Learn from the Past, Practice in the Present, Prepare for the Future

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This issue of the IEEE ENGINEERING MANAGEMENT REVIEW (EMR) is the last of our 50th volume. Looking back on just more than 50 years of publication of EMR-related topics seems apropos. Given this goal, we begin with a series of papers in this issue that takes us from the past 50 years or so. These topics have resonated in the engineering and technology management community—and will likely continue. Clearly, not all topics can be covered—it would be impossible to do so given the breadth and scope of developments in EMR-related fields.

EMR originated as a source to help engineering and technology management practitioners and their organizations gain insights into the latest concepts and applications. During this origination period over the first 40 years, the editor and editorial board's purpose was to identify already published works—from a variety of sources—that the journal could reprint for IEEE membership. Editors would scour the latest topics and themes and reprint articles from the leading journals for IEEE members.

Eventually, EMR evolved to include some original contributions—that were reviewed by the editors and editorial board—to what it eventually became today. Today, EMR only includes original contributions. As a peer-reviewed journal, EMR is now the first line of disseminating innovative practical ideas in engineering, innovation, and technology management.

The notion of publishing articles of practical use to managers, decision-makers, organizations, students, and other academics remains a core philosophy and scope of EMR. Original contributions allow for more current and direct insights for our readership.

EMR has also gained in reputation over the years. Downloads and citation counts have increased greatly—by a couple of magnitudes in each case. These metrics are objectively determined, on which we have performed well. We also get practical subjective validation with the occasional email from readers who tell us that EMR's publications are interesting and useful for them—especially given the rapid pace of innovations in technology and management practices.

In EMR, we realize that we build on previous knowledge and understanding. We do not ignore the past—it provides us with knowledge and experience that is valuable. In fact, scholars and practitioners live by the Latin phrase *nanos gigantum humeris insidentes*—which translates to standing on the shoulders of giants. As one of the world's intellectual giants Isaac Newton in a letter to Robert Hooke admitted, "if I have seen further [than others], it is by standing on the shoulders of giants."

This idea of building on past knowledge with current practice, experimentation, and learning, to see farther into the future, is a small role EMR plays in building

knowledge. Over the past five years, we have published more than 400 articles, inclusive of this issue of EMR. Our articles represent a drop into the broader ocean of knowledge—each contributing in its own way and blending with previous knowledge and understanding. Whether it is just a few paragraphs from a short technology manager notebook (TMN) article, to one of our longer—thousands of words—review articles, the contributions exist and continue.

In a previous editorial, we talked about rigor and relevance. EMR's goal is relevance, but we also support evidence-based robustness and rigor. Looking to the future is always relevant if this leads to actions that can improve the world in some way.

In EMR, we have also editorialized on learning while embracing mistakes and learning from those mistakes. Not all ideas are perfect all the time and these ideas need to evolve. We do keep learning from the current practice and learning what works and what does not add to our knowledge. This knowledge lays a foundation for seeing tomorrow. Not everything we have learned will be useful, as complexities and idiosyncrasies can always throw a wrench into even the best past learned practices. That is why our past should be carefully evaluated based on new complexities that the future throws at us—the practice of the present.

Even giants, such as Newton and his cohorts, could not see the future of their fields with the emergence of relativity and quantum theories. Today's giants will get many things right and support innovation and growth in the future. But the future will also require change and preparation—some changes and preparation are foreseen, but many times they are unforeseen. For society and our species to survive—as we learned in the recent COVID crisis—we need adaptation and resilience. New knowledge offers us this opportunity whether it is for our communities, our organizations, or ourselves.

We hope that EMR will be around for another 50 years to be able to help society in the future through learning from practice in the present and to keep preparing us for the future.

Now, we shift our discussion from a temporal and existential philosophical perspective on knowledge development and dissemination, to providing an overview of this issue of EMR. In most EMR issues, we start with the practice-oriented TMN articles. Instead, this time, EMR articles begin with a look back and forward on a variety of topics.

Looking Back and to the Future

The first set of six articles in this EMR issue is special in that they consider a broad variety of topics ranging from the evolution of our society—the IEEE Technology and Engineering Management Society (TEMS)—to broader society topics related to innovation and inclusiveness.

We begin the articles with a spotlight on TEMS and its history. It begins with the history of IEEE, more than 50 years ago. It is written by Michael Condry (a former TEMS president) and colleagues, most of who were involved in the TEMS evolution over the past 50 years. This first article is based on firsthand knowledge at society and chapter levels. The lessons learned were many, the authors summarize them, broadly for other organizations both volunteer and profit based. They also look to the future on what lies ahead. They provide insights into challenges, but also successes. Practical experience provides much wisdom, and they share this wisdom with us.

