Project Integrated Organizational Quality and Performance Management with Special Reference to Manufacturing [1]

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SYNOPSIS

The four aspects most affected by the Industry 4.0 economy are customer expectations, product development, collaborative innovation, and organizational forms, while supportive project initiatives play an increasingly important role. Concomitantly, it requires modern organizations to have project and programme management acumen, digital maturity, and leadership focused on sustainability, ethics, and new business models. To achieve this requires an organizational culture and mindset focused on collaboration, agility, and a profound dedication to quality and performance.

1. THE VALUE AND QUALITY MANAGEMENT SYSTEMS

The ***quality management system (QMS)*** approach calls for all operations activities in organizational value chain processes to be aligned with the critical success factors in the balanced scorecard strategy map, and that process outputs be measured, appraised, and reviewed to ensure performance. Moreover, there must be a focus on continuously improving people, products, processes, and productivity. Streamlining processes to eliminate wasteful activities or steps cuts fixed and variable costs. Streamlining efforts also yield better output quality, timely delivery, and other customer needs and wants. This leads to organizations performing better and revenues increase as demand for products and services increases. Profit potential then appears at lower volumes, thus opening new market opportunities (Steyn, Dec 2012 and March 2013).

Process improvements and organizational performance are guided by having a sound ***quality management system (QMS)*** embedded in organizations, including manufacturing firms. Increasingly organizations are following the balanced scorecard

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approach, which is fundamentally based on a sound ***value system*** that includes values, beliefs, and total quality management ***(TQM)*** guiding principles. An organization's vision and mission are also guided by the value system and so is its culture. The same can be said for value chain performance quality. Managing ***quality and performance improvement*** resorts under the operations ***support activities*** shown in the example from manufacturing Figure 1 (Schonberger & Knod; prep Steyn 2012).

Figure 1: Managing Quality Improvement is an Operations Support Activity

Metrics are very important with respect to continuous improvement initiatives. One of the four pillars of total quality management philosophy is ***systems thinking,*** which means that organizations must continuously improve process performance through measurements of key performance indicators, followed by appraisals and where necessary reviews. Moreover, a sound ***value system*** leads to collaboratist leadership role modelling excellence ensuring that collaboration between stakeholders in the value chain of the firm is enhanced (Steyn and Semolič, March 2017). Competitive excellence results from this, and a strong focus on customers' needs and wants emerges.

2. QUALITY MANAGEMENT SYSTEM COMPONENTS

2.1 Introduction

At the heart of introducing a ***quality management system (QMS)*** is the Industry 4.0 ***virtual dynamic learning organization (VDLO)*** in which it is embedded (Steyn and Semolič, May 2018). The ***VDLO value chain schematic*** illustrating the systems logic of the balanced scorecard and programme-managed project and supply chain portfolios is depicted in Figure 2. It involves the total organizational ***value chain*** from suppliers to customers inclusive of the ***Supply Chain Portfolio, Continuous Improvement Project Portfolio,*** and ***Capital Expenditure Project Portfolio.***

Although reflected in the Figure 2 ***Value Chain Schematic*** the ***Strategic Transformation Project Portfolio*** is not a permanent fixture since it is only introduced when more radical strategic organizational transformation is required (Steyn and Semolič, Feb 2016). However, functionally it is treated as a normal project portfolio linked the ***Quality Management System (QMS)*** when it does exist. In addition to the projects constituting the three project portfolios, two cross-functional project processes are in the Supply Chain Portfolio. As indicated in Figure 2 these are the ***"Project Initiatives for External Customers"*** and the research and innovation ***(RID) projects*** of the "***Product Development and Commercialisation"*** supply chain processes (Semolič and Steyn, Aug 2018). Hence five different types of project initiatives are operative as elements of the ***QMS,*** the latter two are measured directly and project deliverables of the three project portfolios indirectly.

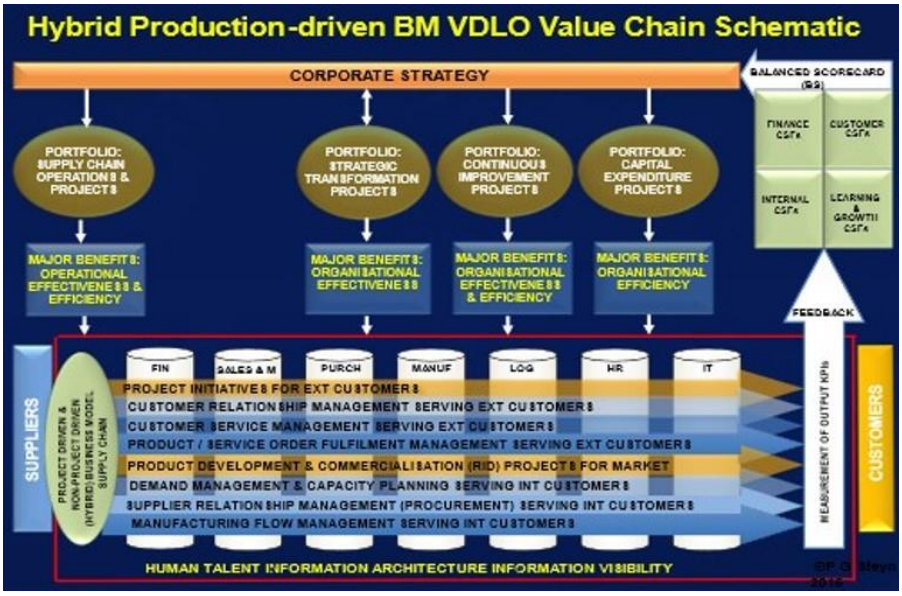

Figure 2: The VDLO Value Chain Schematic Embedding the QMS

The main initiating component of the ***quality management system (QMS)*** embedded in the ***virtual dynamic learning organization (VDLO)*** is the operational output of the cross-functional supply chain processes shown at the bottom of Figure 2. These feed into the ***"Measurements of Output KPIs"*** arrow pointing upwards representing the feedback mechanism of the measured key performance indicator (KPI) outputs of the supply chain processes.

The output measurement values are next fed into the ***"Balanced Scorecard Strategy Map"*** component of the ***QMS*** and appraised using the critical success factors ***(CSFs)*** contained therein. When the appraisals indicate deficiencies in accrual of strategic benefits this strategic information is diverted to the "***Continuous Improvement Project Portfolio"*** component of the ***QMS*** to initiate innovative continuous improvement projects for enhancing the performance of the organization. It may occasionally also lead to development projects done in the ***"Capital Expenditure Project Portfolio"*** enhancing the performance.

