 4, the organization structure of UPM's new GMES program employed the metaphor of a house. The matrix structure embedded in this house was fundamentally different from how the earlier GMES initiative had been organized in terms of the degree to which roles and responsibilities were specified and interlinked.

In addition to a dedicated program management office (PMO), the program organization recognized three types of projects: business process blueprint, IT realization and local rollouts. To build the matrix, three cross-functional streams spanned the three types of projects: test management (which coordinated all user test activities), rollout management (which coordinated rollout schedules) and release management (which coordinated ongoing upgrades). The PMO monitored the progress of all projects and streams, tracked the financials, managed the main supplier linkages, and facilitated the quality and risk management processes. In addition to control through the PMO, as part of the quality process, all deliverables and documentation were reviewed by at least one peer in the matrix, to ensure the quality of work products and close alignment between different projects and work streams. These lateral control mechanisms helped to counteract a tendency toward project autonomy, as was experienced in the earlier failed GMES attempt.

The matrix principle proved to be a great enabler during the pilot stage (and also in later stages) by ensuring the coherence of the manifold activities. To test the industrialized transformation concepts, the program steering committee chose a small mill with low business complexity as a pilot site. The template approach had identified more than 150 different tasks and activities that had to be coordinated for each rollout (including mill information sessions, local kick-offs, pre-configuration, user training, local interfaces development, data migration, technical testing, user acceptance testing, go-live, test run, site acceptance, handover to IT, rollout review, etc.). In planning and preparing for these many activities, the matrix organization and quality

**Figure 4: Matrix-organized Program Organization at UPM**



processes ensured that the activities meshed with each other, resource interdependencies were resolved and no work step was forgotten. For example, the global test manager had to urge IT project personnel to provide quality metrics for technical testing, to determine if and under which conditions the site acceptance tests could proceed. The test manager recalled:

> *"It was a kind of quality assurance to check the deliverables from the other streams. The test entry criteria were a good example. At the pilot mill, we had to check that all the deliverables of the IT and business streams were completed. And after a few rollouts, that became sort of an automatic task."*

In fall 2009, the pilot project went live smoothly and as planned. The global quality and risk team interviewed users and mill managers, and the program team made immediate proposals to further improve and fine-tune the program templates. The pilot mill's general manager commented after the pilot:

> *"We have good feedback on GMES. The project has been well explained from the very beginning. GMES program experiences need to be spread to other UPM projects as well."*

## Principle 4: Tight Supplier Steering

This principle emphasizes strict supplier control, defined procedures, close working relationships and mutual understanding, through both contractual and relational governance means. Tight supplier steering means specifying clear contractual obligations and providing powerful incentives for supplier performance. Over the duration of the program, tight steering is implemented via a separate governance body for all supplier-related issues (instead of having a supplier participate in the program's main meetings). On the relational governance side, contact persons should be specified for all activities that require supplier involvement and clear procedures established for escalating and articulating lessons learned. If the supplier should underperform, these procedures help to facilitate communication and understanding of the goals set for the supplier, and provide clearly specified actions for dealing with issues. The tight supplier steering principle therefore helps to resolve Tension 5 shown in Figure 1 because it *blends contractual and relational supplier governance mechanisms*.

At UPM, the tight supplier steering principle meant, first and foremost, that the relationship with the selected GMES vendor would be structured as a tightly governed client/supplier relationship (in contrast to the misunderstood partnership model of the earlier GMES program). After considering alternative suppliers, the prior systems provider was given a second chance and re-appointed, but under much stricter conditions: this supplier would have to prove its capabilities to deliver on time and with good quality in clearly defined milestones under a zero-tolerance policy. A separate supplier steering committee, chaired by the program director, was established to control delivery and serve as a central point for escalating any supplier issues. In addition to penalties based on quality metrics, UPM clearly communicated and contractually defined that any violation of defined "zero-tolerance" milestones would lead to the contract being discontinued and the appointment of a new supplier. After each rollout, the supplier was included in joint lessons-learned sessions, whose purpose was to analyze potential issues and identify potential improvements in the supplier relationship.

