

# Management and Leadership of Complex Collaborative Digitalization<sup>1</sup> Projects and Programs<sup>2</sup>

**Prof. Dr. Brane Semolic (Slovenia)**  
and  
**Prof. Dr. Pieter Steyn (South Africa)**

LENS Living Lab & Cranefield College

## **Abstract**

*Industry 4.0 and the digitalization of business and society remain a main challenge of modern times. New and advanced key technologies enable the introduction of entirely new business models that provide opportunities for better meeting the needs of users, entrepreneurs, investors, business partners, and society. The complexity of emerging business cases requires collaborative partnering by all relevant value chain stakeholders operating in the business ecosystem. The related research, development, and transformation initiatives are done through research innovation and development (RID) projects and programs. There is an urgent need for collaborative RID projects co-organized and performed by teams of value chain business partners. These complex collaborative projects need a holistic approach, organizational synergy, and outstanding leadership to be successful.*

*Key words: Industry 4.0, complexity, digitalization, collaborative projects and programs, transformation, organizational behaviour, management, leadership.*

## **1. Introduction**

Mataitsane (2019: Online), refers to the problem where digital transformation is not simply the implementation of ad hoc projects or switching to new technologies such as artificial intelligence (AI), but rather it is an organisation-wide transformation effort to change the business into an agile, data-driven, responsive organization for the clients. Importantly, he points out that bureaucratic silos and a belief that transformation is someone else's problem are key inhibitors to achieving digitally mature organisations. Figure 1 illustrates the five stages for successful digital transformation an organization should follow for digital transformation to become its living DNA (Saldanha, 2019: Online).

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<sup>1</sup> Digitalization – is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business (Gartner Glossary, 2023)

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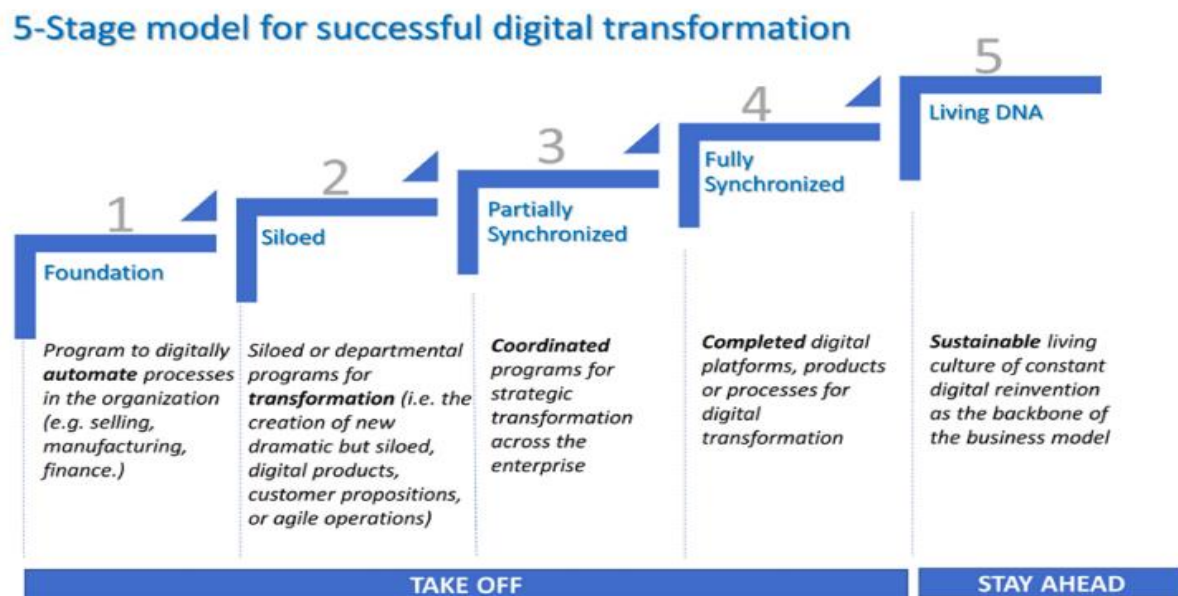


Figure 1: Five stage model for successful digital transformation  
(Source: Saldanha, T. 2019: Online)

Akamai (2019: Online) avers that to achieve digital maturity the organization's operations should be shaped around the correct digital tools. A drive to focus on customer experience delivers the demand for agility and access. The push toward digital maturity can no longer wait if organizations wish to remain sustainable in future. Steyn and Semolic (2018:8), citing Kane (1989), define digital maturity as converting the organization to compete effectively in the increasing digital ecosystem. Maturity exceeds simply implementing new technology by aligning strategy, workforce, culture, technology, and structure with the expectations of the customer, employees, and partners. Digital maturity can thus be seen as an ongoing process of adapting to a changing landscape.

Organizations require an effective digital transformation strategy to remain relevant. Benefits of digital transformation include an improved customer experience, higher productivity, faster time to market for products, brand recognition, higher profitability, and an overall responsive and agile team. Digital transformation in complex collaborative RID project work is critical for increasing the speed of transactions, saving time, and ensuring customer convenience whilst maintaining a higher level of financial security. Moreover, key enabling technologies assist with real-time tracking of transactions and performance monitoring.

At the time of the C19 pandemic breakout, organizations globally found themselves at some level of Industry 4.0 adoption. The following levels can describe digital transformation:

- **Innovation:** the process of creating value by doing the same things better.
- **Digitisation:** converting analogue information into digital formats or platforms.

- **Digitalisation:** use of digital technologies to change a business model and provide new revenue and opportunities.
- **Digital transformation:** Strategically planned change to the organization to stay relevant in a competitive marketplace by leveraging technology.