The above paragraph describes how the ***QMS*** process functions. The detailed components of the ***quality management system (QMS)*** are depicted in Figure 3. As alluded to earlier a sound ***value system*** serves as a strong foundation for an organization's quality management system ***(QMS)*** embedding the guiding principles of ***total quality management philosophy*** that play a fundamental role in innovative continuous improvement initiatives. The quality management system clearly demonstrates how innovative continuous improvement initiatives originate through metrics, and sometimes also capital expenditure initiatives.

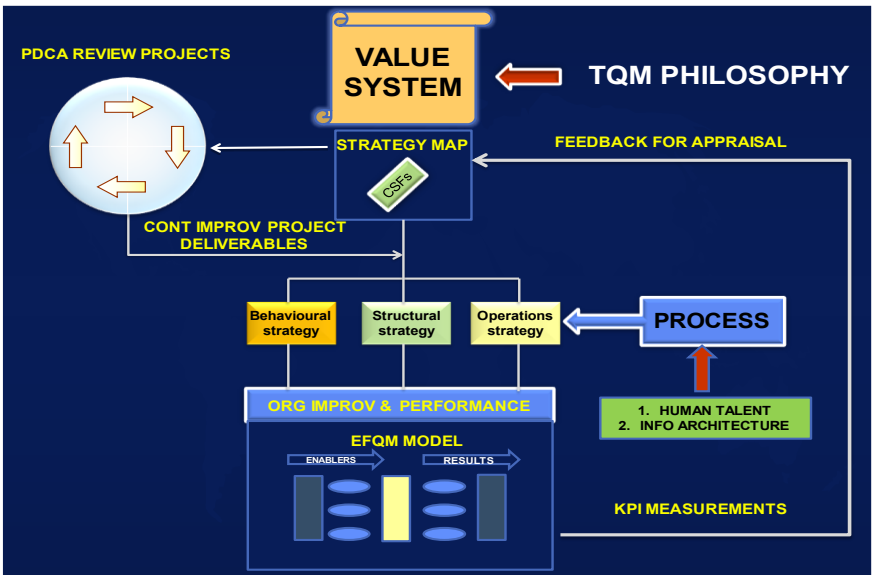

Figure 3: The Quality Management System (QMS)

The important roles played by the different components of the QMS shown in Figure 3 are as follows:

- The ***Balanced Scorecard*** in its ***Strategy Map*** form defining the organization's ***mission*** in its strategic themes and containing the important organizational ***critical success factors (CSFs).***
- The adapted ***Harvey and Brown Organizational Performance and Improvement*** model focusing on the effective behavioural, structural, and operations strategic dimensions for organizational performance.
- The ***European Forum for Quality Management (EFQM) Excellence*** model consists of ***Enablers and Results.*** The main ***"Enabler"*** is Leadership, followed by People, Policy and Strategy; Partnership and Resources; and the Processes delivering results. The ***"Results"*** are People results, Customer results, Society results, and Key Organizational Performance results.
- Results measured by ***key performance indicators (KPIs)*** are then fed back to the ***Balanced Scorecard Strategy Map*** discussed above and appraised using the relevant ***critical success factors (CSFs)*** as the norm. Where appraisals indicate that benefits of strategic importance fail to accrue to a satisfactory degree the ***PDCA*** reviews for innovation and learning are triggered.
- The ***Plan, Do, Check, Act (PDCA)*** cycle is the final component of the ***QMS*** for doing innovative continuous improvement projects ensuring that behavioural, structural, and operational deficiencies are addressed and improved organizational performance is achieved.
- It must be noted that ***although not central components of the QMS***, ***development project deliverables*** emanating from the ***capital expenditure and strategic transformation portfolios*** also contribute to improved organizational performance and its effects integrated into the ***supply chain process outputs.***

Improved organizational performance has a profoundly positive influence on customers' perspectives, *inter alia,* customer service, competitiveness in the marketplace, and market respect, which improve shareholder value for organizations, including manufacturing firms. Cost-cutting achieved by improved processes and systems will likewise improve shareholder value. A more detailed discussion of the role of each of the abovementioned components follows.

2.2 The Balanced Scorecard Strategy Map

In addition to increasing understanding of the organization's vision and mission and tracking key elements of measurable strategy, the ***balanced scorecard*** is utilised for

facilitating the organization's ***"Strategy Map".*** The balanced scorecard in its strategy map form plays a ***dual role*** in the quality management system ***(QMS). Firstly,*** it is an ideal tool for describing corporate strategy in uncomplicated strategic theme terms facilitating easy communication of the mission to all employees. Moreover, it assists in identifying the ***critical success factors (CSFs)*** and associated ***key performance indicators (KPIs)*** for measuring the degree to which organizational benefits are achieved. ***Secondly,*** as process output key performance indicator measurements become available these are fed back to the strategy map to be appraised against the critical success factors for possible continuous improvement review purposes (see Figure 2).

According to Kaplan and Norton, cited by Steyn (2003), a strategy map makes explicit the strategy's hypotheses, and each measure of a balanced scorecard becomes embedded in a chain of cause-and-effect logic that connects the desired outcomes from the strategy with the drivers that lead to the strategic outcomes. An example of a ***strategy map*** devised for a major life assurance company during an education and training intervention by Cranefield personnel features in Figure 4.

The strategy map describes the process of transforming intangible assets into tangible customer service and financial outcomes, across the four perspectives of the balanced scorecard. Similarly, through the strategy map organizational strategic objectives are linked to operations and budgets. The balanced scorecard may therefore also be used to prioritise resource allocation regarding strategy implementation.