The second article fits how engineering and technology management has emerged to shift focus—greatly—to the healthcare profession. Healthcare concerns have always been an issue, but the COVID crisis showed that it could shut down nations and commerce—a disruption to society on par with internationally violent conflicts.

The second article by Katsaliaki and Kumar provides an overview of one aspect of healthcare systems—healthcare delivery. They consider how digitalization technology has emerged and evolved in this field to where we are today. We have published several articles recently on this topic including blockchain [1], general Healthcare 4.0 [2], and informatics and healthcare [3]. They recall the past 50 years with highlights breaking down healthcare delivery into categories for symptom, diagnosis, and intervention and how the technologies have evolved and will continue to evolve.

We move from an industrial-level analysis of innovation to a national-level perspective. One of the world's largest economies—China—has invested greatly in innovation for the past 50–60 years. Its history has been complicated, but the changes that occurred in this nation have been on par with an industrial revolution that took centuries in just a few decades.

Gao—who has been researching China's technological innovation systems for decades—provides some insights into China's unique and rapidly evolving technological innovation history. Gao provides insights into innovations that the country has made and some of the reasons and policies put into place. This innovation includes heavy investment in educational institutions and sciences. The evidence is clear as many studies have now shown that the research output in China and

the rankings of its academic institutions continue to improve.

Clearly, China is unique in the leading role of its governmental institution and political party, with many complexities in its role in social and political situations. Yet, it has gone from a largely emerging and agrarian economy into one of the world's leading technological, urban, and manufacturing giants. Tracing this evolution is not easy, but Gao does provide some insights into the policies that lead to today's innovation system and proposes a direction for future innovations at the Chinese national level.

The next two historical papers deal with managing products and projects. The first of these deals with how one of the most popular tools in the industry for new product development—the stage-gate model—has evolved over the past 40 years. The stage-gate model from idea to launch was introduced by Robert Cooper and has gathered data to show its success with thousands of academic citations of the original article introducing the topic and its advances (e.g. see [4] and [5]).

In this article, Cooper provides insights into various cases and learning over the years in what has led to the 5th Generation of the stage-gate idea-to-launch process. The many examples from actual applications are provided with practical insights into how companies have helped him shape a more agile rapid process—learning from experience to help current practice. He provides advice to future companies seeking to implement this model.

Project management history is replete with the lack of success in projects and how to continuously improve by learning from the past—project management historical scrutiny has been lacking [6]. Project management has a long history going back to before records were kept for some of the most major projects resulting in some of the world's wonders.

Our next article by Love et al. takes us back further than 50 years; back hundreds of years of project management history. Project management is a very broad topic, so they focus on one important dimension—an interesting project management topic that deals more with a failure perspective—*project cost overruns*. They do take a look at what the past has learned, how it is affecting current practice, and then to an *optimistic* future. They rely on a conceptualization called the *Fifth Hand* which speaks to the dualities of project behavior. I will not go into detail here, but I encourage the readers to carefully understand why they are proposing this as a potential explanation and insight into project behavior including the cost overrun problem in capital projects.

Our last paper looking back on decades of perspectives as a special section of this 50th-anniversary issue is a unique and socially important perspective. We shift a bit to focus on a very socially important dimension—that of inclusiveness and equity. A very large majority of humanity is not included in the quality of life afforded modern society. Grobbelaar attends to this issue by considering that various models of innovation have historically, currently, and in the future play a role in inclusive development.

Grobbelaar talks about the need to consider various innovations including frugal innovation, Jugaad innovation, grassroots innovation, social innovation, appropriate innovation, base-of-the-pyramid innovation, inclusive innovation, or innovation for inclusive development. Innovation for economic benefit has been the traditional road, whereas innovation for inclusive development has not been at the forefront of discussion. Historically, it has been an issue, but the concern is more today than ever before as marginalized communities are larger than ever. Grobbelaar looks to a future where innovation becomes more inclusive.

EMR has been trying to include more sustainable innovation articles as it is one of our more important topical areas; we hope that this article by Grobbelaar provides more learning and investigating opportunities to others in practice and academia.

Technology Manager Notebook (TMN) Articles

The next two articles are a regular feature of every EMR issue, TMN articles. The first TMN article by Hirschfelder and Gutmann focuses on research and development and innovation budgeting. Starting with a budget is the first step for setting an investment baseline, which is important to determine whether cost overruns—a historical problem mentioned by Love et al. in an article in this issue of EMR—are likely to occur.

A potential reason for cost overruns and whether a budget is accurate could be due to the type of budgeting that was initially completed. They provide five different reasons and approaches for budget development ranging from internal capabilities and managerial preferences to external benchmarking strategically. The budgeting process is complex with many stakeholders, thus even arriving at a close to an accurate budget requirement is not a trivial task. This task could greatly influence the long-term strategic competitiveness of organizations when it comes to innovation budgeting.

