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Editor's Notes

Welcome to the second issue for 2020. First, It is with great pleasure that I introduce our new member of editorial board. Adriana B. Rodriguez, PhD in Industrial Engineering and a performance improvement project manager at BayCare, one of the largest healthcare systems in the US, and holds the ASQ Master Black Belt and SME Lean Silver certifications. I would like to say my "Big Thank You "to Adriana for accepting my invitation to contribute in this and future issues. All short bios of editorial board members have attached to the last pages.

This issue includes three articles across the spectrum of Quality, Excellence and Operational Research fields. The first article is *"Transition to Quality 4.0,"* by Marcio C. Machado. This article presents insights for this transition. Issues with human factors, leadership, flexibility, competitiveness, and new product development are presented as challenges for Quality 4.0

The second article is, *"What is the Global OE Index?"* by Dawn Ringrose. This article describes what happened behind the scenes of the inaugural research project that was launched in 2015 and led to the development of the Global OE Index. Initially referred to as 'the first global assessment on the current state of organizational excellence', the research was characterized by foundational elements that have been part of the process and has evolved with lessons learned. The project is intended to provide benefit to the excellence community in general and the working population at large.

Our third article is, "How to Leverage Lean for a Scaling Healthcare Transformation," by Adriana B Rodriguez. This paper suggests the integration of the four pillars of Lean with other concepts like Customer Experience, applications of AI and Robotization, and Big Data to create a strategic network that allows mutually beneficial interactions among the ecosystems and the whole system to pursue a common goal.

The last pages of QOR Newsletter include:

- "Important announcement for ONLINE ICQEM20," by Paulo Sampaio
- "Operational Research for Developing Countries novel contributions --- online, at IFORS," by Gerhard Wilhelm Weber
- "Opportunity to work with Global Research Team," by Mohammad Hossein Zavvar Sabegh

You are cordially invited to submit articles QOR Newsletter, working individually or in collaboration with others. Your submissions are much appreciated and will contribute to the early development and success of the QOR Newsletter.

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Transition to Quality 4.0

Marcio C. Machado, Ph.D
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Abstract:

Industry 4.0 brings challenges for companies in all sectors. Transitioning from a traditional business approach to an entirely digitized one will require transition mechanisms for change for all business processes and systems. Therefore, quality must also undergo adaptations to what can be called Quality 4.0. This article presents insights for this transition. Issues with human factors, leadership, flexibility, competitiveness, and new product development are presented as challenges for Quality 4.0.

Keywords: *Quality 4.0, Connectivity, Big data, Competitiveness*

Introduction

Companies that produce manufactured goods, provide services, or resell products are facing new challenges that go beyond traditional operational performance improvements. The technologies of industry 4.0 have had a substantial impact on the manufacture and supply of products and services, and, naturally, these technologies can also boost quality in operations and production. Modern technologies and platforms, such as social media, Internet of Things (IoT), Cloud Computing (CC), Artificial Intelligence (AI), and Cyber-Physical Systems (CPS), have boosted several fields in the productive sector, including industry (Sader et al., 2019).

The concept of Quality 4.0 is not new. As highlighted by Sisodia & Forero (2020), later 90's studies say that advancements in Communications and Information Technologies would automate quality functions. Furthermore, after 20 years "quality professionals should then shift focus to anticipating change and integrating new concepts into business models"(Sisodia & Forero, 2020). A large amount of data on operating and maintenance conditions generated, from the interconnection of just one machine, will require significant quality analysis and value from quality. Therefore, quality 4.0 professionals should be able to deal with not only a large amount of data but also the identification of its correct application because it will be the processes that determine the use of the data and not the other way around (Sisodia & Forero, 2020).

Sisodia & Forero (2020) also proposed the following definition for Quality 4.0:

"Quality 4.0 refers to the digitalization of Total Quality Management and its impact on quality technology, processes and people. It builds upon traditional quality tools and considers also connectedness, intelligence and automation for improving performance and making timely data-driven decisions in an end to end scenario, involving all the stakeholders and providing visibility and transparency." (Sisodia & Forero, 2020, p.35).

One of the models that represent the quality in the context of Industry 4.0 is presented in Figure 1. The model proposed by Lim (2019) considers quality 4.0 as the integration of Information Technology (IT) and Operations Technology (OT) mediated by Human Intervention. Despite its generic approach, the model sheds light on different aspects of the quality 4.0 transition.