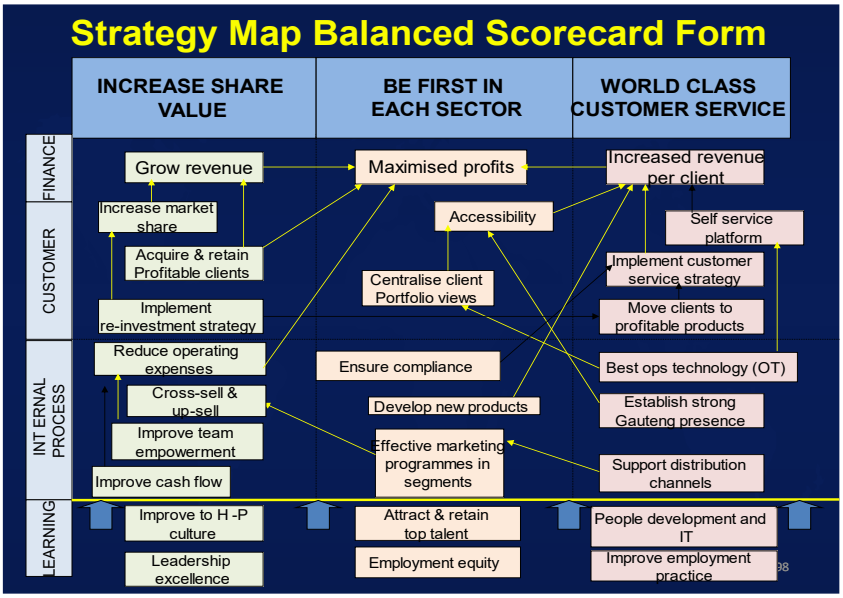

Figure 4: Strategy Map for a Life Assurance Organization.

It is of paramount importance for organizations to introduce rigorous management of leading, creating, implementing, and improving to achieve benefits of strategic importance. The ***strategy map*** indicates the strategic themes that will best achieve an organization's vision and mission. Moreover, as shown in Figures 2, 3, and 4 it embeds the critical success factors ***(CSFs)*** for appraising process key performance indicator ***(KPI)*** measurements through appraisals to ascertain whether organizational benefits of strategic importance are accruing to a satisfactory degree. If not, the subsequent ***review process*** identifies remedying continuous improvement initiatives leading to improved effectiveness and efficiencies in the organizational value chain.

2.3 Organizational Performance and Improvement

The adapted ***Harvey and Brown Organizational Performance and Improvement*** model shown in Figure 5 focussing on behavioural, structural, and operations strategy is the next important component of the ***quality management system (QMS).*** The Cranefield-adapted Harvey and Brown model comprehensively demonstrates the three strategic dimensions for improvement and transformation.

Figure 5: The Three Strategic Dimensions for Organizational Improvement

The quality management system ***(QMS)*** is focused on improvement through transformation and change. Change strategy is a high-level approach to an integrated, organization-wide transformation. ***Behavioural strategies*** emphasize the use of human resources.

Managers mistakenly often place more emphasis on analysing an organization's technical capabilities and tend to neglect the human element.

Organizations, including manufacturing firms, have a habit of suffering from complacency and stagnation and with most transformation and change initiatives it is undoubtedly the most difficult to change behaviours. Today's leading organizations are blessed with a performance-orientated culture and a sound system of authority, responsibility, and accountability. The quality management system ***(QMS)*** monitors behaviour elements in all processes and ensures that behavioural strategies remain focused on keeping the attitudes of people aligned with the organization's system of values, beliefs and guiding principles.

The quality management system ***(QMS)*** is also focussed on improvement via the ***structural strategy*** route which aims at adapting an organization's architecture and design for the better. This means that the lines of authority, span of control, and arrangements of work functions are monitored and modified when necessary. An organization structure is important because it provides the framework that relates the elements of the organization to one another. Organizations must eliminate bureaucratic structures where functional departments operate in isolation. For example, appraisals and reviews in this respect will aim to change a system of authority, responsibility, and accountability entrenched in silo vertical functional departments, to one that combines with the horizontal system that cuts across boundaries and incorporates collaborative partners (Semolič and Steyn, Sept 2017).

Organizational ***operations strategy*** has two components, namely, a process component and an infrastructure component. The infrastructure component in turn has two sub-components, viz, human talent and information architecture. The quality management system ***(QMS)*** is focused on improvement via this route. For example, appraisal and review activities will call for resources to be organised into cross-functional supply chain, project, and process teams where required. All stakeholders engaged in implementation must be assigned appropriate authority. The most important critical success factor is to engage maximum support from top leadership, also in the form of building relationships of trust amongst operations stakeholders.

Moreover, Industry 4.0 organizations, including manufacturing firms, are increasingly implementing sophisticated ***digitalised systems*** such as information and communication technologies ***(ICT)*** and mechatronics. Information architecture is intended to help employees with their operational duties and to deliver superior customer service. A common theme of systems thinking, and knowledge management is to improve operations and methods that will result in innovative processes, products, and services. To maintain or gain market share, supply chain processes must operate cross-functionally, guided by a process manager who keeps continuous track of customer requirements.

2.4 The European Forum for Quality Management (EFQM) Excellence Model

2.4.1 The EFQM Model and Factories of the Future

The next component of the ***quality management system (QMS)*** is the ***European Forum for Quality Management (EFQM) Excellence Model*** described earlier. It consists of ***Enablers*** and ***Results*** where the main ***"Enabler"*** is Leadership, followed by People, Policy, and Strategy; Partnership and Resources; and the Processes delivering results. The ***"Results"*** are People results, Customer results, Society results, and Key Organizational Performance results.

Organizations are rapidly changing and repositioning their businesses to capture growth opportunities more effectively and efficiently in the new Industry 4.0 economy. Steyn (July 2010) avers that the gap between expected change and the ability to manage the required transformation is ever-widening. Hence, organizations are adapting their business models, focusing progressively more on innovations, while reconfiguring to take advantage of collaboration opportunities. When creating new business models, products, services, and processes new knowledge and skills are generated and achieved. Moreover, accelerated information flow inspiring change requires that management decisions be made more frequently and more quickly in the new economy (Steyn and Semolič, March 2017).

Innovative ***key technologies and enablers*** impact heavily on the way modern organizations are led, managed, and governed (Semolič and Steyn, April 2023). It motivates organizations to apply innovative continuous improvement by re-engineering their systems and business processes. This stimulates continuous improvement of knowledge, skills, and behaviours of the human resources component to sustain a competitive advantage, coupled with effective and efficient ***knowledge management.*** Manufacturing firms have also become ***research and innovation-intensive*** to the advantage of countries that pay attention to growing their manufacturing sector. Manufacturing is an indispensable element of the innovation chain and is a key enabler for economic and societal challenges for advancing industrial competitiveness. Moreover, ***Research and Innovation Priorities*** are important for social impact such as increasing human achievements.