The second TMN article by Wehde relates to team empowerment. Wehde's experiences in self-directed teams include successes, but also failures. This history of practice provided lessons on what should and should not be done to arrive at successful team empowerment practices.

Wehde's lessons essentially point the reader to consider managing by objectives and key results. He also points us to resources that support these practical lessons that others have introduced in management books.

Organizational Management and Innovation

The next five articles in this issue of EMR focus on various dimensions of organizational and innovation management of the organization.

The first article in this section is by Williams et al. They begin by stating the increasing importance of data and big data requires organizations to carefully consider business intelligence (BI). BI is dependent on evolving and new information systems to help organizations build strategic competitiveness. The idea of success factors was mentioned in team empowerment success by Wehde in this issue; these factors are now introduced for implementation of this organizational system innovation.

Using three groupings of technical, organizational, and process factors, they introduce a model and checklist of 23 factors that contribute in some way to the successful implementation of BI systems. They support many of the factors and their relationships through a historical review of practical and theoretical literature. The extensive list of factors can prove valuable for the adoption and implementation of many types of organizational systems.

BI helps to build organizational resilience. People in the organization also play a role in resilience. Organizational resilience is the core issue investigated by Ibrahim in the second article in this section. The basic argument is that diversity, in culture, talent, structure, and other areas, is necessary for resilience.

Similar to ecological ecosystems being more resilient the more diverse they are, Ibrahim brings to light that multiple types of diversity especially people and culture can greatly contribute to the resilience of organizations. He looks at the history of various influences of diversity and resilience and brings them together in a designed organizational resilience structure that includes competence, resources, actions, models, and attributes. Diversity implications on the structure and various functions are detailed.

Organizations need to manage their environmental impact to not only consider their own resilience—and reduce risk—but also broaden ecological resistance. This issue takes the idea of organizational resilience studied by Ibrahim that is influenced by ecological resilience full circle back to organizations' relationship to environmental resilience. The paper by Dagestani and Qing considers the historical practices and learning related to organizational environmental disclosures.

In their findings of the review, they find that improved organizational general performance and working or urban environments improve with environmental disclosure. Is it not only about voluntary but also about mandatory—city rules and regulations—that are part of the broader environmental disclosure governance mechanisms.

Related to environmental performance is the idea of minimizing waste. Lean thinking practices—the topic of the paper by Alves—are focused on waste reduction. Alves does touch upon this issue of the relationship between lean and green. The focus is broader here in how the organizational innovations of lean can work well with industry 4.0 technological innovations. Finally, this relationship can be used by organizations to advance thought to broader social issues with lean thinking. Social concerns related to conflicts and catastrophes can be effectively managed by organizations when facing these disruptions. Resilience, Society 5.0, and lean thinking are intermingled in this latest future thought based on historical evidence and philosophy that needs to evolve—as evidenced by previous works in EMR [7].

The next article relates the various innovation streams of this EMR issue's organizational innovation papers including people, processes, and technologies. The article—coauthored by Brem and Utikal—considers timing models for organizational innovation and creativity. In their article, they talk about impulsivity and schedule to take advantage of creativity performance most effectively. They provide general insights that can prove valuable to organizational culture formation for innovation and the level of routinization—as a general outcome. Breaking routines were common in the COVID crisis [8], and they build on this knowledge and environment to provide these additional insights.

Technological Innovation and Management

In this section, we have three articles—although technological issues were covered in many of the previous articles in this issue, we have some that are more driven by technology rather than organizations; although, organizational issues are evident in each.

The topic of blockchain adoption—covered in various previous issues in EMR (e.g., see [9], [10], and [11])—is the focus of the first paper in this section. Unlike the previous approaches trying to understand how and why organizations adopt or do not adopt, the paper by Yfantis and Ntalianis provides a way to motivate personnel to adopt blockchain. Having any employee adopt a new technology is difficult especially if the technology is difficult to understand and apply.

In this way, change management and motivation play important roles. Gamification is a way that Yfantis and Ntalianis believe can motivate people to adopt this blockchain technology. Using the Octalysis Gamification Framework, they develop a tool and apply it to a public setting to support the adoption of blockchain. Using a survey based on technology acceptance, they found that gamification was effective. The question is whether gamification—through badges and awards, for example—to motivation technology adoption and other change management required programs. This practical application can be useful for these and other environments.

Katsaliaki and Kumar, earlier in this issue of EMR, provided a short history of healthcare delivery and technology. In the next article, Liu et al. write about how autonomous vehicles can support effective healthcare delivery. Autonomous vehicles have been a major topic in the past and for the future, as EMR has published a technological roadmap for autonomous vehicles in the transportation industry markets [12] and an earlier article on the future of mobility [13].