The supplier relationship became heavily stressed during the GMES program rollout stage. Rollouts took place in five clusters, with each cluster involving three to five parallel rollouts in a timeframe of less than a year. The first cluster included less complex production sites, and the final cluster included the more complex specialty paper mills (those with a separate sheeting section for paper cutting). These parallel rollout activities put the supplier under great pressure. More than once, approval of a go-live delivery was jeopardized because there were too many severe software and integration issues during operational test runs. The former program manager for the supplier explained:

> *"The workload at first was huge, and that caused some resource limitation and ... challenges for us to start those projects and of course, when we work simultaneously we cannot [ensure] that everything and*

*every rollout is fully made in the same way. We had to onboard new people … who at first did not really understand the … industrialized concept."*

The tight supplier steering principle, with its joint problem-solving processes, proved invaluable in this type of situation. Delivery-related issues were escalated and addressed behind the closed doors of the supplier steering meeting, where it was re-emphasized that there was zero contractual tolerance for delays on major milestones. If the vendor failed to deliver on agreed quality metrics, continuation of the vendor relationship and extension of the contract for the next rollout cluster were at stake. Eventually, the vendor relationship stabilized and the quality of program deliverables, both by UPM and the supplier, were perceived by the mill managers to be good or excellent. The supplier program manager commented:

*"It took a little bit time, [and a] few rollouts, until we got it working on [the supplier] side. It was something that you have to learn—to get from the old habits to the new ones—but the message [from] UPM was very clear."*

## Principle 5: Cascaded Planning

The cascaded planning principle implies a program scheduling and tracking methodology that demands strict overall schedule adherence at the program level, while allowing some freedom in the detailed planning. The aim of this principle is to reduce program management complexity and increase the activities that can be conducted in parallel. Operational backbone implementation and transformation programs—while pursuing clearly defined strategic goals—are unique efforts that typically deal with a high degree of uncertainty at multiple stages.

Cascaded planning requires scheduling at different levels of a program (e.g., steering level, program level, project/stream level). While overall milestones are set at the steering level, detailed schedules can be updated by project and stream managers and fed into the master plan in rolling-wave planning cycles. Thus, cascaded planning helps to resolve Tension 6 in Figure 1 (program scheduling) by *balancing schedule stability at the program level with flexibility* at the project and stream level.

The cascaded planning principle was new to UPM (the earlier GMES attempt had been run as five unrelated and partly parallel projects with loosely agreed endpoints). For the first time, an integrated, detailed master program plan was created. Consolidating the first detailed project and stream plans into the master plan was a major effort for those who were used to mill managers or the supplier dictating schedules. However, with each quarterly update of the master plan, the iterative scheduling process became more routine, as did the weekly progress reporting based on the master plan. Progress at the steering committee level was reported against major program milestones, including the zero-tolerance supplier milestones.

Although the cascaded planning principle was fundamental throughout the entire program, it proved to be particularly valuable at the later stages, when the program faced some organizational turbulence (as shown in Figure 3). In year four of the program, UPM acquired a medium-sized competitor with six production sites. Two of these acquired paper mills were subsequently dismantled, but the program scope was increased and the schedule extended to include four new rollouts in an additional cluster. The cascaded planning technique facilitated this and other schedule changes. The integrated master plan provided the program management team with the transparency needed to make informed schedule decisions, while the complexity of each re-planning effort was reduced by delegating to different program team members. Schedule changes were already part of rolling-wave program procedures (i.e., something program personnel had routinized). Thus, once scope decisions were made at the steering committee level, the program benefitted from the template-based approach and was able to proceed with the industrialized rollout procedures as planned. The supplier's key account manager explained:

*"When you run a program like this … you normally can't just make changes to the organizational scope. But, this was done within the GMES program. [We coped with] mills coming in and going out from the*

*scope, and it happened actually quite fast, because it was very well planned. So if you have a very strong methodology, you can do it; otherwise, I would say that this would not have been possible."*