Senior management and particularly the executive need to pay attention to ***research and innovation*** to advance a proper ***manufacturing strategy*** for the firm. Technological innovation is the ultimate solution provider for growth and job creation. According to the ***European Factory of the Future Research Association Framework (EFFRA, 2017)*** advanced manufacturing systems play a critical role in making key enabling technologies

and new products competitive, affordable, and accessible. Manufacturing ***Challenges and Opportunities*** and ***Key Technologies and Enablers*** determine the desired impact of the ***Research and Innovation Priorities*** stipulated in the ***Factories of the Future Framework*** and it is imperative that the ***European Forum for Quality Management (EFQM) Excellence Model*** shown in Figure 6 fully aligns with it.

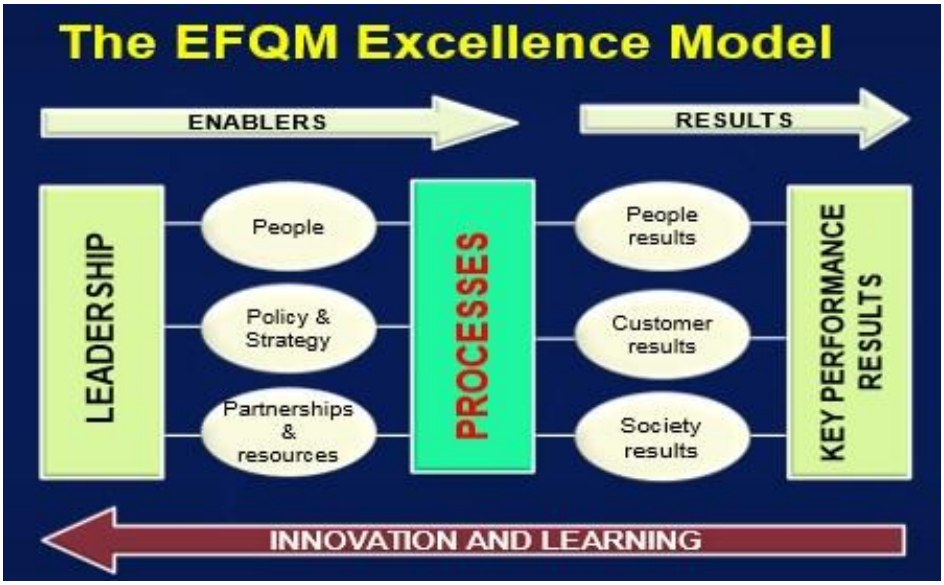

Figure 6: The EFQM Excellence Model

The ***EFQM*** model stipulates ***eight areas of excellence:***

- Being a result-orientated organization.
- Focusing continuously on the customer's needs and wants.
- Excellence in leadership and constancy of purpose in the organization.
- Management by process and facts.
- People development and involvement.
- Supporting continuous learning, innovation, and improvement in the organization.
- Partnership development (creating virtual networks of partner organizations for product development and other supply chain operations).
- Public responsibility.

2.4.2 EFQM Eight Essentials of Excellence Linked to the EFFRA Framework

As competency of organizational leadership is an important key success factor, the ***EFQM Excellence Model*** places it high on the agenda of organizational improvement and performance. Hence, the main enabler in the ***EFQM excellence model*** is

appropriately identified as leadership. This is followed by people, policy and strategy, partnerships, and resources, and finally, processes which deliver the outputs to be measured, appraised, and when required also reviewed. The results are identified as people results, customer results, society results, and key organizational performance results. The feedback system bringing ***innovation and learning*** to the organization is all-important for continuous improvement initiatives and the success of the ***quality management system (QMS).***

The measurements of the process outputs are fed back to the balanced scorecard strategy map of the quality management system and appraised utilising critical success factors ***(CSFs).*** Should the appraisals indicate benefits of strategic importance not accruing to a satisfactory degree, a review process leading to continuous improvement initiatives is initiated, bringing the ***plan-do-check-act (PDCA) cycle*** into action. The improvement initiatives are aimed at the behavioural, structural, and operational strategic dimensions focused on transforming the organization and improving its performance.

Innovative continuous improvement initiatives are about improving organizational excellence. The profound value of the eight essentials of excellence espoused by the ***EFQM*** model discussed above is the focus that it brings regarding essential dimensions that need to be measured and improved upon through the functioning of the quality management system ***(QMS).*** For this reason, it is plausible that the ***eight essentials of excellence*** be linked to the ***EFFRA Framework (2017)*** model illustrated in Figure 7.

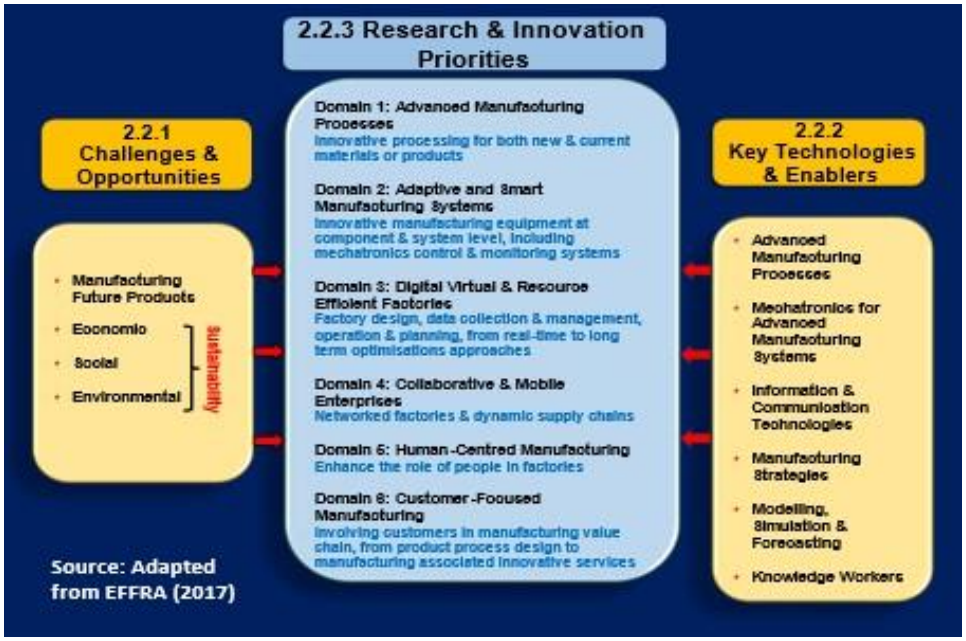

Figure 7: The EFFRA Framework Model (EFFRA,2017)

The ***first*** essential ***"being a result-orientated organization"*** rests on the premise that excellence is dependent upon balancing and satisfying the needs of all stakeholders. This will lead to significant benefits such as adding value for all stakeholders that are involved and bringing sustainable long-term success to organizations, including manufacturing firms. Mutually beneficial relationships will result, and relevant measures put in place for purposes of metrics and knowledge management aligned with the full spectrum of ***Key Technologies and Enablers*** of the ***Research and Innovation Priorities Framework***.