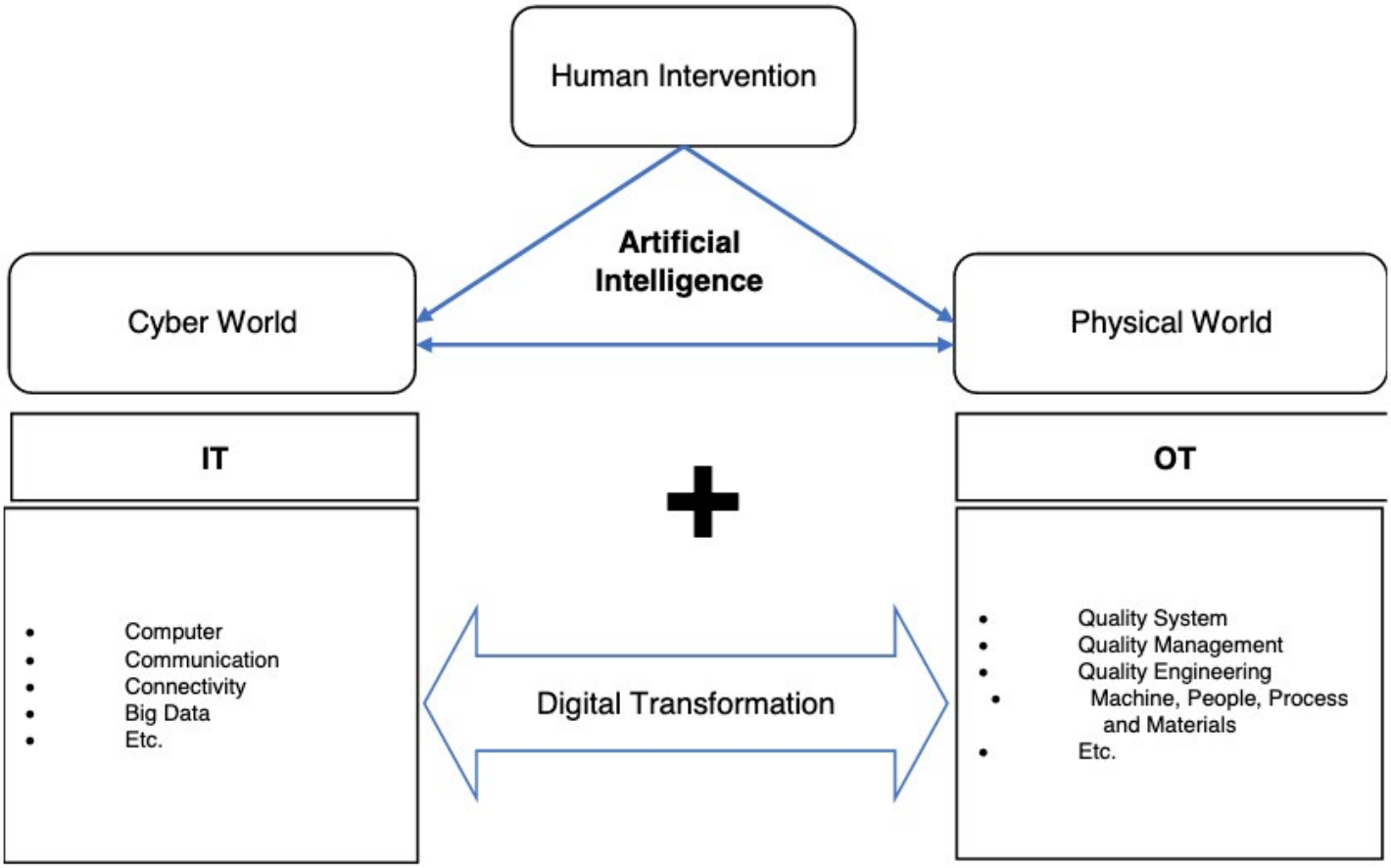

Figure 1: Adapted from Lim (2019)

In this context, the big challenge is to understand how to make the transition to this new perspective, Quality 4.0.

Discussion

To make the transition to Quality 4.0, organizations and managers need to identify which key elements make the transition. Besides, it is necessary to develop skills that make it possible to determine the real applicability of each of the new technologies and approaches. Therefore, Quality 4.0 should be data-driven, as should be engineering requirements, engineering calculations, testing, modeling, and simulations. These traits bring changes to quality engineers' hole from eminently technical to decision-maker and quality engineering as a discipline. Zonnenshain & Kenett (2020) bring some examples of this change:

- Bring as much diverse data and as many different viewpoints to any situation as they possibly can
- Use data to develop a deeper understanding of the business context and the problem at hand,
- Develop an appreciation for variation, both in data and in the overall business
- Deal with uncertainty and the possibility that you may make mistakes
- Recognize the importance of high-quality data and invest in trusted sources and in making improvements.

In this way, advances in quality arising from the technologies of industry 4.0 will require a new workforce and leadership. As we can see, the human factor will play a central hole on the transition to Quality 4.0. Senior management should lead the process of adapting, implementing, and applying advanced manufacturing technologies, and set strategic quantitative and qualitative goals for the development of advanced manufacturing. Communication and work teams with customers and the market will need to use innovative and advanced information technologies. Engineers will need to review the various operational processes to adapt them to advanced manufacturing technologies. Managers and workers will be trained in the skills needed for advanced manufacturing. Multifunctional teams will perform an analysis of the company's productivity improvement due to the implementation of advanced manufacturing technologies and methods (Zonnenshain & Kenett, 2020).