## Industrialized Transformation Outcomes at UPM

The evaluation of the new GMES rollouts triggered an overall program review, which concluded that the program had performed superbly on all program management parameters: the program finished on time, on budget and with the expected quality and scope. The successful closure of the program meant that UPM was able to realize all the targeted business benefits. Global business process harmonization enabled UPM to establish a multi-mill production environment and thus centralize production planning to a few global supply chain centers. In turn, this enabled better decision making and allowed UPM to manage supply chain operations globally. The GMES rollouts accomplished the coordinated replacement of legacy systems at all sites, which improved application management, reduced overall license and maintenance fees, enabled standard application support processes and simplified version and release management. The program also enabled the group IT function to reorganize manufacturing IT systems services and support. Overall, UPM achieved the planned annual operational savings of several million Euros in IT expenses, while enabling a globally harmonized planning capability and operational excellence in manufacturing. The global business process owner commented:

*"Perhaps the biggest benefit is really production planning and what has happened in supply chain; that was possible only because of GMES. At the moment, more or less all production and supply chain activities are concentrated [at two specific locations]. That has been the biggest single business advantage provided by GMES."*

The industrialized transformation approach used for the new GMES program helped UPM execute business change at 22 production sites (this number includes old mills with heterogeneous legacy systems, and newly acquired mills) in a centrally coordinated, highly standardized and replicable effort. This approach not only reduced project interdependencies, but also allowed the transformation to be completed in a cost-efficient way. Before the new GMES program was concluded, UPM leaders made an important decision: thereafter, the industrialized methodology was deemed a "best practice" for other change initiatives within the business. The chair of the steering committee praised the program:

*"The program team managed to contribute relevant best practices and ensured effective implementation in practice. Noticeable was the highly competent expertise, the pragmatic and solution-oriented way of working, and the collaborative and professional behavior toward customers on all levels, combining firmness and modesty."*

The GMES capabilities have enabled UPM to further increase the scale of its business operations and also laid a foundation for developing new digital services in the coming years. After completing the work on the operational backbone, UPM's management was able to focus on IT investments to support more innovative projects related to customer engagement. For example, the GMES enables the sharing of real-time delivery plan information with customers, the preparation of business analytics on quality and production data, and the deployment of next-generation multi-mill operations.

## Lessons for Industrialized Transformation Leaders

The success of UPM's GMES program suggests that the five industrialized transformation principles can be effective for other companies seeking to build, expand or perfect their operational backbones. In light of the common tensions that need to be resolved in IT-enabled business transformation programs (see Figure 1), we characterized the first two principles (template-based and business-driven) as *radical* change strategies and the other three (matrix-organized, tight supplier steering and cascaded

planning) as *balanced* approaches for program execution.

The UPM case shows that, to succeed with operational backbone implementations, transformation leaders need to perform two roles. First, at the strategic level, leaders need to push toward the extremes of process standardization and coordinated IT replacement by following a business-driven approach. Second, at the program execution level, leaders need to reconcile tensions inherent in program governance, supplier relationships and program scheduling. The three balanced execution principles help them to identify risks early on and deal with them in a routinized fashion, while at the same time not overstretching the complexity of program control by allowing for some freedom at the project and stream levels.

Although the five industrialized transformation principles can deliver value for any globally operating company that seeks to ready its operational backbone for the digital age, we recognize that these principles cannot be applied in a recipe-like fashion. First and foremost, leaders need to make informed decisions about positioning their transformation programs vis-à-vis each of the six tensions shown in Figure 1. As illustrated by the UPM case, this task requires discretion, consultation and judgement. Once the direction is set, organizations also need to complement their tension-resolution strategies with adequate leadership.[16]

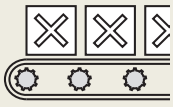
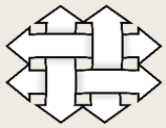
UPM's program managers learned that pushing to the extremes of each tension, or balancing the extremes, can be extremely demanding. From UPM's experience, we have identified five lessons that will be valuable to leaders of industrialized transformation in other organizations. These lessons are summarized in Figure 5 and described below.