The path of digital transformation for an organization is illustrated by Jisc (2020: Online) in Figure 2 as follows:

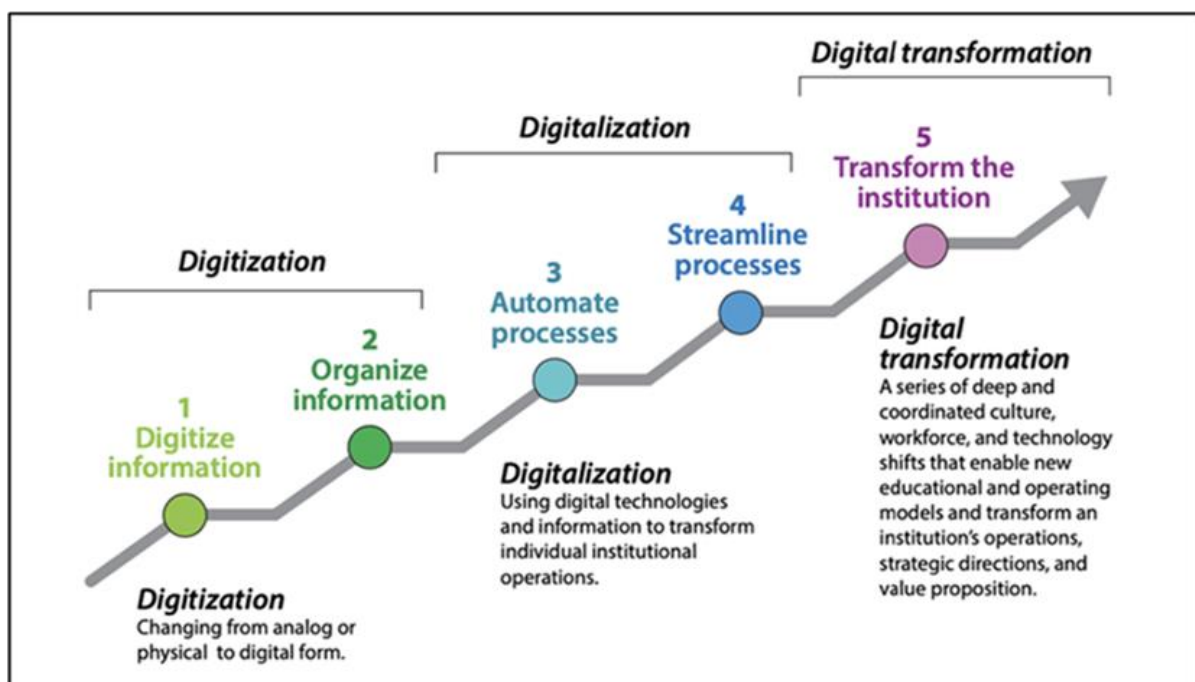


Figure 2: The three Ds of digital transformation (Source: Jisc, 2020)

To exploit innovative technologies for the benefit of all stakeholders requires a profound understanding of how these novelties will affect personal and business lives, organizations in developed and less-developed countries, and how they will reshape organizational landscapes, and societies and culture. It is vitally important to gain a holistic understanding of the risks involved and to plan appropriate solutions for the timely mitigation of the risk and associated complexity. This has hardly ever been done on time in the past, despite having had ample opportunity to critically peruse existing business models and to act to prepare and empower people for the looming threat of transformation and change. Unfortunately, organizations traditionally resist strategic organizational and behavioural transformation and change, often to their substantial detriment.

In 2014, PricewaterhouseCoopers declared (PwC Report, 2014) that the Fourth Industrial Revolution, which is characterised by increasing digitisation and interconnection of products, value chains and business models, has arrived. The researchers recognised that the globalised industrial environment was becoming increasingly dynamic, complex, and high-tech, but that new key enabling technologies (KEBs) were providing opportunities for the introduction of new

market services and for upgrading existing products through innovative services and business models. It became clear that to achieve a competitive edge, organizations would need to focus on their key competences and develop both technological and organizational excellence.

Challenges caused by rapid technological development and emerging global energetic, ecological, economic, political, and social crises require partnering and collaborations between industry, academic, political, and civil society partners. The context, extent, and complexity of these challenges gear emerging strategies with entrepreneurial, political, and social agendas to foster partnering and collaboration needs. Moreover, new digitalized and digitized products, services, technologies, emerging industries, new business models, organisation systems, projects, etc, are by themselves largely complex (Semolic & Steyn, 2018). These challenges stimulate the redefinition of existing and the development of new services and value chains, affecting the need for new corporate competencies and culture change.

## 2. Rise of Business Complexity

Michael Simmons (2018) claims that he found studies independently conducted by four of the greatest thinkers of modern times that came to the surprising conclusion that many of the world's top entrepreneurs, like Bill Gates, Steve Jobs and Elon Musk, along with some Nobel Laureates, possess a rare skill called "*integrative complexity*." Integrative complexity is the ability to develop, and hold opposing traits, values, and ideas and then integrate them into larger ones (Semolic & Steyn, 2018).

Solving the challenges of integrative complexity is a demanding task already at the level of a single organization. This requires the cooperation of various professions and business functions involved in the organization's supply chain and total value chain. Typical business cases of such development projects and programs demand the identification and implementation of complex - interwoven technological and business scenarios, which require the participation and support of various stakeholders involved in the performance of technology and business processes. Significant challenges stem from emerging inter-organizational value chains' collaboration and partnering with collaborative RID<sup>3</sup> projects and programs (known as "RID projects").

Partnering in RID digitalization projects occur when two or more participants organizations are involved. In such projects, different, independent (not formally connected) organisations are partnering and collaborating on jointly identified and defined *collaborative project business cases (CPBCs)* with their own individual business needs and expectations. The core business drivers for such partnering and collaboration efforts are:

- Limited capabilities (competencies, technology, specialisation, experience, etc.) and resources (human, equipment, financial) for planned applied research, innovation, and development efforts.
- Needs for sharing project costs and risks in pre-competitive industry research projects.

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<sup>3</sup> RID – RESEARCH (new theoretical knowledge search), INNOVATION (creation and pilot testing of novelties), and DEVELOPMENT (implementation and start-up of novelties commercialization).

- Needs for the joint innovation ecosystem capacities development, or requirements of the external project-funding or co-funding organisations (different local, regional, national and international project funding agencies).