The ***second*** essential ***"focusing continuously on the customer needs and wants"*** aims at the organization's customer being the final arbiter of product and service quality, which leads to customer loyalty. Hence, the manufacturing firm must be aligned with ***Domain 6: Customer-focussed Manufacturing*** of the ***Research and Innovation Priorities*** of the ***EFFRA Framework.*** Customer retention and market share gain are best optimised through a clear focus on the needs and expectations of current and potential customers. This will result in long-term benefits for the manufacturing firm such as market share gain, a clear understanding of how to deliver value to the customer, and minimising transaction costs.

The ***third*** essential ***"excellence in leadership and constancy of purpose in the organization"*** focuses on the behaviours of an organization's leaders creating clarity and unity of purpose and is aligned with the ***Manufacturing Strategy*** aspect of ***Key Technologies and Enablers*** of the ***EFFRA Framework.*** Moreover, it also creates an environment in which the manufacturing firm and its people can excel (Steyn and Semolič, May 2020). The resulting benefits are maximised people commitment and effectiveness, and a clear sense of direction for all incumbents. The organization will also gain market respect, and all its activities will be aligned and deployed in a structured and systematic way.

The ***fourth*** essential ***"management by processes and facts"*** means that more effective organizational performance will be achieved when interrelated activities are better communicated, understood, and systematically managed. Decisions concerning current operations or planned improvements will be made using ***reliable information*** that includes stakeholder perceptions. Major challenges that organizations face, including manufacturing entities, are the growing complexity of processes and supply networks, cost pressures, growing user and customer expectations for quality, speed, and custom products. There is a move away from manufacturing being perceived as a production-centered operation to a human-centered business with a greater emphasis on workers and information flow.

Information and Communication Technology (ICT) as a ***Key Technologies and Enabler*** aspect of the ***EFFRA Framework,*** support constant information feedback without breaks between product designers, engineers, state-of-the-art production facilities, and customers. Significant benefits that accrue are a better focus on desired organizational performance outcomes and maximising the use of human talent and physical resources. Consistency of outcomes and effective control of variations result. Fact-based management is then utilised to set realistic goals and strategic direction.

The ***fifth*** essential ***"people development and involvement"*** is of utmost importance considering the major influence of Industry 4.0 key enabling technologies (KETs) in organizational innovative continuous improvement initiatives. For manufacturing firms, this needs to be aligned with ***Domain 5 Human-centred Manufacturing*** of the ***EFFRA Framework*** for enhancing the role of people. The workforce must be properly educated and trained in the technicalities and application of these technologies. The information generated in the factory environment, which needs to be managed and adequately transformed from the data level to the knowledge level, is at the core of modern manufacturing.

Information in this respect must be fully understood and utilized by workers at all organizational levels and business processes of the value chain. The full potential of an organization's people is best released through shared values, and a culture of trust and empowerment, which encourages the involvement of everyone. This leads to significant benefits related to maximising participation of the human resources and creating positive attitudes and high morale. It will result in effective sharing of knowledge and opportunities for people to learn and develop new skills. Positive organizational recruitment and retention will emerge.

The ***sixth*** essential ***"supporting continuous learning, innovation, and improvement in the organization"*** is of utmost importance for innovative continuous improvement initiatives. For manufacturing entities these essential needs strong alignment with ***Domain 1: Advanced Manufacturing Processes, Domain 2: Adaptive and Smart Manufacturing Systems, Domain 3: Digital, Virtual, Resource Efficient Factories,*** and ***Domain 5*** alluded to above of the ***EFFRA Framework***. These Domains focus on innovative processing for both new and current materials or products; innovative manufacturing equipment at component and system level, including mechatronics control and monitoring systems; factory design, data collection and management, people development, as well as operation and planning, from real-time to long term optimisations approaches.

Organizational performance is maximised when based on the management and sharing of knowledge within a culture of continuous learning, innovation, and improvement. Organizational agility and flexibility will result, which is a hallmark of the digitalised virtual dynamic learning organization ***(VDLO)***. For organizations, including manufacturing firms, this leads to performance optimisation, opportunity identification, and cost reduction. Importantly, also to prevention-based innovative improvement activities within the daily work of all associates. ***Information and Communication Technologies (ICT)*** as a ***Key Technologies and Enabler*** aspect of the ***EFFRA Framework*** also plays a profoundly important role in the sixth essential.

The ***seventh*** essential **"partnership development"** is of paramount importance in the Industry 4.0 economy with the advent of virtual networks of partners to assist with innovative product design and development projects, and other supply chain and functional activities (Semolič and Steyn, Sept 2017). Hence, it needs to be aligned with ***Domain 4: Collaborative & Mobile Enterprises*** of the ***EFFRA Framework*** focusing on networking and dynamic supply chains. Collaboration between multiple partner organizations is becoming essential in Industry 4.0 and onwards in daily operations. Small, medium, and large enterprises stand to gain profoundly from collaboration solutions in their virtual partner networks ***(VNPs).***

Through ***collaboration,*** businesses can sell products as a service and certified suppliers can offer value-added services such as maintenance and upgrades to customers. Moreover, capability-based contracts offer use-based billings from partners or subcontractors instead of requiring upfront investments in machinery. Uptime is assisted by remote service management, while reducing travelling costs for servicing, increasing service efficiency, and accelerating innovation processes through remote updating of device software.

Modern firms work more effectively when mutually beneficial relationships are formed and built on trust, and knowledge and integration are ***shared with partners.*** Significant benefits result from the ability to create value for all parties forming part of the partnership arrangement. More benefits are synergy that results concerning resources and costs, and the competitive advantage gained by firms through ***relationships*** that endure between partners.