## Lesson 1. Employ a Template-based Approach to Get the Program Up and Running

Globally operating companies that aim to build a value-adding operational backbone should apply a consistent, template-based, replicable approach to planning and implementation.

16 See Nelson, R. R. "IT Project Management: Infamous Failures, Classic Mistakes, and Best Practices," *MIS Quarterly Executive* (6:2), June 2007, pp. 67-78. This article shows that program management mechanisms and leadership approaches are complementary, and concludes that "project managers should be, first and foremost, experts in managing processes *and* people" (emphasis added).

**Figure 5: Five Industrialized Transformation Leadership Lessons**

| Positioning | Principle | | Leadership Lessons |
|---|---|---|---|
| ***Radical*** **Transformation Strategy** | 1. Template-based |  | Employ a template-based approach to get the program up and running |
| | 2. Business-driven |  | Engage the best business process experts to lead the transformation |
| ***Balanced*** **Program Execution** | 3. Matrix-organized |  | Empower roles and align responsibilities in the program organization |
| | 4. Tight supplier steering |  | Enable suppliers to adopt the industrialized transformation mindset |
| | 5. Cascaded planning |  | Establish program management practices that make risks transparent |

"Template" should not be understood narrowly as merely a standard technology solution. Rather, templates can also be used to describe bundles of to-be business processes and program management mechanisms that aim to ensure a replicable and consistent implementation approach. Thus, transformation program leaders need to allocate sufficient time and resources for developing the necessary templates and building the required program capabilities during the first stage of a program.

As well as providing business harmonization, the UPM case reveals that a template-based approach has two further advantages. First, templates help team members deal with uncertainty in the program and associated roles and responsibilities. Second, templates address the concerns of business stakeholders at all levels, by creating trust in the working principle of consistency (inherent in a template-based approach). UPM's program director recalled, for example, how a local manager of a recently completed rollout explained a forthcoming rollout to a newly appointed local rollout manager:

> *"You don't need to worry, they know what they do. They follow a template, and they will tell you what you have to do, without you even having to ask what you have to do."*

During the early stages of a transformation program, when there is still a high degree of uncertainty, program leaders therefore need to strengthen their teams' prescriptive planning capability and also ensure that the core principle of template-based reuse is at the forefront of all stakeholders' minds. As implementation gets under way, leaders can refer back to templates to address stakeholder concerns. At later stages, it is of paramount importance to monitor whether the templates are being used as planned; conformance to templates should guarantee that the expected results are achieved.

## Lesson 2. Engage the Best Business Process Experts to Lead the Transformation

Transformation leaders should be bold enough to request the best functional experts the organization has available to drive business process change. Although many of the necessary capabilities can be gained through training or acquired externally, business processes are typically the most organization-centric part of a transformation program. However, experts typically play crucial roles in their business line functions. Transformation leaders first need to use their internal networks to identify the best experts. They then need to convince these people that assignment to the transformation program is in their, and the organization's, best interest, and get top management buy-in for the assignments. They may also need to explain to top management the ramifications of not assigning these key individuals to the program (as happened at UPM).

In choosing the lead business process owner for its transformation program, UPM's program director was able to engage a strong manager who had excellent prior work experience in various stages of the manufacturing process. This manager was supported by a team of sub-process owners, whose presence in program meetings, communication skills and process expertise were crucial for driving the change and overcoming local resistance to the new ways of working. The lead business process owner concluded:

> *"The most important thing in the GMES program was that we defined the blueprint. We defined processes, and we defined features that we have in the system. Even if we had a lot of changes from the mills, there was always a good amount of discussion on whether these were really beneficial for the other mills. But we were able to reduce the amount of local features; that's the most important thing we did in GMES. We had an industrialized approach, and we followed that strictly."*

## Lesson 3. Empower Roles and Align Responsibilities in the Program Organization

Transformation leaders should set an organizing principle for their programs that balances program control with project-level autonomy. It is particularly crucial for this organizing principle to empower the project and stream managers, because this frees up transformation leaders to focus on long-term strategic issues and allows them to effectively delegate implementation-related decisions.