Liu has also previously positioned this autonomous vehicle market from an entrepreneurial perspective [14] and explained a business case for the future of infrastructure for autonomous vehicle infrastructure [15]. Liu argues that building a social good technology for mobile healthcare also means integrating autonomous vehicles with Healthcare 4.0 [2] and telemedicine [3] technologies. Several implications, issues, and dimensions from patients, providers, and policymakers are described in detail in this article.

Healthcare and technology intersect in a very unique review of the past for the future in the next article by Sood et al. In this case, they identify and review how Industry 4.0 technology, such as eCloud Manufacturing, Internet of Medical Things, Soft Robotics, and Cyber-Physical Systems, have and can be further integrated with additive or 3-D manufacturing in soft tissue engineering. Soft tissue engineering can help with organ transplants, surgeries, and disfigurement. To improve quality of life and extend life spans, these revolutionary technologies are socially and ethically important. They identify what areas have shown promise in the past and directions for future research.

Product and Project Management

The final four articles in this issue of EMR are each focused on product and project management concerns.

The first two articles in this section focus on more operational aspects of project and product management. Both of them also include technological dimensions—which really cannot be separated from organizational and people issues. These articles also relate to the historical work and perspective of the stage-gate model from idea to launch by Robert Cooper.

In the article, by Yasuhira and Ishida, the visualization of the product development process based on design maps is introduced. Similar to the stage-gate model for product development, this paper introduces the idea of design maps as a multistage integrative and practical approach—but more from an operational technical design and implementation perspective. It also relates and can be integrated with other EMR publications that seek to shorten and improve the product development process ranging from developing a clear roadmap for successful product development [16] to rapid virtual prototyping [17].

Yasuhira and Ishida—instead of discussing strategies and products—in their paper, discusses a methodology for visualizing *design intent*. They do have a broad perspective in considering how teams can implement these product designs into society and systematically—products that customers really need [18]. A *design map* that visualizes product design intent through a tree diagram is introduced. Also, a holistic *Himozuke method* is introduced with a practical case that also includes other visualization tools. Similar to the goal of Cooper's agile stage-gate model, ultimately the approach is meant to deliver appropriate and effective products in less time.

Product development or almost any engineering endeavor is a complex organizational and institutional activity. As can be seen in the previous article—by Yasuhira and Ishida—a single product can have many complexities that would need to be visualized. In this process, information overload from marketing, engineering, materials, supplier management, and historical data can easily occur. How to help engineers and managers make sense of this? That question is addressed—but broadly—in a literature review by Govindarajan et al. in the next article.

Govindarajan et al. investigate graphic facilitation as a way to

simplify the engineering workflow. They review the literature and discuss the promise of graphical representation based on history, but the history is relatively short and sparse. Thus, their recommendations include several future practices and concerns in a roadmap for the future visualization of graphic facilitation of engineering workflow. The literature review and evaluation are comprehensive and useful for organizations and management and project management improvement.

This brings us to the final two articles in this issue of EMR that each focuses on some aspect of project management. EMR's past has seen publications in project management improvement [19] and eventual success [20]. The paper by Fareed et al. returns to project success—less from a technological perspective—and more from a managerial and organizational behavior perspective.

Fareed et al. argue and show that a combination of emotional, managerial intelligence, and transformational leadership is a strong predictor of public project success. Although technology does offer help and solutions in project management, project managers need to combine soft and hard skills, leadership competencies, and management while engaging with people and be effective in terms of processes, tasks, and objectives. This is an important outcome of this penultimate article in this issue of EMR. The proof is now given to another type of project, that of critically important and complex public projects.

Agarwal and Anantatmula return to the issue of managerial and organizational behavioral and psychological concerns in project management. They build on their article "Psychological Safety Effects on Knowledge Sharing in Project Teams" [21] by more clearly and carefully providing insightful implications for project managers in practical situations. This short article is packed with important implications based on rigorous research, i.e., psychological safety plays a crucial role in the mental health of workers and the overall health of organizations.

Overall, the future of engineering and technology management as evidenced here is grounded in strong historical and rigorous research and with a clear understanding of managerial and organizational practices. Project management with people, technology, and external forces, as we have seen in these articles, provides a complex environment needing better and more careful understanding.

Conclusion

For more than 50 years, we have been trying to link theory with practice for engineering and technology managers. It is likely that as practice and theory evolve, new directions and insights will be needed. Progress and innovation will exist as long as humanity and society need solutions to solve their problems and change continues.

Progress, crises, and disruptions continue to occur; individual and social needs continue to evolve. However, we cannot and should not discard the lessons from history and current practice to identify how we can do well in the future. EMR has had a 50-year history in understanding and introducing new ideas, and it will continue to provide these opportunities as we look to another 50 years of contributing to individual, organizational, and social knowledge.

We also want to be a vehicle that will motivate scholars, practitioners, and students to contribute to this future.

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