Quality flexibility is another critical objective to transition to Quality 4.0. Kubat (2018) says that quality needs a flexible software platform because "quality is a moving target," and being flexible, quality can adapt to an in-flux factory environment. Cyber-Physical Systems can help manufacturing systems by simulating production scenarios to operate at the optimum situation, minimizing the time required to design and test the production system and improve process flexibility (Sader et al., 2019). However, flexible systems, adapted to the unique and fluctuating needs of the factory, can be expensive to implement and maintain. This situation brings another challenger to the transition.

Results

This article searched in the recent literature for evidence of key elements for transition to Quality 4.0.

Zonnenshain & Kenett (2020) stressed the importance of integrating reliability engineering with quality engineering through two parallel efforts:

- Upgrade the effectiveness of reliability engineering for systems development using the opportunities of the new era, like Big Data analytics, Prognostics and Health Monitoring (PHM), and modeling and simulation
- Integrate the reliability engineering processes with the quality engineering processes Concerning Business Excellence Models, the combination of the organizational excellence and the Quality 4.0 concept will require also considerable investments and a wholly new work position development (Nenadál, 2020).

According to Sader et al. (2019), quality professionals need to pay attention to some key points when transitioning to the integration of TQM and Industry 4.0. First, it is necessary to assess the impact of data privacy and security on quality issues and, second, to develop a process to maintain the flow of information related to quality management avoiding data loss or inaccuracy.

In this sense, in their narrative literature review, Sony et al. (2020) identified eight key ingredients for the implementation of Quality 4.0. These called key ingredients were categorized, and they were collated into higher-order themes. The key ingredients were as follows: (a) handling big data, (b) improving prescriptive analytics, (c) effective vertical, (d) horizontal and end-to-end integration through Quality 4.0, (d) use Quality 4.0 for strategic advantage, (e) leadership in Quality 4.0, (f) training in Quality 4.0, (g) organizational culture for Quality 4.0 and (h) top management support for Quality 4.0. They were summarized and are presented in Table 1:

Table: 1 – Key ingredients for the implementation of Quality 4.0.

KEY INGREDIENTS	DEFINITION
HANDLING BIG DATA	Means to cope with Big data in terms of volume, variety, and velocity of the generation of new data. These big data can be used in Quality 4.0 for improved quality of design, quality of conformance, and quality of performance of products and services.
IMPROVING PRESCRIPTIVE ANALYTICS:	These prescriptive analytics algorithms in quality management can, in terms of human levels, provide recommendations for quality of design, quality of conformance and quality of performance, or appoint intelligent algorithms that will result in decision automation through machine learning.
USING QUALITY 4.0 FOR EFFECTIVE VERTICAL, HORIZONTAL, AND END-TO-END INTEGRATION:	Vertical integration creates a flexible and reconfigurable manufacturing system through, for example, an informational system. Horizontal inter-organizational integration leads to corporations among companies. End-to-end integration is the integration of all activities, which are product-centric value creation.
USING QUALITY 4.0 FOR STRATEGIC ADVANTAGE:	The continuous improvement by using both digital technologies and big data can conduct to a strategic advantage.
LEADERSHIP IN QUALITY 4.0:	It is necessary to extend the Knowledge-oriented leadership to incorporate innovative role-modeling, stimulating knowledge diffusion, supportive behavior, delegation, consulting, and mentoring.
TRAINING IN QUALITY 4.0:	Quality 4.0 skills such as installing and operating IT, RFID tags, and big data analysis, even as the transformational skills such as adaptability, critical thinking, creativity, and social skills will be required from employees.
ORGANIZATIONAL CULTURE FOR QUALITY 4.0	Adhocracy and hierarchical culture should be balanced in an organizational transformation for Quality 4.0.
TOP MANAGEMENT SUPPORT FOR QUALITY 4.0:	Quality 4.0 implementation faces different challenges such as resistance from stakeholders and implementation of change initiatives than top management support is critical for Quality 4.0 success.

Conclusion

Competitiveness between companies will force the transition to Quality 4.0. Artificial intelligence can offer companies more insights into products and processes of superior quality, impacting not only the company's operations but also those of its suppliers. This set of possibilities leads to the offer of better products on the market, increases the organization's competitiveness, and brings a new challenge to the competitive scenario.

Connected products, inventories directly associated with quality records, quick solutions to problems related to the quality process, reduced process audits, and improved supplier relationships are some of the numerous challenges imposed by the transition to Quality 4.0. Interconnectivity and Big data led the company towards an integrated approach of customers, suppliers, company, process, and products towards quality 4.0.

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What is the Global OE Index?

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Abstract

This article describes what happened behind the scenes of the inaugural research project that was launched in 2015 and led to the development of the Global OE Index. Initially referred to as 'the first global assessment on the current state of organizational excellence', the research was characterized by foundational elements that have been part of the process and has evolved with lessons learned. The project is intended to provide benefit to the excellence community in general and the working population at large.