RID projects are usually overly complex and need the good understanding, orchestration and support of all project stakeholders in all project life cycle phases (Semolic & Steyn 2018). The complexity of the collaborative business cases of digitalization RID projects has multiple facets. The integrative complexity of such projects must be observed from the following aspects (Semolic, 2018; Steyn & Semolic, 2019):

- *Business complexity* – addresses the complexity issues of the industry in question, value chain and business processes complexity, project or program business case complexity, business maturity complexity and industry stakeholder complexity.
- *Technology complexity* - addresses the issues of products/services technology complexity, engineering technology complexity, project business case's technology scenarios complexity, complexity of business processes technologies, technology infrastructure complexity, and value chain innovation ecosystem complexity.
- *Organizational complexity* - addresses the complexity of the inter-organizational value chain coordination system, the complexity of the corporate organization structures, the complexity of business processes, and the complexity of corporate management and governance systems.
- *Behavioural complexity* - addresses the complexity of the participating partners' competencies and mindsets, leadership, and corporate culture complexity issues.

This paper deals with corporate digitalization RID projects' challenges from the views of business, organizational, and behavioral complexity aspects.

New digitalization applications and systems are mostly developed and introduced through RID projects, usually sponsored and co-financed by various public funding programs. Undoubtedly, technological aspects are vital for success from a technical point of view.

However, suppose they lack partnering organizations' management and governance support to provide the required accompanying organizational changes or insufficient stakeholder support. Projects can face significant problems and even not achieve expected goals in such cases.

### **3. Business Complexity of Digitalization RID Projects**

In practice, situations often occur where people are not completely satisfied with their achievements upon completing RID projects. This is often the case in large complex digitalization RID projects with many partners and other stakeholders. The focus is often mainly on the

technical aspects of new technological solutions, while organizational and behavioural changes are not addressed adequately.

This problem is due to absence of new business model implementation and related organizational changes required as enabled by new digitalization technologies. Digitalization projects must be addressed holistically while considering technical, organizational, and behavioural aspects leading to strategic transformation and change.

Figure 3 depicts a portfolio of interrelated corporate processes that must be holistically addressed in a digitalization RID project's business case. These processes are (Semolic, 2022):

- *Technology value chain* – processes and functions related to the technologies of product or service operation, and the technological processes of their realization;
- *Business value chain* - business functions, processes and activities that enable and support the implementation of the technology value chain and the realization of business goals.
- *Management processes* – are related to planning, organizing, providing resources, leading, and controlling the technology and business value chain processes, and securing adequate effectiveness and efficiency of all operations.



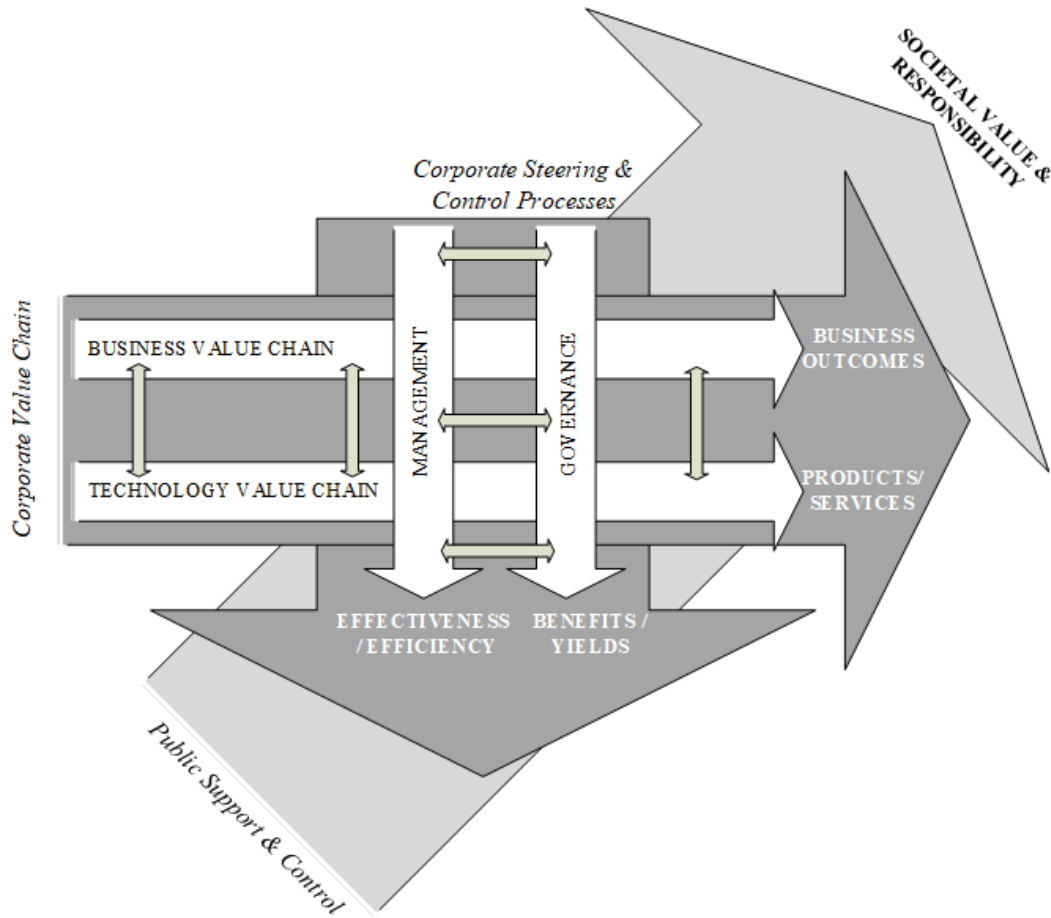


Figure 3: Portfolio of interrelated corporate processes (Semolic, 2022)

- *Governance processes* – according to ISO 21500 governance provides principles, policies and the framework by which an organization is directed and controlled.
- *Processes of public and societal support and control* - compliance with the legislation and rules of the external co-financier(s) and the provision of the public good.