The ***eighth*** and final essential is **"public responsibility".** The long-term interests of organizations and its people are best served by adopting an ethical and sustainable approach and exceeding expectations related to the economic, social, and environmental aspects of the ***Challenges and Opportunities*** component of the ***EFFRA Framework.*** Moreover, economic sustainability also relies on optimal implementation of the whole

range of the ***EFFRA Framework's Key Technologies and Enablers*** in particular involving ICT, and mechatronics for advanced manufacturing. Addressing economic performance across the supply chain is of profound importance for public responsibility since it delivers cost-efficient production and reduces market prices.

Social sustainability means increasing human achievements in operations systems and organizing and designing to ensure that organizations remain socially sustainable and competitive. Interdisciplinary research and innovation must provide the basis for the design of adequate environments and workplaces. Environmental sustainability means reducing energy consumption and using renewable energy where possible. Breakthroughs in technologies supporting renewable energy are of high importance. Reduction of resource consumption should include water, emissions, and noise that do not end up in the final product. Significant benefits that accrue are credibility, performance, and enhancement of organizational value-add. Moreover, the public awareness, safety, trust, and confidence that people have in organizations are also enhanced.

2.5 The Plan, Do, Check, Act *(PDCA)* Cycle

Paragraph 2.2 alluded to the balanced scorecard strategy map playing a ***dual role*** in the quality management system ***(QMS).*** The discussion now returns to the second role the strategy map plays, i.e., when process output key performance measurements become available and are fed back to the strategy map for appraisal and review against the critical success factors ***(CSFs)*** concerning benefits of strategic importance accrual.

Dr Edward Deming is globally recognised as the "father" of total quality management ***(TQM)*** and creator of the ***Plan, Do, Check, Act (PDCA)*** cycle for continuous improvement. He was instrumental in developing the concepts of innovative continuous improvement for creating value-add in organizations, and urging them to arduously apply his ***fourteen elements of Six Sigma*** demonstrated below:

- Create constancy of purpose to improve the organization's products and services. Consistency of purpose calls for focusing on strategic goals and objectives. Share information and promote team involvement in the planning and implementation of change.
- Adopt the total quality management philosophy to add effective value to the organization.

- Become dedicated to continual, rapid improvement in quality, cost, response times, flexibility, variability, and service.
- Cease dependence on inspection to improve quality. Make it easier to provide goods or services without error or process variation.
- End the practice of awarding business based on price alone.
- Constantly improve the production and service systems in the organization.
- Institute training on the job. This means that organizations should continually invest in human resources through cross-training for mastery of multiple skills, and education.
- Make certain that leadership acumen and excellence are given high priority in the organization.
- Drive out fear, instead build trust and support through good leadership.
- Break down barriers between departments by improving communication through cross-functional high-performance teams. Organise resources into multiple chains of customers.
- Eliminate slogans and exhortations.
- Remove barriers to pride of workmanship.
- Institute a programme of self-improvement.
- Put everyone to work to accomplish the transformation.

The above elements championed by Dr Deming promote a commitment to continuous improvement. It means that organizations, including manufacturing firms, must adopt practices that encourage employees to continually identify and act upon opportunities to improve and develop the virtual dynamic learning organization ***(VDLO)*** and encourage double loop learning and knowledge management to prosper. Based on the above principles Deming proposed the Plan-Do-Check-Act ***(PDCA)*** Cycle of continuous improvement, also known as the “Deming Wheel” as illustrated in Figure 8.

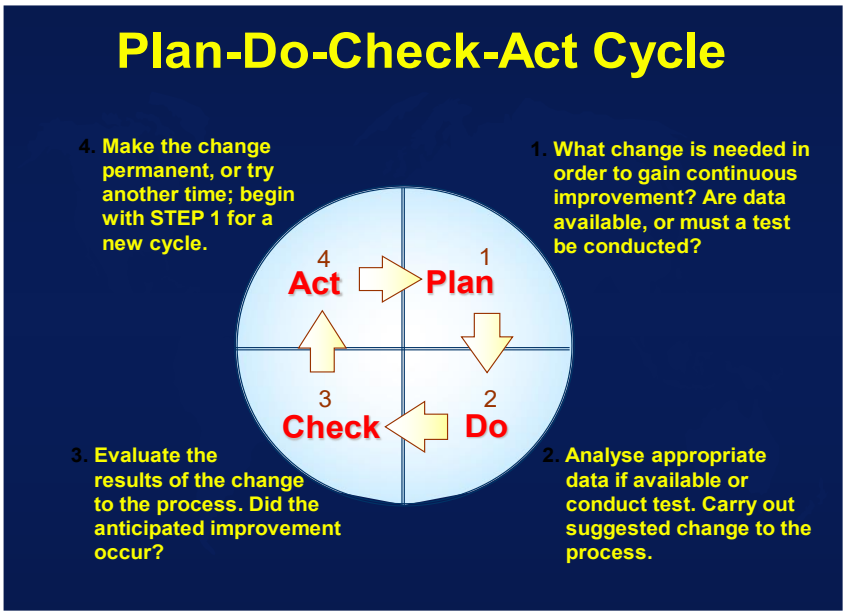

Figure 8: The PDCA Cycle for Continuous Improvement Projects

Note the questions that are asked at every stage of the project-managed continuous improvement ***PDCA cycle***, and the correlation with the project life cycle's conceptualisation, development, implementation, and termination phases. Continuous improvement project deliverables that comply at Step 3 "Check", are made operational at Step 4 "Act", and enhance the effectiveness and efficiency of the organizational behavioural, structural, and/or operational strategy aspects. When a quality management system ***(QMS)*** is in place the organization confirms its commitment to continuous improvement, as well as systems thinking, knowledge management, and learning. It will adopt practices that encourage employees to continually identify and act upon opportunities to improve.

Moreover, it makes certain that a strategy is in place for transforming into a virtual dynamic learning organization ***(VDLO)*** and encouraging double-loop learning and knowledge management. All production activities (including projects) in functional and cross-functional processes are aligned with critical success factors ***(CSFs)*** in a balanced scorecard strategy map. Functional and cross-functional value chain process outputs are regularly measured using key performance indicators ***(KPIs)*** linked to the critical success factors ***(CSFs).*** This is followed by appraisal and review of the results stemming from the measurements to assess the degree of strategic benefits achieved. Reviews identify ***continuous improvement projects, the*** implementation of which will improve organizational performance and excellence.