Leaders also need to ensure that this organizing principle enables those who lead projects and streams to regularly align their responsibilities with each other, as role conflicts can (and most likely will) occur.

A matrix program organization structure helped UPM to achieve this goal by enabling projects and streams to cross-coordinate. In turn, this structure took some of the oversight burden off the program leader's shoulders. A local rollout manager at UPM pointed out:

> *"It is challenging for some project members who have not worked in a matrix before, but it's really needed to manage the complexity in such a huge program."*

Although the matrix model is clearly different from classic program/project/sub-project hierarchies, it provides a structure that empowers people and enables their continuous alignment in a transformation program. Although there is no one-size-fits-all approach to program organization, communicating roles and responsibilities is a key prerequisite for any transformation program. As illustrated in Figure 4, a clear structure can provide orientation for new and existing program staff, and also help communicate the program structure to the other stakeholders.

## Lesson 4. Enable Suppliers to Adopt the Industrialized Transformation Mindset

Transformation leaders should ensure that suppliers understand and are committed to the industrialized transformation priorities, at any time. Systems suppliers typically try to fulfill any wishes their customers may have (for a fee), regardless of whether these wishes are in the scope of the program. As UPM's earlier failed GMES attempt showed, "partnership thinking" does not always lead to success. To succeed in an industrialized transformation, leaders need to tightly steer the systems supplier, but also complement this steering by "softer" approaches of communicating program priorities and principles. It is necessary, but not sufficient, to link defined milestones to contractual incentives. A large-scale transformation may also require a cultural shift on the supplier side, as the following quote from a program manager at UPM's supplier illustrates:

> *"The traditional attitude is ... flexibility ... we try to do whatever the customer wants, and this kind of thinking ... the industrialized concept ... requires that we try to be as close as possible to the template processes, and that was something we were not familiar with."*

To assist the supplier in managing this cultural shift and in adopting an industrialized mindset, transformation leaders and everyone else involved in the supplier relationship need to inform suppliers about current priorities at given moments. Therefore, tight supplier steering can be extremely demanding, but it is necessary to retain the supplier's attention over the entire program.

## Lesson 5. Establish Program Management Practices that Make Risks Transparent

Cascaded planning techniques provide both overall schedule stability and project level flexibility, particularly when complemented by practices that reveal program risks and their ramifications. Transformation program leaders, and project and stream managers, must remain alert to potential risks and communicate these as part of rolling-wave planning. Identified risks need to be assessed, monitored and aggregated if necessary. Program leaders should then take those risks that are deemed highly likely and potentially severe to the steering committee so that risk mitigation actions can be agreed upon. Scenario planning is an effective tool for supporting risk assessment and mitigation at this level of the organization.

Once a transformation program is moving forward like a well-oiled machine, senior business executives may overlook risks or be blind to potential dangers. When UPM's transformation program faced turbulence caused by the acquisition of four additional production sites, the steering board was not fully aware of the schedule ramifications for GMES. Program leaders were able to explain these risks and discuss various scenarios based on the available information.

A strong methodology for planning, scheduling and risk management gives transformation program leaders a tool to make the ramifications of decisions taken outside the scope of a program visible at the steering committee level. This is why a strong methodology is a must-have on any transformation program.

## Concluding Comments

Although globally operating companies in traditional industries are moving into the digital era, many still lack the necessary operational backbone that could support scalable business growth and digital innovation. To succeed in large-scale operational backbone implementation programs, leaders need to recognize and resolve various tensions at the strategic and program execution levels. UPM's experience shows that effective program leaders play two roles: they push the organization to extremes to seek business-driven process change, while also employing balanced execution mechanisms to implement changes and cope with uncertainties throughout the program.

UPM called their approach an *industrialized* transformation—a specific archetype of IT-enabled transformation. We have described this approach in this article, together with the five principles that underpin it. Although leaders in other organizations will have to devise their own strategies for resolving the tensions, UPM's ultimate success with the industrialized approach is testimony to the effectiveness of the five principles.