Technological and business processes are part of the corporate value chain, steered and controlled by management and governance processes. All corporate processes must be consistent with the rules and procedures of the public administration and the society it supervises.

The integrative complexity of described RID's projects and their business cases needs to be addressed holistically, considering all the processes mentioned above and the needs of their stakeholders.

#### 4. Complexity of Partnering RID Project Organizations

In addition to paragraph 2 regarding organizational complexity, the importance of challenges brought by project partners, their specific business needs and expectations, their corporate organizational structures, and their capabilities must be addressed. These aspects need to be incorporated, documented and harmonized in the collaborative project business case (CPBC). The primary purpose of the CPBC document is to provide guidelines for collaborative RID project governance, coordination, and management toward achieving project goals. The CPBC is a master-baseline planning document of collaborative RID projects, which needs to be managed and updated during the project life cycles. It integrates and harmonizes individual *partner project business cases (PBCs)* into the overall project goals and objectives. Moreover, it defines inputs for scope of work and expected deliverable definitions. Figure 4 illustrates the matrix project organization of a collaborative RID project.

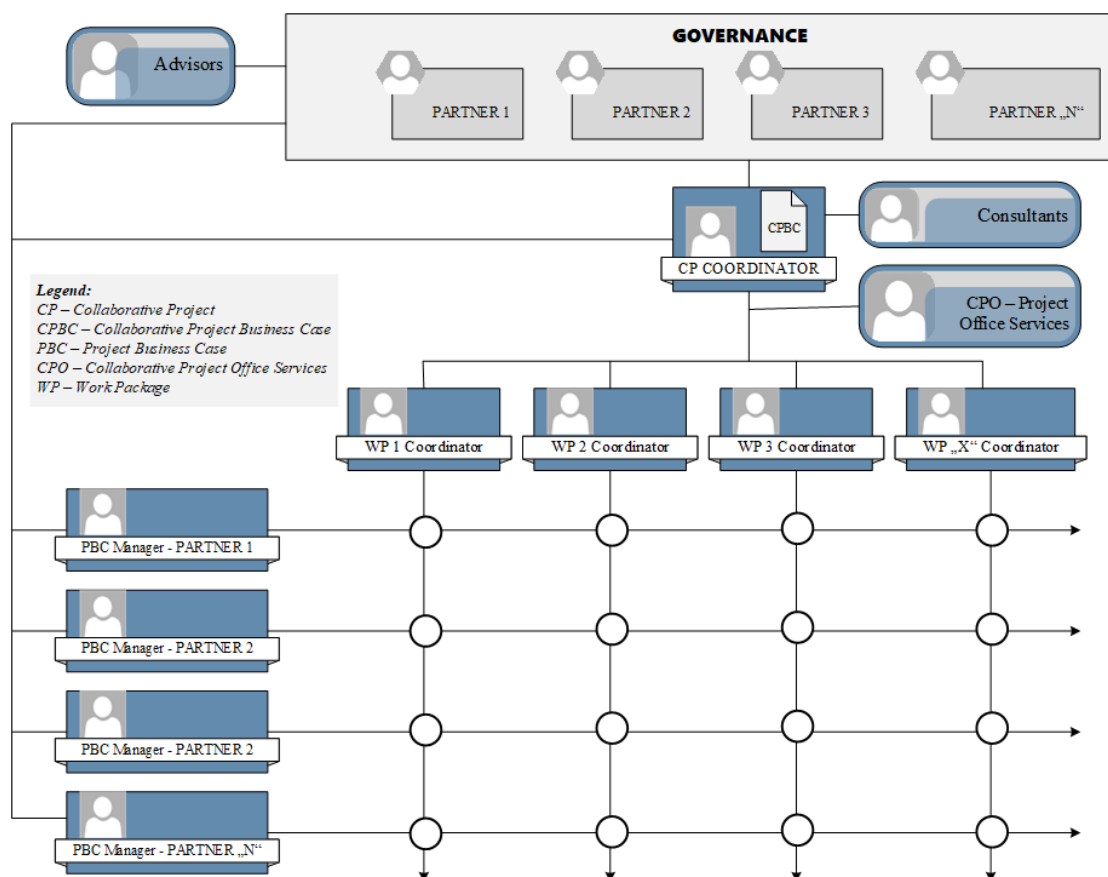


Figure 4: The matrix project organization of a collaborative RID project (Semolic, 2022)

The RID project coordinator is appointed by the leading project partner, the project initiator. The coordinator's responsibility is to prepare the *project charter* based on the collaborative project



business case (CPBC) compiled by participative project partner representatives. The RID project coordinator collaborates with the partner representatives to appoint the RID project team member roles and responsibilities. Each project partner must appoint an authorized project coordinator responsible for the management of their own partner project business case (PBC). Moreover, representatives from collaborative partners and external project co-funding organizations constitute the collaborative complex RID project governance body members. It can be concluded that complex collaborative digitalization RID projects are organizationally highly demanding and require astute coordination and support from all participating partners.

## **5. Behavioural Complexity and Leadership of RID Projects**

### **5.1 Behaviour and Mindsets**

According to Professor Otto Scharmer of the Massachusetts Institute of Technology (MIT) too many outdated Industry 2.0 and 3.0 mindsets still prevail in organizations. He argues that one cannot solve current 4.0 problems with 3.0 and worse mindsets. The new millennium has developed into an Industry 4.0 connected-complex-whole-ecosystem. But thinking is generally way behind, stuck in 2.0 and 3.0 based on scarcity, fear, competition, and control.

The only way to truly change is to upgrade the awareness of the participants in a system. Outdated paradigms and beliefs are the biggest threats. Schamer's Matrix of Social Evolution illustrated in Figure 5 shows how people behave on each level, whether in an individual (micro: attending), a group (meso: conversing), an organization (macro; organizing) or global system (mundo: coordinating). The 4.0 ecosystem awareness indicates what is actually required in today's world.