3. COMMIT TO A CONTINUOUS IMPROVEMENT STRATEGY

The above discussion stresses the importance of organizations, including manufacturing firms, being fully committed to the strategy of continuous improvement. Practices must be adopted that encourage employees to continually identify and act upon opportunities to improve concerning behavioural, structural, and operational strategic dimensions. As alluded to earlier this will result in transforming organizations to become virtual dynamic learning organizations ***(VDLOs)*** where double loop learning and knowledge management are encouraged by adopting a quality management system ***(QMS)*** as discussed in the preceding sections. Typical ***innovative continuous improvement initiatives*** are inter-alia:

- Business process reengineering.
- Information systems improvement.
- Infrastructure enhancements.
- Production process improvements.
- Logistics value chain improvements.
- Product/service delivery improvements, and development initiatives such as:
- Product research and innovation development (RID) projects.

Due to the high technology nature (key enabling technologies or KETs) of the Industry 4.0 economy, continuous improvement projects are becoming more regular. For superior performance, an organization must be committed to a strategy of innovative continuous improvement. As discussed earlier the appraisals and reviews emanating from innovative continuous improvement often indirectly trigger capital investment projects that also contribute to organizational performance.

To be successful organizations must prioritise projects in the innovative continuous improvement ***"funnel and gates"*** process and allocate resources concerning maximising the benefits of strategic importance related to its mission. A baseline plan must be created for each project, including a sound project schedule, budget and effective high-performance team (Burke, Rory 2023). Proper monitoring and controlling must occur during implementation and the innovative change actions must be efficiently managed. All projects done as innovative continuous improvement initiatives must follow the "funnel and gates" model of structuring the process, as shown in Figure 9. Ideas

emanating from the review process of the quality management system ***(QMS)*** are then channelled into the funnel as initiatives.

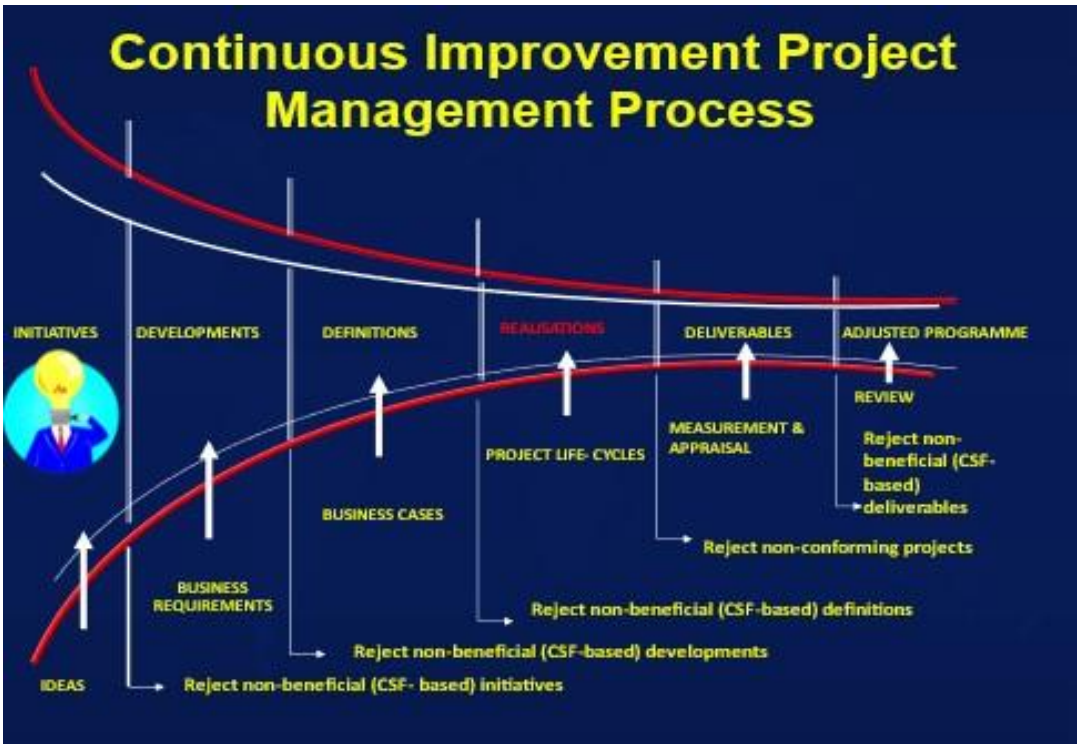

Figure 9: Funnel and Gates Process for Innovative Continuous Improvement Projects

At the ***first gate*** initiatives deemed non-beneficial for the organization are rejected. Business requirements are added to those initiatives that make the grade and become what is known as potential developments. At the ***second gate*** developments that are deemed non-beneficial for the organization are rejected. The developments that make the grade then become ***definitions*** when the business case information is added from sponsors.

All four of the project life-cycle phases, i.e., conceptualisation, design, implementation, and termination, fit into the ***realisation*** space of the funnel and gates. Only business cases that are not rejected as non-beneficial at the third gate become projects for implementation. Only projects that are not axed during the realisation phase of the funnel and gates, pass through the ***fourth gate*** and become ***deliverables.*** Deliverables are then also subjected to measurements, appraisals, and reviews. Those that qualify during appraisal are then made permanent, meaning these are accepted as true improvements that will bring benefits of strategic importance to the organization.

4. THE GROWING IMPORTANCE OF PROJECT INITIATIVES IN PERFORMANCE MANAGEMENT

It was earlier discussed how the ***VDLO value chain schematic*** depicted in Figure 2 demonstrates the systems logic of the balanced scorecard and programme-managed project and supply chain portfolios. The Industry 4.0 ***VDLO value chain*** embeds the ***Supply Chain Portfolio*** housing two cross-functional project processes. These are the ***"Project Initiatives for External Customers"*** and "***Product Development and Commercialisation"*** processes. Moreover, the value chain also embeds the ***Continuous Improvement Project Portfolio, Capital Expenditure Project Portfolio,*** and ***Strategic Transformation Project Portfolio.***

The main initiating component of the ***quality management system (QMS)*** is the operational outputs of the cross-functional ***supply chain,*** which include the ***"Project Initiatives for External Customers"*** and "***Product Development and Commercialisation"*** processes. The first process engages in doing contracted projects for external customers, while the latter process engages in ***research, innovation, and development (RID) product*** and service projects. When appraisals and reviews of the supply chain process outputs are done and shortcomings occur in the accrual of strategic benefits, this information is diverted to the "***Continuous Improvement Project Portfolio"*** to initiate innovative continuous improvement projects.