The UPM case also demonstrates how an industrialized program for building an operational backbone can be implemented. UPM made use of mechanisms (such as appropriate governance bodies, coordination processes, lateral roles and planning methodologies, as summarized earlier in Figure 2) to help balance the various tensions. Findings from the UPM case also illustrate how transformation leaders at other organizations can complement the five principles with leadership approaches that help make change happen and stay on track, even in turbulent times.

Having built a best-in-class operational backbone, UPM is now looking to develop new value-adding digital services. It also continues to use the industrialized methodology for similar backbone projects in other business areas. The supplier, which initially experienced great pressures to deliver, now refers to UPM's transformation program as one of its prime customer references.

UPM's market environment and internal capabilities are similar to many other globally operating firms in manufacturing and other mature industries. Given this, we are confident that the industrialized approach to building an operational backbone can be a cost-effective way of delivering large-scale IT-enabled business change, in a coordinated, disciplined and replicable effort.

## Appendix: Research Method

The multi-year case study insights in this article were collected in several stages, based on inside and outside modes of inquiry.[17] The five industrialized transformation principles described in this article, together with their application at UPM, are the result of multiple years of action research[18] at UPM. Rather than being dispassionate observers, action researchers are involved in collaborative analysis of a specific situation (specifically, the failure of UPM's initial GMES attempt) and in collaborative change actions (specifically, the industrialized transformation approach).[19] Between 2008 and 2009, the first author (the "researcher") supported the ramp-up phase of the successful GMES program in an external role. The second author (the "practitioner") was program director of the successful GMES program over its entire duration, from 2008 to 2014.

17 Inside inquiry refers to situations where the researcher is immersed as an organizational actor, while outside inquiry refers to the researcher being a detached observer. For more information, see Evered, R. and Louis, M. R. "Alternative Perspectives in the Organizational Sciences: 'Inquiry from the Inside' and 'Inquiry from the Outside,'" *Academy of Management Review* (6:3), July 1981, pp. 385-395.

18 Action research emphasizes the intervention of researchers and the use of cyclic joint reflections with the goal of addressing a specific practical problem through creating organizational change. For more information, see Baskerville, R. and Myers, M. D. "Special Issue: Action Research in Information Systems," *MIS Quarterly* (28:3), 2004, Foreword, pp. 329-335.

19 The action research process can be divided into two stages: the diagnostic stage, which involves collaborative analysis, and the therapeutic stage, which involves collaborative change. For more information, see Blum, F. H. "Action Research--A Scientific Approach?," *Philosophy of Science* (22:1), January 1955. pp. 1-7.

Collaboration between researchers and practitioners is essential in action research because the practical outcome (truth) is the result of interactions between reflective individuals who provoke reactions in each other and in other involved stakeholders. After the failure of UPM's earlier GMES initiative, the authors were part of the core team that developed the ideas for the industrialized transformation approach described in this article. Over the duration of UPM's successful multi-year transformation program, the authors documented changes in the industrialized approach and maintained a constant dialogue on its application and on their observations and interpretations of events.

After the successful completion of the new GMES program, the authors engaged in additional cycles of reflection, to share their experiences and develop generalized learnings. They drew on their personal recollections as well as information contained in various internal documents (e.g., steering committee meeting minutes, rollout reviews) to write up a detailed case narrative that covered all stages of the transformation program. In the process of compiling this initial narrative, the authors began to formulate the key principles underpinning the industrialized transformation approach, which resulted in a preliminary version of the five principles described in this article.

Because action research is an iterative process in which preliminary outcomes are refined over several cycles of inquiry,[20] the authors complemented their perspectives with those of other collaborators. Eight semi-structured interviews were conducted with key players in the successful GMES program. Six were UPM employees (three in the business, three in IT) and two were from the supplier. The table below lists the interviewees and their roles.