Introduction

It is surprising there has never been an index that captured the current state of organizational excellence. While the field of organizational excellence (OE) has defined the principles and best management practices of high performing organizations (excellence models) and recognized organizations that have successfully implemented such, there has never been research that has captured the current state of excellence. This article describes what happened behind the scenes of the inaugural research project that was launched in 2015 and has led to the development of the Global OE Index. It shares the foundational elements that have been part of the process and the lessons learned and revisits the benefits this research was anticipated to provide to the excellence community in general and the working population at large.

A Team Project

Back in 2015, the Executive Members of the Organizational Excellence Technical Committee QMD ASQ were discussing a potential team project and a decision was made to conduct research on the current state of excellence. Dawn Ringrose was asked and agreed to lead the project, using the Organizational Excellence Framework model and automated assessment and reporting tool. At that time, it was anticipated the study would take two years to complete and understood the project would have $0 budget.

It was an exciting project as excellence models had defined the principles and best management practices that were common to high performing organizations [1,2,3,4,] research over the past 25 years had validated the positive relationship between implementing these models and improving organizational performance [5,6,7,8,9,10] and award programs had recognized organizations that had successfully implemented the models [11]. But even with all this good work, there had been a noticeable gap – *What was the current state of OE anyway?* This question needed to be answered!

Data collected on the current state of organizational excellence had been lacking as the research to date focused on national excellence award recipients, an elite group of organizations that had worked hard to successfully implement excellence models and earn recognition.

To capture the current state of OE, it would be important to collect data and information on a random sample of organizations that would provide a good cross-section of respondents by:

- Role – leadership, management, staff, other
- Size – micro (1-25 employees), small (26-100), medium (101-999), large (1000+)
- Type – business, government, non-profit
- Industry Sector:
    - o General – service or manufacturing
    - o Specific – 21 sectors and sub-sectors (International Standard Industrial Classification)
- Country or Region – 218 countries or 7 regions (World Bank Analytical Grouping)
- Varying Level of Awareness – knowledge, understanding and experience with excellence models

Such a collection of data and information would provide a snapshot of current state and capture the extent to which organizations had a culture committed to excellence and had deployed best management practices!

Assessment Instruments

Two assessment instruments were used for the study - Teaser Assessment and Full Assessment. The Teaser Assessment gathered feedback on the culture of excellence in the organization while the Full Assessment gathered feedback on the culture and also the deployment of best management practices.

Several incentives were offered to respondents:

- All respondents could learn more about high performing organizations. They were invited to download a complimentary copy of the Organizational Excellence Framework, a 240-page publication that defined the principles and best management practices common to high performing organizations and shared implementation guidelines for the user
- Respondents to the Teaser Assessment received a complimentary feedback report that was delivered directly to their inbox. This report identified the interrelationships between low rated principles and directly related best management practices
- Respondents to the Full Assessment could reflect on how their organization measured up to high performing organizations as they participated in the self-assessment exercise
- All respondents could compare their organization to others by viewing the real time dashboards on the webpage *https://organizationalexcellencespecialists.ca/workshops-events/global-oe-index/* and reading the more detailed final report

Both assessment instruments provided space for open-ended comments and collected demographic information about the respondent and the organization. During preparation of the final report, it was noted there were over 200 pages of open-ended comments! These comments provided real rationale for the ratings and valuable insights about what was going on within organizations. To uphold the promise of confidentiality, the demographic information was maintained in strict confidence and in accordance with privacy legislation in Canada and New Zealand. And respondents were not contacted again other than to invite additional participants from their organization.

To assure reliability and validity:

- The automated tool allowed the respondent to seek additional information as they moved through the assessment. By holding their cursor over the statement or rating scale, the respondent accessed more information to clarify the meaning
- Respondents in leadership and management roles were recruited given their knowledge and experience with the management system
- Respondents were asked to be open and honest in the self-assessment exercise and assured their information would remain confidential
- Up to three respondents from each organization were invited to participate in the research. And in cases where there were multiple respondents, both ratings and open-ended comments were analyzed to gauge variability
- Researchers strived to attract a desired number of respondents by size, industry sector and country. With a significant sample size estimated at 9,000 respondents this was a daunting task. For the final report published in April 2019, this sample size was not achieved but there were a good cross-section of respondents that allowed aggregate reporting by size, industry sector and region

Research Team

Throughout the project, researchers appealed to a wide audience hoping there would be interest in collaborating on a project intended to provide benefit to all. These audiences included but were not limited to:

- Leaders at national excellence award programs
- Members of LinkedIn and social media groups such as Facebook and Twitter
- Delegates at international conferences
- Executive Directors at industry and professional associations
- Country members of ISO TC 176
- Readers of excellence related newsletters

It is important to note, the appeal that returned the best response rate of all was the researchers using a personal approach to reach out to their contacts. Towards this end, over 400 volunteer researchers were recruited around the globe and generously agreed to dedicate time to the study! These researchers are acknowledged in the Final Report as Contributors in Appendix 3. *They are the rock stars of this study as they represented a grass-roots effort that made the Global OE Index a reality!*

Key members of the research team included:

- Members that led and guided the project: the Project Leader, Dawn Ringrose; Assistant to the Project Leader, Mohammad Hossein Zavvar Sabegh; Project Advisor, Paulo Sampaio
- Core Research Team members that committed to recruiting respondents from their country over a longer time frame

- Support Research Team members that were dedicated to recruiting a given number of respondents over a shorter time frame

To provide guidelines for the research team, the Project Leader and Project Advisor developed a Project Charter. The Charter communicated authorization and provided a description of the project along with risks, assumptions and constraints. In addition, monthly online meetings were held to speak about progress to share creative approaches and best practice. The Assistant to the Project Leader workeddiligently to follow up with the Support Research Team members to track progress, offer encouragement and develop creative approaches to increase the response rate. To establish a strong sense of team, a private LinkedIn site supplemented the foregoing efforts and provided a forum where members could communicate regularly about the project.

Throughout the study interim reports were published on the OETC LinkedIn site, articles were written for BPIR and the Global Benchmarking Network newsletters and presentations were made by researchers attending domestic and international conferences in a number of countries such as: Canada, China, India, Iran, New Zealand, Slovenia, Spain, United Arab Emirates, United States. And internally, reports were developed for the researchers that captured the number of respondents by size, industry sector and country so the team understood what had been accomplished and what needed to be done.

The final report was published in April 2019 and shared the aggregate results for 1,079 respondents that offered a good cross-section of the desired population by organization size, industry sector and region. It was exciting to have a number of high responding countries and a decision was made to prepare more detailed reports that would highlight the current state of a given Country versus Other Countries. A series of blogs for these countries were published on the webpage and more detailed presentations were placed in the hands of researchers that made presentations to local and international audiences. These presentations shared not only the aggregate results but also invited attendees to participate in the conversation about what was going well, what needed to improve and next steps. It was a real grass-roots community effort!

Benefits

As envisioned, the global research study has provided benefit for all stakeholders - the excellence community in general and the working population at large.

Such benefits included, but are not limited to:

- Uniting the excellence community on a common project
- Encouraging organizations to start or continue their improvement journey using an excellence model
- Making organizations aware of best management practices that will help improve performance
- Providing dashboard results that show the extent to which organizations have a culture committed to excellence and have deployed best management practices
- Building on strengths and identifying opportunities for improvement
- Encouraging organizations to assess current state
- Sharing aggregate results and encouraging organizations to compare current state with others
- Making organizations aware of awards should they want to be recognized for their commitment
- Developing long term potential through improving the performance of organizations that will ultimately:

o Contribute to a local economy, trade and resident quality of life

o Enable all countries to participate, in a more competitive and sustainable way in the global economy

o Make the world a better place for future generations

Next Steps

Looking back to the beginning of the study, it was anticipated the project would take two years to complete. This was indeed wishful thinking as it was five years before a preliminary final report could be published! But it was worth it, as this inaugural report provides tremendous insights about what is going well and what needs to improve. And it has generated some excitement around the world about how we can work collaboratively toward a common aim and work together to raise the bar.

After the final report was published in April 2019, a decision was made to continue the study. After all, it simply made good sense considering that:

- Much work remained to achieve the desired sample size and to develop a more robust report
- Respondents have shared through open-ended comments how valuable the assessment exercise had been for their organization
- Industry sectors have been curious about how their members can work together to improve performance
- Excellence communities have expressed interest in how their country compares to Other Countries and how they can be more involved
- Governments appreciate their role in encouraging organizations to improve performance so these undertakings will make a positive contribution to the economy, trade and resident quality of life

It is indeed encouraging to know this global research project has been living up to the anticipated benefits!

Accordingly, we invite all like-minded others to join us in making this Global OE Index a robust and valuable index that will continue to deliver value to the excellence community in general and the working population at large. I really believe it is all about TEAM – *Together Everyone Achieves More.*

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How to Leverage Lean for a Scaling Healthcare Transformation

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Abstract

Transforming healthcare into an affordable, accessible, and high-quality health system is a long-term journey where diverse factors, and ecosystems interact independently and sometimes with different and competing objectives.

This paper suggests the integration of the four pillars of Lean with other concepts like Customer Experience, applications of AI and Robotization, and Big Data to create a strategic network that allows mutually beneficial interactions among the ecosystems and the whole system to pursue a common goal.

The applications of some Lean tools in a consultative or partnership approach promote small and significant behavioral leadership changes that are needed to transform the culture. Finally, there is an open invitation to Lean practitioners, healthcare leaders, researchers, and public in general to investigate in a deeper way the author's ideas to improve our body of knowledge and offer practical ways to achieve the healthcare transformation.