Appraisals and reviews sometimes also highlight the need for development projects to be done in the ***"Capital Expenditure Project Portfolio",*** the deliverables of which also enhance the organization's performance. Hence, the quality management system ***(QMS)*** demonstrates how innovative continuous improvement initiatives originate through metrics, often spurring capital expenditure initiatives. Although the ***Strategic Transformation Project Portfolio*** is not a permanent fixture and is only introduced when more radical strategic organizational transformation is required it is still functionally treated as a normal project portfolio linked to the ***Quality Management System (QMS).*** Hence ***five different types*** of ***project initiatives*** are elements of the ***QMS.***

The important roles played by the different components of the ***QMS*** shown in Figure 3 are as follows:

- The ***Balanced Scorecard*** in its ***Strategy Map*** form defining the organization's ***mission*** in its strategic themes and containing the important organizational ***critical success factors (CSFs)*** used for appraisal and review decisions.

- The adapted ***Harvey and Brown Organizational Performance and Improvement*** model focusing on the effective behavioural, structural, and operations strategic dimensions for organizational performance.
- The ***European Forum for Quality Management (EFQM) Excellence*** model consists of ***Enablers and Results.*** The main ***"Enabler"*** is Leadership, followed by People, Policy, and Strategy; Partnership and Resources; and the Processes delivering results. The ***"Results"*** are People results, Customer results, Society results, and Key Organizational Performance results.
- Results measured by ***key performance indicators (KPIs)*** are then fed back to the ***Balanced Scorecard Strategy Map*** discussed above and appraised using the relevant ***critical success factors (CSFs)*** as the norm. Where appraisals indicate that benefits of strategic importance fail to accrue to a satisfactory degree the ***PDCA*** reviews for innovation and improvement are triggered.
- The ***Plan, Do, Check, Act (PDCA)*** cycle is the final component of the ***QMS.*** It generates innovative continuous improvement project deliverables ensuring that behavioural, structural, and operational deficiencies are addressed and improved organizational performance achieved.
- Note that although not ***central components*** of the ***QMS***, development ***project deliverables*** emanating from the ***Capital Expenditure Portfolio*** and ***Strategic Transformation Portfolio*** contribute to improved organizational performance which is then measured by the collective ***supply chain process outputs.***

It must be noted that when appraisals and reviews indicate that benefits of strategic importance are not accruing to a satisfactory degree:

- ***Continuous Improvement Project Portfolio*** projects which enhance organizational performance are commenced via the ***PDCA*** cycle.
- This often highlights a need for ***Capital Expenditure Project Portfolio*** development projects for enhancing organizational performance.
- When operational, the ***Strategic Transformation Project Portfolio (OD)*** development projects also enhance organizational performance.

Moreover, ***development project deliverables*** of the ***Capital Expenditure Portfolio, Strategic Transformation Portfolio,*** and ***Product Development and Commercialisation"*** research and innovation development ***(RID)*** projects need to be measured in two ways:

- Firstly, by project management ***team members*** for ***Business Case*** alignment purposes.
- Secondly, the ***effects of the deliverables*** need to be measured by SC process ***output management*** for ***QMS*** performance purposes.
- ***VDLO*** performance is measured continuously in an integrated and coordinated ***QMS***.

From the above, it is evident that Industry 4.0 modern-minded organizations are engaged in an array of different ***project types*** managed from ***five different project offices*** spread throughout the ***VDLO*** value chain. Moreover, organizational performance is measured continuously using a fully integrated and coordinated ***Quality Management System (QMS).***

It needs to be stressed that in addition to the above, key technologies and enablers, business models, and strategies demand new relationships, knowledge, technical competencies, and a sound corporate culture. This requires collaboratist leaders who are role models of embedding collaborative, integrative, and cooperative mindsets in modern firms and ensuring sustainability in the economic, social, and environmental spheres. Moreover, research and innovation priorities need to be focused on advanced digitalized and integrated products, services, and organization (manufacturing) processes; adaptive and smart organization (manufacturing) systems; digital, virtual, and resource-efficient factories; networked organizations (factories) and dynamic supply chains; and human-centered and customer-focused operations and services (including manufacturing).

5. CONCLUSIONS

Existing and new Industry 4.0 technologies provide opportunities for organizations to increase the value of their products, services, processes, and systems to all stakeholders and entirely redesign their businesses. Organizations implement and maintain this value through new enabling technologies, new business solutions, new flexible, interconnected, harmonized, optimized technological and business processes, and more user-friendly organizational structures and workplaces.

These novelties require new competencies, a change in corporate culture, and changes in the industry business environment. Successful transformation of the whole industrial sector towards Industry 4.0 involves a mix of radical and revolutionary changes at the organization/company level, in the value/supply chains, innovation ecosystems, and at

regional, national, and international levels (corporate legislation change, regulation of markets, collaboration enhancement, etc.).

The QMS and EFQM models discussed earlier are critical and indispensable concepts and practices that must be integrated into all operations and transformation processes, enabling value creation for all stakeholders.

Some commentators advocate that a new industry revolution is on hand - Industry 5.0 (or even 6.0). They claim that Industry 5.0 is more "people-centric" and deals with collaboration challenges between humans and machines, problem-solving skills, decision-making abilities, and creativity. However, based on their knowledge of how technology innovations generate "technology revolution" type changes the current authors believe that the “Industry 5.0 claim” is really part of the development phase of Industry 4.0

Moreover, Freeman avers about change in the techno-economic paradigm that develops Schumpeter’s “creative gales of destruction” concept – massive transformations associated with the diffusion of a new techno-economic paradigm involving radical innovations and new technological systems with economy-wide applications and effects (Monck & Co, 1988). Industry 4.0 enabling technologies undoubtedly generated preconditions for such changes - Schumpeter's "*creative gales of destruction*," which create profound opportunities to revolutionize, redesign, and improve businesses, industries, society, and people’s daily lives.

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