Field: Structure of Attention	Micro: <b>ATTENDING</b> (Individual)	Meso: <b>CONVERSING</b> (group)	Macro: <b>ORGANIZING</b> (institutions)	Mundo: <b>COORDINATING</b> (global systems)
1.0: habitual awareness	<b>Listening 1:</b> Downloading habits of thought	<b>Downloading:</b> <i>Conforming:</i> speak- ing from fitting in	<b>Centralized control:</b> Organizing around hierarchy	<b>1.0 Centralized:</b> <i>commanding</i>
2.0: ego-system awareness	<b>Listening 2:</b> Factual, open-minded	<b>Debate:</b> <i>Confronting:</i> Speaking from differentiating	<b>Divisionalized:</b> Organizing around differentiation, decentralizing	<b>2.0 Free Market:</b> <i>competing</i>
3.0: stakeholder awareness	<b>Listening 3:</b> Empathic, open-hearted	<b>Dialogue:</b> <i>Connecting:</i> Speaking from inquiring others, self	Distributed/networked: Organizing around stakeholders groups	<b>3.0 Social Market:</b> <i>negotiating/networking</i>
4.0: eco-system awareness	<b>Listening 4:</b> Generative, open-presence	<b>Collective Creativity:</b> <i>Co-creating:</i> Speaking from what is moving through	<b>Eco-system:</b> Organizing around what emerges (co- sensing, co-creating)	<b>4.0 Co-creative Eco-system Economy</b> <i>Awareness Based Collective Action</i>

Figure 5: Matrix of Social Evolution (Prof Otto Scharmer, MIT)

Scharmer opines that the biggest leadership challenge today is that awareness is fragmented and focused on ego: “what’s in it for me?” Real leadership work is to help people see the whole and change their perspective from “me” to a systems view: “we”. Back in the past, leadership 0.0 was communal and shared in the community.

1.0 is top down in a hierarchical pyramid, aligned with centered organizations.

2.0 is delegation and competition, aligned with decentralization in organizations.

3.0 is participatory, relational leadership in a networked, stakeholder environment.

4.0 leadership is co-creating with the wellbeing of the whole in mind!

Professor Scharmer believes the questions to answer are: “Where is your organization at this point? And where are you?”

The above are the main challenges of contemporary organizations and their environments. Modern effective and efficient virtual dynamic learning organizations (VDLOs) have become more cross-functional, flexible, agile, and virtual over time. Their boundaries are blurred and not closed as they were at the time of the early industrial eras. In the Industry 4.0 economy it is profoundly important to master the management and leadership complexity challenges of the complete range of project- and supply chain portfolios. Of particular interest are the Supply Chain Portfolio collaborative research, innovation, and development (RID) projects, its innovation ecosystems, and related emerging competences.

In recent years the world is witnessing simultaneous and profound changes in all areas of private and public corporate activities. Organizational and private lives are becoming highly volatile and value-driven, demanding continuous innovation and learning. These changes, caused by the inflow of new digital key enabling technologies<sup>4</sup> intertwining with peoples' daily lives, influence the way organizational activities and daily chores are performed (Semolic and Steyn, Sept. 2017). Moreover, this is only the first taste of more dramatic changes in the years to come.

The key research findings in the 2016 Global Industry 4.0 Survey Report, published by PWC (Geissbauer, Vedso, Schrauf, 2016), reflect the following needs or situations:

- Industry 4.0 moved from theories and strategies to the real investments and actions.
- Companies that successfully implemented Industry 4.0 no longer need to choose between focusing on a better top or bottom line. They can improve both at the same time.
- Deepen digital relationships with more empowered customers. Customers will be at the centre of changes to value chains, products, and services (customer expectations are one of four aspects most influenced by the fourth industrial revolution).
- Focus on people and culture to drive transformation. This survey output shows that industry's most profound implementation challenge is not the right technology, but a lack of digital culture and skills in their organizations.
- Data analytics and digital trust are the foundation of Industry 4.0.

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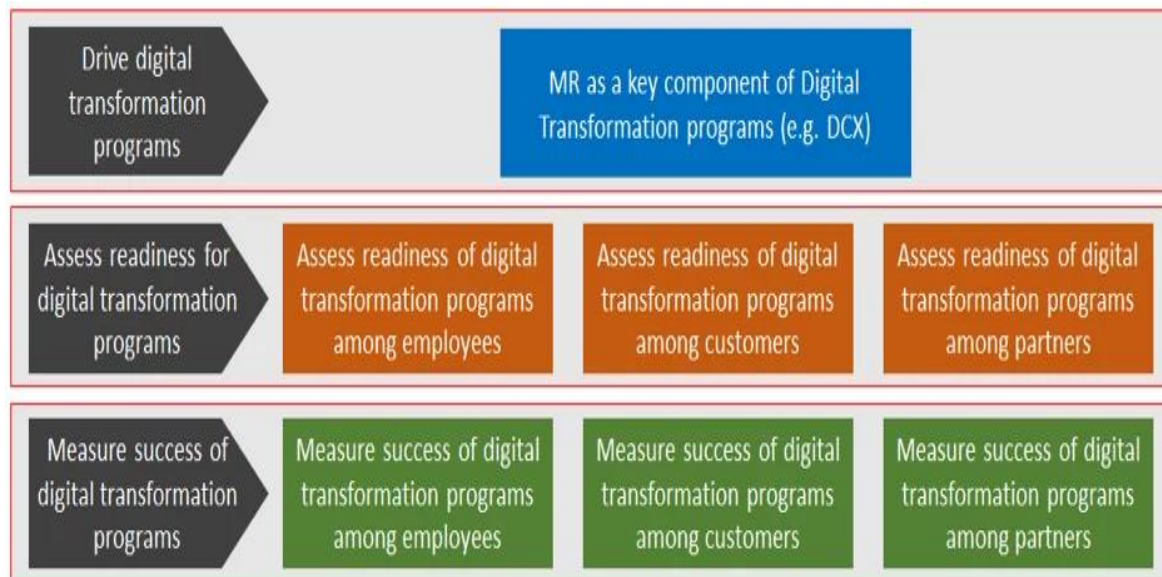
<sup>4</sup> **Enabling Technologies** - Equipment and/or methodology that, alone or in combination with associated technologies, provides the means to generate giant leaps in performance and capabilities of the user. For example, the coming together of telecommunication technologies, internet, and groupware has levelled the field so that even smaller firms are able to compete in areas where they otherwise could not (Business Dictionary, 2018)