We first asked the interviewees for feedback on the draft narrative. Next, using an interview guide built around our initial observations, we conducted a series of semi-structured interviews to further explore the four main stages of the transformation program and the five industrialized transformation principles. Each interview lasted between 30 and 60 minutes and focused on the topics the interviewee was most knowledgeable about. The interviews were conducted by both authors and recorded.

The interviews were transcribed and then coded by both authors, who embarked on another cycle of reflection. We first identified comments that supported, complemented or corrected the initial views in our case narrative. The analyzed data was then discussed by the two authors, and the narrative and five principles were adjusted to reflect learnings from these multiple perspectives. At this stage, the five principles were also complemented with specific leadership lessons, with the aim of developing our UPM-

20 Davison, R. M., Martinsons, M. G. and Kock, N. "Principles of Canonical Action Research," *Information Systems Journal* (14:1), January 2004, pp. 65-86.

**UPM Interviewees**

| Affiliation and Role | Involvement in GMES Program (Including Timeframe) |
|---|---|
| UPM Global Business Process Owner | Project lead for business process blueprint (2008-2010) |
| UPM Global Solution Owner | Process owner production planning, business blueprint project (2009-2014) |
| UPM Mill Production Manager | Process owner manufacturing, business blueprint project (2011-2014) |
| UPM Global Solution Owner | GMES test manager (2009-2011), rollout manager (2011-2013) |
| UPM Mill Processes and Systems Manager | Local rollout manager in a cluster 4 mill (2010-2014) |
| UPM Head of Business/IT Services | GMES steering committee and external program management (2008-2014) |
| Supplier Service Delivery Manager | Supplier's program manager for the GMES program (2008-2014) |
| Supplier Key Account Manager | Supplier's key account manager for UPM during and beyond the GMES program |

specific insights into generalized concepts for a broader class of problems (namely, resolving the tensions in IT-enabled transformation programs).[21] The case narrative provided the basis for the description in this article of the five principles and their application at UPM.

Overall, the research presented in this article fulfills the four pragmatist premises of action research:[22] First, it established the purpose of action—to turn around a specific operational backbone implementation program that had been challenged on time, cost and quality. Second, practical action was situated in the specific problem setting at UPM, including the systems supplier. Third, this practical action informed theory on the tensions in IT-enabled transformation programs shown in Figure 1. The UPM case shows why and how operational backbone implementation programs may need to push toward the extremes at the strategic level while balancing the tensions at the execution level. Lastly, our reasoning and action is socially situated because we acted and interacted as participants and observers within a team of collaborators, both during the initiative and while preparing this article.

## About the Authors

**Till J. Winkler**
Till J. Winkler (winkler@cbs.dk) is Associate Professor of Information Technology Management and Digitalization in the Department of Digitalization at Copenhagen Business School, Denmark. Prior to obtaining a Ph.D. in Information Systems from Humboldt University of Berlin, Germany, he worked as a management consultant at Capgemini's CIO Advisory Services unit. His research on IT governance, cloud computing and digital health has appeared in journals including *MIS Quarterly Executive*, *Journal of Management Information Systems*, *Health Policy and Technology* and *Journal of Theoretical and Applied Electronic Commerce Research*. He serves on the editorial boards of several business and information systems journals.

**Petteri Kettunen**
Petteri Kettunen (petteri.kettunen@upm.com) is UPM's Vice President, Business IT Services for Papers and Specialty Papers. He has long-standing experience from working in various IT management positions. In 2010, he was awarded a Ph.D. in computer science from the University of Tampere, Finland. From 2008, he was Transformation Program Director in UPM's paper production organization until the completion of the program in 2014. Since 2017, he has been a member of the UPM IT management team responsible for business IT service delivery for multiple business areas.

21 Generalizing to a class of problems is a characteristic of prescription-driven management research. For more information, see van Aken, J. E. "Management Research Based on the Paradigm of the Design Sciences: The Quest for Field-Tested and Grounded Technological Rules," *Journal of Management Studies* (41:2), February 2001, pp. 219-246.

22 op. cit., Baskerville, R. and Myers, M. D., 2004.