Introduction

Many researchers have contributed to the understanding of the Lean Principles and the 4 P (Philosophy, Process, People & Partner, Problem Solving) Model deployment in healthcare (Cavmak & Kaptanaglu, 2017). Some case studies have pointed out factors leading to successes and failures of Lean deployments that have emphasized Process and Problem Solving tools (Hung, Gray, Troung, & Harrison, 2017) (Strzelczak & Mueller, 2015) (Mazzocato, et al., 2014). Simultaneously, researchers and Lean practitioners in sectors like the financial and service industries have explored the deployment of Lean initiatives in conjunction with other concepts such as Customer Experience (CX), digital technologies, Artificial Intelligence, Robotic Process Automation, and Big Data to transform and adapt the organization to new customer's demands (Truog, 2017). The purpose of this document is to explore proper implementation pathways for the Lean 4 Pillars model in combination with these novelty concepts to reach the Healthcare transformation.

This proposal is based on two premises to be considered in the framework of the healthcare transformation. These premises are based on the knowledge and experience of the author accumulated through years serving as a performance improvement consultant in different industries, including the healthcare industry.

1. Deployment of Lean management in the health sector is not the goal, but the vehicle to close the gap between healthcare transformation strategy and operationalization of the healthcare transformation.

The goal of the healthcare transformation strategy is to offer affordable, accessible, and high-quality healthcare. To make it a reality, Lean should create a network structure that cascades from the strategic to the tactical level, and engender respect for their extended network of partners and suppliers as being vital to the overall success of the system.

2. As an enabling function, we need to go beyond the more technical and widely known pillars of the Lean Model - Process, and Problem-solving - and pay attention to the other two pillars of Lean Management - Philosophy and People and Partner - to be able to adapt to an evolving healthcare system.(Kaltenbrunner, Bengtsson, Mathiassen, Hogberg, & Engtrom, 2019)

This paper considers healthcare transformation from a heuristic point of view where multiple ecosystems interact in a dynamic way, and where Lean can be used as the network that sustains the system, supporting an environment with shared beliefs. To operationalize the healthcare transformation, this paper proposes to deploy initiatives across the new ecosystems, and the use of a consultative approach to facilitate leadership changes that ignite the culture that sustains the healthcare transformation.

Proposing a Lean Approach

Closing the gap between strategic and tactical deployment is a critical link for any strategic and management model to accomplish its objectives. "The alignment among strategy, performance, and customer is considered the key element to bring value to any organization." (Rodriguez & Furterer, 2008). On top of that, the increasing need to meet patients' expectations, as well as the changes to healthcare structures, policies, care delivery models, financial sustainability, and the digital innovations that define the patient experience in smart health communities make the Healthcare strategic transformation more complex (Emmanuelli, et al., 2020). Results from a case study conducted at the Department of Radiation Oncology at UNC to develop a Lean thinking conceptual model and a measurement instrument revealed positive correlations between the adoption of Lean thinking at the individual level and the perceptions of the organizational infrastructure for Lean improvement and patient satisfaction (Mazur, Stokes, & McCreery, 2019).

The Philosophy and People & Partner pillars of Lean reinforce the interaction at the strategic level and the Process and Problem-Solving pillars create the infrastructure at the tactical level. A comprehensive deployment of Lean principles has the potential to reinforce a sustainable foundation that integrates the new ecosystems of payers, providers, pharmacists, manufacturers of medical devices, developers of medical applications and start-ups, regulatory and compliance agencies, and cybersecurity providers, along with health analytics, to make possible an affordable, accessible, high-quality health care reality. (Deloitte, 2019)

For Lean to better support the integration of these dynamic ecosystems, we need to change the deployment paradigm from top-down and bottom-up to multidimensional and cross functional deployment to go beyond the walls of hospitals. In doing so, we can focus on creating a network of ecosystems where provider-payer relationships, provider-pharmacist relationships, medical devices, AI and robotization, regulatory institutions, health analytics, and data science can coexist in clinical and non-clinical environments to provide the best experience and care to the patients (Lindborg, 2020).

A review of AI interventions for health in low- and middle-income countries describes how these interventions can help to address several health challenges, but also points out the flaws that AI is facing related to its development and deployments. Some AI developments respond to particular stakeholders' interests and the availability of data for the build, rather than responding to end-users' needs. Also, the lack of a standard way to assess the efficacy and effectiveness of AI applications makes it difficult to compare the benefits of AI over current standard of care (Schwalbe & Wahl, 2020). In alignment with the proposed digital principles for AI, Lean principles can cope with these challenges by enforcing the deployment of tested AI applications that serve people and processes, and by ensuring engagement and collaboration of end-users during the deployments (Schwalbe & Wahl, 2020).

Reaching the (Schwalbe & Wahl, 2020) goal of a better healthcare system should include Lean practitioners partnering with leaders and experts from customer experience, population health, healthcare analytics, IS vendors, and providers, among others, to explore different deployment approaches that strengthen these dynamic network of ecosystems. Lean philosophy embraces a flexible mindset balanced with standardized decision making based on new technologies and medical evidence (Figure 1). Lean deployment initiatives should be aligned to the major shift in strategy from taking care of sick patients to focusing on prevention and early intervention.