- Robust, enterprise-wide data analytics capabilities require meaningful change. Companies need to develop robust organizational structures to support data analytics as an enterprise-level dynamic capability.
- Industry 4.0 is accelerating globalism, but with a distinctly regional flavour.
- Significant investments with big impacts are required: It is time to commit. It is estimated that global industrial product companies will invest billions of dollars in the coming years. The primary focus will be on digital technologies like sensors or connectivity devices, as well as on software and applications like manufacturing execution systems (MES). Moreover, companies are investing in the education and training of employees and driving organizational transformation and change.

The Roundtable on Digitizing European industry – Work Group 1 Report, avers that “digitalization is essentially an innovation issue”, and organizations are approaching it with the usual wide variety of attitudes, methods and expectations encountered in managing innovation. These attitudes depend on the organization’s digital maturity. Kane et al (2017) define digital maturity as follows: “Digital maturity is about adapting the organization to compete effectively in an increasingly digital environment. Maturity goes far beyond simply implementing new technology by aligning the company’s strategy, workforce, culture, technology, and structure to meet the digital expectations of customers, employees, and partners. Digital maturity is, therefore, a continuous and ongoing process of adaptation to a changing digital landscape”.

Steyn and Semolic (2017, March) aver that Industry 4.0 businesses are flourishing in regions and countries where organizations are armoured with adequate competences, available resources, super-transformational collaboratist leadership, sound corporate cultures and sustainable regional support. Modern Industry 4.0 organizations in regions and countries also search for new methods to create favourable business conditions by providing adequate supporting services. It is evident that technology changes are not enough to achieve expected results, as was the case in the past. The burning question is how organizations can successfully cope with complex collaborative projects, many of them digitalization research and innovation development (RID) projects.

Cranefield College PhD candidate Tanya Keller (2023) avers that Maruti Techlabs contends that most companies' challenges are not entirely related to technology. The biggest impediments to adoption relate to the cultural challenges of organisational alignment, resistance or lack of understanding and change management. Considering this, Sankaran (2018: **Online**) raises the opinion that there are distinct ways market research can become a key enabler in obtaining the data that will guide the rollout of digital transformation across the organisation. As presented in Figure 6, market research can answer questions about the readiness of employees, customers, and partners, the recommended pace of transformation and strategies the organisation should adopt, and how to address the challenges along the journey.



*Figure 6: Market Research as the Enabler of Digital Transformation  
 (Source: Sankaran, 2018: Online)*

According to Keller (2023) many studies have indicated that gaining visibility into the customer experience is one of the biggest challenges on the digital transformation agenda. Market research has been a critical discipline in assessing and tracking customer experience. Deeper analytics of the customer experience post-purchase could assist the organisation in tracking the client’s satisfaction and acting quickly and precisely where improvements in service and product, including complex collaborative RID product development, are required.

Martin (2021: **Online**) answers the question: “what is the difference between Market Research and Data Science” by explaining that data science is an interdisciplinary field involved in analysing basic information to find statistical insights, informing business decisions, and noting that the role of the market researcher is almost identical. Successful organisations will harness the insight generated by the market research and data science teams and integrate the insights-finding mechanisms. This is critical to breaking down the barrier between market research and data science to allow the organisation to understand past behaviour and future predictions. Thus, organisations aiming to succeed must find a way to effectively merge teams to use fact-based quantitative, data-rich, emotive opinions.

## 5.2 Collaboratist Leadership

The complexity of modern technologies, i.e., robotics, artificial intelligence, mass data, internet of things, integrating information technology and operations technology, etc., calls for specialisation and sustainable collaboration among partner organizations and demands exceptional talents and well-educated human resources. Consequently, organizational design, development and governance have entered a challenging new phase (Steyn and Semolic, 2016).



In the Industry 4.0 economy organizations that experience an overall dearth of collaboratist leadership will have difficulty in maintaining and improving their levels of operational productivity and strategic benefit realisation. Steyn and Semolic (2020) aver that collaboratist leaders are super-transformational and constitute a shift away from old “motivations” of bureaucratic powers, towards inspiring people to believe in a vision of economic and social progress. This motivates people to abandon their own personal self-interests in favour of the organization’s interests.

Advantages stemming from creating dynamic open innovation virtual dynamic learning organizations (VDLOs) to achieve strategic success in Industry 4.0 complexity are clear but cannot be successful without a concomitant shift from bureaucratic to “smart” collaboratist leadership, the most profound dynamic capability element of modern-day organizations. Leadership has a strategy focus on the one hand, and a people focus on the other hand. Having a strategy focus is about positioning the organization in the market environment. To ensure that value add in complex collaborative digitalization RID projects is achieved beneficially in a responsible and ethical manner, collaboratist leaders optimally utilise the balanced scorecard and shape their role modelling in accordance with the eight dimensions of a psychological climate, *inter alia*, trust, support, innovation, cohesion and autonomy.

Moreover, leading and building on the strengths of human capital means having a solid understanding of people’s behaviours, mindsets, and their relationships, and building their careers based on talents. With the dawn of Industry 4.0, society and business witnessed rapid technological developments that require higher levels of creativity and innovation, especially for doing complex collaborative digitalization RID projects. The fourth industrial revolution economy has greatly impacted the way that organizations are led, managed, and governed. Accelerated information flow and disruptive key enabling technologies (KETs) inspiring change, require rapid management decisions. In management functions of the Industry 4.0 economy (see Figure 7), leading takes up the prime position, followed by creating, implementing, and improving. Improving is the catalyst for innovation, and closely associated with the total quality management (TQM) component of innovative continuous improvement.

