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Dundar F. Kocaoglu
Portland State University

Timothy R. Anderson
Portland State University, tim.anderson@pdx.edu

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Technology Management for Reshaping the World

Dundar F. Kocaoglu, Timothy R. Anderson

Department of Engineering and Technology Management, Portland State University, USA

Abstract- The world is changing rapidly, and technology is playing the central role in making the changes happen. The events since PICMET '01 have made it clear that every society everywhere in the world is affected not only by the changes, but also by the technology behind them. There are very few events in the world today that are not dominated, or at least influenced, by technology. This observation can be explained by recognizing the current period in the history of the world as the "technology era." When technology is properly used and managed, it leads to the reshaping of the world for the benefit of humankind. If technology is not managed well, humankind becomes a slave to it. This paper discusses the role of technology in society and the importance of properly managing it in the technology era.

I. INTRODUCTION

The dominant forces that were shaping modern society through the early part of the nineteenth century were feudalism, imperialism, regional power struggles, and the rise and fall of civilizations driven by basic sciences, arts, architecture and literature.

As food became the critical resource, the world entered the agricultural era later in the nineteenth century. In the new world that started to emerge, the center of power shifted to the regions where food production was the most efficient and food distribution was the most effective. The forces that dominated the pre-agricultural era were still critical but not dominant anymore. They paved the way and provided the basis for agricultural knowledge and farming capability as the new dominant forces that started to shape the world. Food became the determining factor between the haves and the have-nots.

The late nineteenth century and the first half of the twentieth century brought the world to the industrial age. The dominant forces that started to shape the world were mass production of industrial goods through efficient manufacturing. Once again, the forces that shaped the pre-industrial era provided the basis for this new phase, but they no longer dominated it. The center of power started shifting to the regions and countries that excelled in developing and utilizing the dominant forces that were shaping the industrial world. A new line of demarcation emerged between the "industrialized" and the "non-industrialized" world.

Then the world entered a new era in the second half of the twentieth century. There were long debates about what to call it. The "post-industrial" era was not descriptive enough, nor was it accurate. The world had not stopped being industrialized, and it still has not. The "service era" was not appealing because it gave the image of a society where, figuratively, everybody would be working in fast food restaurants. That was not the way the world was being shaped, and it still is not. Of course, the new era was much more than

that. We had entered the technology era in which the world was being shaped by knowledge; the society was revolving around technology; and the center of power was, once again, shifting to those who were able to develop and manage the dominant forces that were shaping the world. Those dominant forces were technological know-how and capability.

II. THE TECHNOLOGY ERA

The world does not go from one era to another in discrete steps. We recognize the changes after they start influencing our lives, after they start reshaping the world. When ENIAC demonstrated the capabilities of the first electronic digital computer in the mid-20th century, we hardly recognized that the world had stepped into a new era that would be characterized by the rise of the computer, information and communication technologies. Nor did we recognize that the reduction of the "digital divide" between the haves and the have-nots would be the key challenge for many years to come.

Just as the formative centuries of modern society are characterized by basic sciences, art and literature; the agricultural era is symbolized by the agricultural societies; and the industrial era is represented by manufacturing efficiencies; the technology era has several defining characteristics. The key characteristics that differentiate the technology era from the previous eras are

- *Research and Development*
- *Coping with uncertainties*
- *Disruptive technologies*
- *Discontinuous innovations*
- *Out-of-the-box thinking*
- *Creativity, and*
- *Commercialization of creative ideas*

The knowledge-driven world that we see in the technology era is R&D-dependent. It thrives on the generation and dissemination of knowledge and is built on the R&D outputs. Because of the unknowns that are continually explored in R&D initiatives, the uncertainties are the norm, not the exception in this era. The repetition and improvements of the past successes are no longer adequate. The extrapolation of current knowledge is no longer sufficient. Disruptive technologies are emerging in the entire technological spectrum, and changing the direction of the innovations, causing discontinuities in the way we think and the way we live. The discontinuous innovations are developing because of the creative thinking that challenges the norms, establishes new rules and follows through the creative concepts all the way to market success. In short, we are living in a world that constantly renews itself. That is the technology era.

III. SOCIETAL CHANGES

It takes many steps to move from the industrial era to the technology era. *First*, it is necessary to move from imitation to innovation. Success in the knowledge-driven world is dependent upon the creation and implementation of new ideas. Improved replication of the old concepts are no longer sufficient. *Second*, bold moves are needed for meeting the challenges of the continuously changing world in the technological era. This requires a move away from incremental innovations toward radical innovations. *Third*, a step-by-step move is needed from product improvements to process improvements, and from process improvements to “changing the way of doing business.” As the world continues to change rapidly, those who insist on doing their business the same way that they always have done will simply find themselves using a recipe for failure. It is clear that the way we do business in the next few decades will look nothing like what we did in the last few decades. In fact, we are already witnessing radical changes in our lives as the technology era reshapes the world. Just a few examples will demonstrate the profound changes taking place in society in meeting the challenges of the reshaped world of the technology era:

- Organizations are changing from co-located groups of workers to virtual entities spanning multiple continents.
- Employees are changing from “9 to 5 workers” at fixed locations to distance professionals.
- Supply chains are changing from suppliers within a geographic boundary to suppliers throughout the world.
- Purchasing is changing from visiting retail stores to visiting the web.
- Publications are changing from printing media to electronic media.
- Communications are changing from the paper/pencil mode to the e-mail mode.
- Document storage is changing from filing cabinets to computer disks.
- Education is changing from classroom lectures to computer-assisted delivery.
- Employment is changing from lifetime security to skill-based competition.
- Compensation is changing from a seniority basis to a meritocracy basis.
- War strategies are changing from the superiority of brute force to technological superiority of information and military intelligence.

IV. COMPETITIVENESS

As these changes take place, the centers of power in the world are quickly emerging in line with the requirements of the technology era. The March 22, 2002, issue of *Financial Times* reported the findings of a study conducted by Robert Huggins Associates, a U.K. think tank, analyzing the world

regions in terms of their competitiveness in today’s knowledge-based technology era [1]. The study was based on a Knowledge Competitiveness Index (KCI) developed along the following seven dimensions:

1. Ability to create new ideas
2. Exploitation of the economic value of new ideas
3. R&D expenditures by businesses
4. Spending on education
5. Information Technology infrastructure
6. Levels of employment in knowledge-intensive industries
7. Number of patents registered.

It should be noted that these competitiveness factors are very different from the classical notions that were being used in the pre-technology era. Cost of labor, manufacturing productivity, tax structures, etc. are not even mentioned. Instead, the competitive strength of the world regions is directly linked to their ability in generating, processing and commercializing knowledge as required by the technology era.

V. NEXT STEPS IN THE TECHNOLOGY ERA

It is also important to note that the technology era started with computer technology, and gained momentum with the emergence of information and communication technologies, and the convergence of the three. We are now observing the next big step in the growth of this era. With biotechnology, nanotechnology and new energy technologies rapidly emerging and positioning for convergence with the computer, information and communication technologies, the pace of the reshaping of the world is clearly accelerating. It is interesting that society is already adapting to the changes dictated by this emerging technological configuration. Biotechnology-related terminology is already in our daily lives. It was not too long ago that “G.E.” meant “General Electric.” Now it also means “Genetically Engineered” plants and tissues. “G.M.” was always the acronym for “General Motors.” Now, we also use it to refer to “Genetically Modified” foods. “G.D.” is used not only for “General Dynamics,” but also for “Genetically Designed” human beings. Considering that we are still at the very early stages of biotechnology, it is significant that we have incorporated it into our daily life and language so quickly.

VI. THE ROLE OF PICMET '03

PICMET '03 recognizes the critical role that technology management will play in reshaping the world in the coming decades. Its objective is to provide leadership in establishing a strategic pathway toward success in fulfilling that role.

This CD-ROM contains the Proceedings of PICMET '03 and covers the breadth of topics covered by the conference. It includes all of the papers and for certain industry applications, presentations, from PICMET '03. The papers have been selected for their representation of the technology

management field in the year 2003. The papers have undergone a refereeing process. The papers organized into 40 tracks and are listed below:

- Technology Management Framework
- Strategic Management of Technology
- Technology Management Education
- Technological Changes
- Technology Planning and Forecasting
- Technology Roadmapping
- Technology Assessment and Evaluation
- Technology Diffusion
- Technology Commercialization
- Technology Marketing
- Technology Transfer
- Collaborations in Technology Management
- Competitiveness in Technology Management
- Decision Making in Technology Management
- Innovation Management
- R&D Management
- New Product Development
- Virtual Enterprises
- Entrepreneurship/Intrapreneurship
- Information Technology (IT) Management
- Knowledge Management
- Project/Program Management
- Resource Management
- Productivity Management
- Manufacturing Management
- Supply Chain Management
- Software Process Management
- Management of Technical Workforce
- Intellectual Property Issues
- Cultural Issues
- Environmental Issues in Technology Management
- International Issues in Technology Management
- Historical Perspectives
- Science and Technology Policy
- E-Business
- Biotechnology Industry
- Telecommunications Industry
- Wireless Technology
- Semiconductor Industry
- Healthcare Industry

VII. CONCLUSION

As the world moves ahead in the technology era, it is up to us to prepare society for the opportunities and challenges of the coming decades and manage the emerging technologies to reshape the world for the benefit of humankind. If we succeed, we will have taken a giant step toward harnessing the tremendous impact of the emerging technologies toward making the world a better place to live. If we fail, we will have allowed the technology to manage us, instead of us managing it, and forfeited our responsibility to society as technology managers.

REFERENCES

- [1] D. Turner, "World's Knowledge Economy Dominated by US Regions," in *Financial Times*. London, 2002, pp. 12.