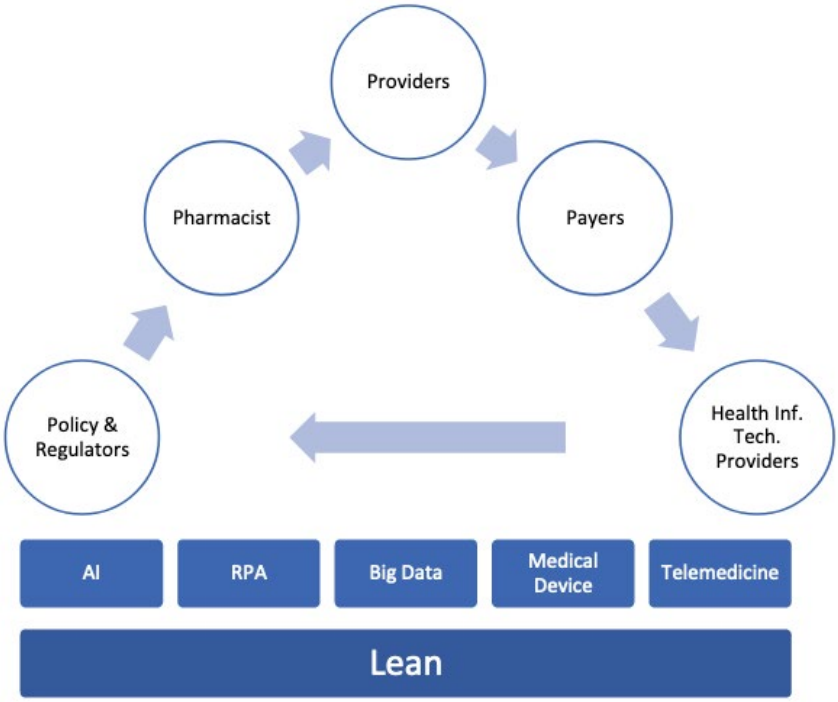

Figure 1. Lean enables healthcare ecosystems integration

Many research papers have provided significant evidence on how Lean had improved the operational performance of several health units by focusing on the flow of the process and providing value to the patient (Mazzocato, et al., 2014). Lean project initiatives improve processes, and Standard Work for Leaders and Management of Daily Improvements (MDI) create the muscle to operationalize the healthcare transformation. Thus, Lean as an enabling function sustains culture and leadership changes.

According to a study conducted by the Agency for Healthcare Research and Quality (AHRQ) in 10 diverse systems, "Lean lacks the capacity to transform culture and generate care that is deeply patient centered, transcends organizational boundaries, and foster collaboration for population health among social and medical services" (Harrison, 2007). Those studies evaluate Lean as the main efficiency improvement strategy affecting overarching financial and clinical outcomes. However, any project-based initiative, such as a Lean process improvement project, should only be measured within the limited boundaries of the project itself.

Based on 200 research papers, Michael I. Harrison concludes "Regrettably, limited evidence supports…high expectations… successful Lean application typically yields focused, step-by-step improvements rather than dramatic jumps in performance or transformational organizational and culture changes that run broad and deep. At the same time, with these caveats, Lean tools and techniques, along with other quality approaches, still have value" (Harrison, 2007).

To establish Lean philosophy as foundational to healthcare transformation requires a comprehensive reframing of our project-based tools and techniques by incorporating a consultative approach that backs day-to-day leadership changes. Such changes should focus on long term commitment, the use of reliable, thoroughly tested technology that serve people and processes, and boosting innovation by setting and sharing stretch goals. The use of Gemba and Layered Process Audits (LPAs) constitutes great Lean tools that can be leveraged to promote leadership changes. Partnering with the leadership team to design a leadership standard work routine across the different healthcare ecosystem is necessary to support daily behavioral changes while creating a structure based on the organization's strategic goals (Figure 2).

Figure 2. Consultative approach to promote leadership changes

Special focus is needed to handle experimentation and risk management in healthcare. The healthcare culture is risk-averse, primarily driven by regulations and policies, and the transformation to a smart health community may expose healthcare organizations to new crimes such as cyberattacks. Coaching leadership in crisis management by training them to use small routines to solve problems daily will prepare the organization to better deal with outage, crisis management, and its consequences without losing focus in our long-term mission. “Leaders need more development for crisis management,”(Deloitte, 2019) and a culture that allows the direct and hierarchical leadership style to evolve to a more experimental leadership style.

Leadership in healthcare have grown up in a world where you need to be excellent technically, manage people well, know how to respond to customers, fix problems quickly, and have all the answers. With an increased focus on results, managers have seen an escalation in their personal accountability, triggering a response in the form of control as a protection mechanism. (Savage, Brommels, & Mazzocato, 2019).

In this environment Lean tools like Kata and Servant Leadership, in a consultative approach, support a participatory democracy where leaders feel comfortable debating, because it is not expected that they have the solutions to all problems. Instead, they can enable more engagement and collaboration across disciplines, experimenting their way forward instead of trying to decide their way forward, and in doing so generating innovative ideas and solutions (Savage, Brommels, & Mazzocato, 2019).