“Smart” collaboratist leaders are always committed to innovative continuous improvement in everything they do. This is an important dynamic capability and pillar of total quality management (TQM). Innovative continuous improvement is profoundly important for technology management, innovation management and knowledge management success. Moreover, the latter two elements are highly supportive of technology management, especially in complex collaborative digitalization RID projects. In virtual dynamic learning organizations (VDLOs) employees are encouraged to continually identify and act upon opportunities to improve. This sustains the virtual dynamic learning organization and encourages dynamic capabilities of double loop learning, systems thinking, creation of knowledge, and knowledge management.



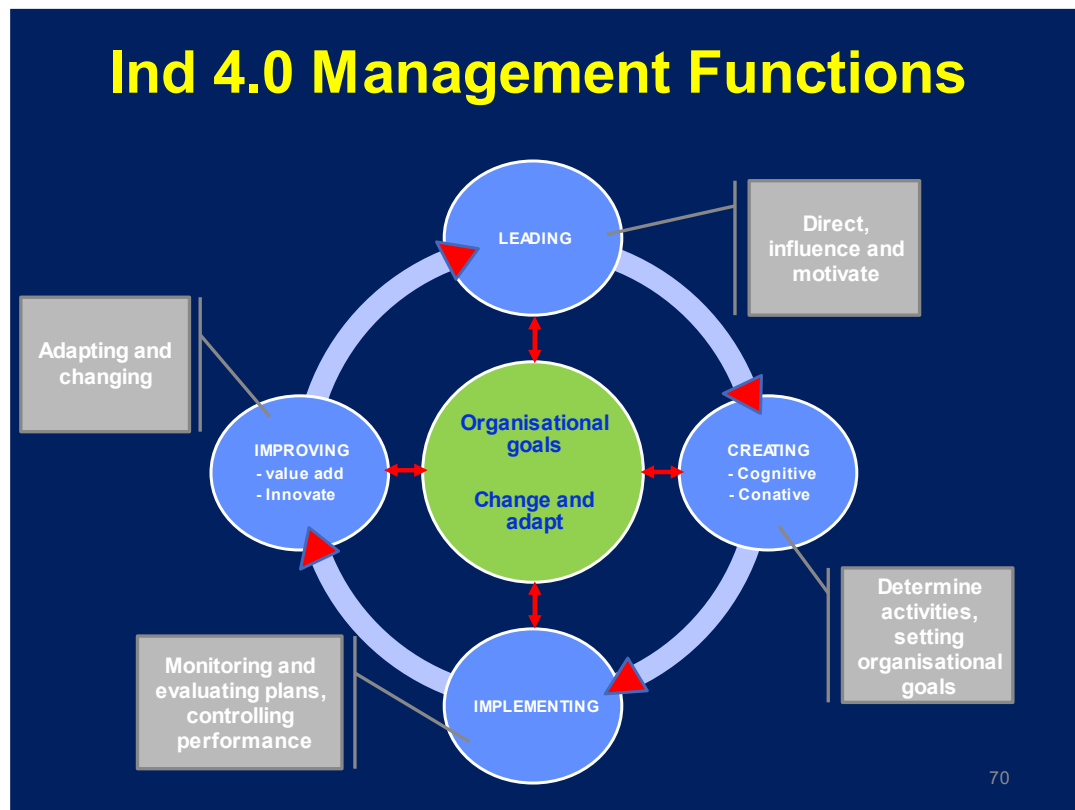


Figure 7: Management Functions in Virtual Dynamic Learning Organizations (VDLOs)

“Smart” collaboratist leaders know that all functional and cross-functional process outputs in the organization’s value chain must be measured by utilising appropriate key performance indicators (KPIs) that are linked to the critical success factors (CSFs) mentioned above. The results of the measurements must be appraised to assess to what degree strategic benefits are delivered. If an appraisal indicates that the strategic benefits do not accrue to a satisfactory degree, a review aimed at an innovative continuous improvement initiative follows. Hence, smart leaders who understand systems thinking also grasp the importance of adopting the balance scorecard as a component of their quality management system (QMS) in measuring the performance.

It is the task of executive leaders, who are responsible for the organization’s strategic analysis, strategic development, and strategy implementation, to introduce an effective learning and growth strategy. Leadership acumen and excellence are very important factors in achieving this. If absent it will cause the organization to fail. Steyn and Semolic (2016) advocates the importance of having a Chief Portfolio Officer at the executive level to ensure effective leadership in Industry 4.0. The knowledge, skills, and behaviour of the human resources component in the organization need also to be continuously improved to maintain a competitive advantage.

Collaboratist leaders know that the Learning and Growth perspective of organizational strategy is vital to the success of virtual dynamic learning organizations (VDLOs) engaged in complex

collaborative digitalization RID projects performed by the product development and commercialization supply chain process. Moreover, collaboratist leaders who promote knowledge-based learning cultures and create 4.0 mindsets, are continuously focused on organizational transformation and change to sustain performance. A marked feature of VDLOs is their high levels of collaboration, coordination and integration of strategic analysis and development, and strategy implementation.

Hence, super transformational collaboratist leaders facilitate organisational learning, rely to a large degree on autonomy, and in doing so encourage decentralised decision-making. Importantly, they focus on trustworthy supportiveness to win the commitment of the workforce and simultaneously raise their motivational levels as well as their innovative capabilities, while persisting to create a culture of continuous learning.

Collaboratist leaders balance their attention between actions that create progress and the motivation of virtual team members. They possess unique qualities suited to the Industry 4.0 economy, and act as mentors and coaches to team members by listening to their concerns and needs. It encompasses the need to respect and celebrate the individual contribution that each member in a collaborative virtual network of partners makes to the team. Well-directed diversity of team members gives it true strength. Collaboratist leaders are visible and available to dynamically provide direction to virtual networks of partner project teams. They are master listeners, focus on identifying the needs of people instead of dictating to them, and empathise with others. This creates trust and support between the leader and the virtual project team members. Moreover, they have the skills to inspire and keep people motivated despite the complexity and high risk associated with digitalization RID projects Industry 4.0 organizations are engaged in.

## **6. Conclusions**

Complexity is found in all areas and levels of businesses and societies. Challenges of complex collaborative digitalization RID projects need special attention. A culture of partnering and collaboration is essential for the effective and efficient digital transformation of industries, their business ecosystems, and society.

The complexity of Industry 4.0 technologies and associated business models requires the holistic, interdisciplinary approach of stakeholder "partnership and collaboration" to achieve success. This is not happening to a satisfactory degree and the gap between individual professional disciplines that address Industry 4.0 issues in isolation is unfortunately still the overwhelming challenge.

Limited partnering and collaboration in research, innovation and development initiatives are much to prevalent. Instead of focussing on the challenges of bringing Industry 4.0 to a holistic conclusion in an integrative way (technological, organizational, and behavioural), a search for

new challenges of a dawning Industry 5.0 is preferred, such as emerging business models and organizational solutions triggered by 4.0 technologies. It is apt to conclude that these aspects are in fact an integral part of the transformation and change of the business environment and society of Industry 4.0.

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## About the Authors



### **Prof Dr Brane Semolič**

Founder and Head of LENS Living Lab  
International living laboratory  
Celje, Slovenia



**Brane Semolič** studied mechanical engineering, engineering economics, and informatics; he holds a scientific master's degree and doctorate in business informatics. His focus of professional interest is industrial and system engineering, innovation and technology management, virtual organizations and systems, project and knowledge management. He has 40 years of working experiences in different industries (industrial engineering, IT, chemicals, household appliances, government, and education), as an expert, researcher, manager, entrepreneur, counselor to the Slovenian government and professor. He operates as head of the open research and innovation organization LENS Living Lab. LENS Living Lab is an international industry-driven virtual living laboratory. He is acting as initiator and coordinator of various research and innovation collaboration platforms, programs and projects for the needs of different industries (ICT, robotics, laser additive manufacturing, logistics, education). He was co-founder and the first director of the TCS - Toolmakers Cluster of Slovenia (EU automotive industry suppliers). Since 2004 he is serving as the president of the TCS council of experts. Besides this, he is operating as a part-time professor at the Cranfield College.

He was head of project and information systems laboratory at the Faculty of Mechanical Engineering, Head of the Project & Technology Management Institute at the Faculty of Logistics, University of Maribor and professor of project and technology management at the graduate and postgraduate level. He acted as a trainer at the International »European Project Manager« post-graduated program, organized jointly by the University of Bremen.

He was the co-founder and president of the Project Management Association of Slovenia (ZPM), vice president of IPMA (International Project Management Association), chairman of the IPMA Research Management Board (2005-2012), and technical vice-chairman of ICEC (International Cost Engineering Council). He actively participated in the development of the IPMA 4-level project managers' certification program. He introduced and was the first director of the IPMA certification program in Slovenia. He has been serving as the assessor in this certification program since 1997. He performed as assessor in the IPMA International PM Excellence Award Program in China, India, and Slovenia.

Brane is a registered assessor for the accreditation of education programs and education organizations by the EU-Slovenian Quality Assurance Agency for Higher Education. He was a Member of Strategic Advisory Board of European Competitiveness and Innovation, as well as the president of the Slovenian Chamber of Business Services. Brane received the award as ICEC Distinguished International Fellow in 2008. He received the »Silver Sign« for his achievements in research, education, and collaboration with the industry from the University of Maribor in 2015.

Professor Semolič is also an academic advisor for the **PM World Journal**. He can be contacted at [brane.semolic@3-lab.eu](mailto:brane.semolic@3-lab.eu). Additional information about the LENS Living Lab can be found at <http://www.3-lab.eu/>.



### **Prof Dr. Pieter Steyn**

Cranefield College  
South Africa



**Dr. Pieter Steyn** is Founder and Principal of Cranefield College, a South African Council on Higher Education / Department of Education accredited and registered Private Higher Education Institution. Cranefield offers an Advanced Certificate, Advanced Diploma, Bachelor of Business Administration degree, Postgraduate Diploma, Master's degree (MCom), and PhD. He holds the degrees BSc (Eng), MBA and Doctor of Commerce, and is a registered Professional Engineer.

He was formerly professor in the Department of Management, University of South Africa and Pretoria University Business School. He founded the Production Management Institute of South Africa, and in 1979 pioneered Project Management as a university subject at the post-graduate level at the University of South Africa. Prof Steyn also taught at the Chung-Shan Institute of Science and Technology in Taiwan as a guest lecturer.



He founded consulting engineering firm Steyn and Van Rensburg (SVR). Projects by SVR include First National Bank Head Office (Bank City), Standard Bank Head Office, Mandela Square Shopping Centre (all in Johannesburg), as also, Game City- and The Wheel Shopping Centres (in Durban). He, *inter alia*, chaired the Commission of Enquiry into the Swaziland Civil Service; and acted as Programme Manager for the Strategic Transformation of the Gauteng Government's Welfare Department and Corporate Core.

Prof Steyn is a contributing author of the “*International Handbook of Production and Operations Management*,” (Cassell, London, 1989, ed. Ray Wild) and is the author of many articles and papers on leadership and management. He is a member of the Association of Business Leadership, Industrial Engineering Institute, Engineering Association of South Africa, and Project Management South Africa (PMSA); and a former member of the Research Management Board of IPMA. He serves on the Editorial Board of the PM World Journal. Moreover, he is the owner of the Aan't Vette Wine Estate and De Doornkraal Vinotel (4-star hotel) in Riversdale, Western Cape.

Prof Steyn can be contacted at [cranefield1@cranefield.ac.za](mailto:cranefield1@cranefield.ac.za). For information about Cranefield College, visit [www.cranefield.ac.za](http://www.cranefield.ac.za).