MDI deployment at the strategic level should grow from functional deployment, hospital deployment, or facility deployment to include key leaders of the ecosystems that coexist in healthcare. To make this level of change possible, especially at the strategic level, it is important for leaders to commit to a shared vision for an affordable, accessible, high-quality healthcare nourished by a high-level sentiment of compassion and caring for others (Boyatzis, Smith, & Van Oosten, 2019).

The recommended consultative approach supports daily leadership changes which agree with the proposed individuals’ transformation journey to Lean thinking model (Mazur, Stokes, & McCreery, 2019), where a combination of context enablers and individual characteristics must be present to achieve a Lean thinking transformation. Lean coaches support healthcare leaders in their learning process, creating a positive environment where they can

experience the benefits of the use of Lean tools and methods in their working areas, making them more reflective and committed to change and sustaining organizational culture. The theoretical model for an individual's transformation to Lean thinking is rooted in concepts that revolve around teaching people to think more deeply about their own beliefs, and in "learning by doing," or experiential learning. The journey has four sequential milestones: awareness, readiness-(Cavmak & Kaptanaglu, 2017)to-engage, active engagement, and finally personal transformation. A combination of individual and contextual factors helps individuals move from awareness to readiness, and active participation in Lean based activities help them move to the active engagement milestone. When the individual can reflect on their personal benefits from Lean tools and methods applications, they reach a level of engagement and commitment that is the end state for the transformation to Lean thinking.

Going beyond the accomplishment of specific goals and instead set inspirational long-term objectives that require experimentation and some level of risk taking, moving from the task-oriented mindset to a more relationship-oriented mindset, and creating a commitment to building a learning organization that accepts that mistakes are occasionally made are all cultural changes required in the healthcare transformation and supported through a consultative approach of Lean deployments.

Conclusion

This paper presents the authors' ideas after conducting a literature review on research papers from Pub Med, Web of Science, Research gate, whitepapers from Deloitte, and podcasts from McKenzie, among others, and comparing empirical observations from the healthcare sector and other industries with different approaches to deploying Lean management.

The intent is to transfer knowledge and practical use of Lean tools within the healthcare industry and inspire more discussion, case study and research that cover the gaps in this area. This review is aiming to help individuals, organizations, practitioners, and researchers to better understand the key elements to leverage Lean for a scaling healthcare transformation.

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Operational Research for Developing Countries novel contributions --- online, at IFORS

Gerhard-Wilhelm Weber

Professor at Poznan University of Technology, Poznan, Poland

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Adriana B. Rodriguez is a performance improvement project manager at BayCare, one of the largest healthcare systems in the US, and holds the ASQ Master Black Belt and SME Lean Silver certifications. Adriana got her doctoral degree in Industrial Engineering and a M.S. degree in Engineering Management at the University of Central Florida. During her time in academics, she lectured in the areas of Quality Management, Experimental Designs, and Introduction to Industrial Engineering, Applied Computer, Algebra, and Geometry. Her research areas included customer experience, process optimization, lean six sigma, strategy design and deployment, data analytics, and applications of artificial intelligence. Her interests include identifying new gaps in the management body of knowledge, where the interaction between theory and real life and between researchers and practitioners is fundamental. Within the consulting sphere she has managed global interdisciplinary projects in various service companies, and more recently in the healthcare sector. Adriana has demonstrated her skills as a transformative leader by successfully leading global cross-functional programs and Proof of Concepts in Operations, Sales Analytics and IT functions; managing performance improvements projects' pipeline from qualifications to closure; developing and deploying training programs designed to increase organizational excellence maturity; advising C level executives in strategy deployment using data mining, data modelling and statistical analysis; closing more than 25 improvement projects; and training, coaching and mentoring high skilled candidates at different levels of the organization. As an active member of the American Society of Quality (ASQ), she participated in the ASQ MBB Exam Development and in the Lean Six Sigma ASQ training development Project for 2019.

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4. Analítica Avanzada: Estrategia para el Ordenamiento Territorial. Ciudades y Regiones: Inteligentes, Analíticas y Sostenibles (book in edition)

Advanced Analytics Technologies:

1. OPTEX Optimization Expert System a cognitive robot that capitalize the experience in mathematical modeling and that generate Decision Support Systems in many technological platforms like IBM ILOG, GAMS, AMPL, MOSEL, AIMMS, C. Oriented to develop Enterprise Hypothalamus using Mathematical Programming 4.0.
2. OPCHAIN (OPtimizing the Value CHAIN) a collection of specialized solutions for optimize the value chain in general agroindustry supply chains, transport systems, energy systems (oil, gas, electricity), retail systems, logistics bank systems, financial and risk management, marketing optimization, mines and regional planning.
3. SAAM (Stochastic Advanced Analytics Modeling) cognitive robot specialized in applications of Machine Learning (Predictive Advanced Analytics: Support Vector Machines, Clustering, Artificial Neural Nets, Advanced Probabilistic Models and Optimization) using Mathematical Programming models.

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