A BODY OF KNOWLEDGE FOR MANAGEMENT OF TECHNOLOGY (MOT-BOK)

Rias J van Wyk

President: Management of Technology Accreditation Board (MOTAB)

1. Abstract

A management of technology body of knowledge (MOT-BOK) has been the subject of research for the past eight years. In 2011 it was discussed at the Twentieth International Conference on the Management of Technology. A fundamental format was suggested which was distributed for preliminary evaluation. This process has now to be taken further. The purpose of this paper is to outline the history and seek comment and consensus.

2. Introduction

During the Twentieth International Conference on Management of Technology held in Miami in April 2011, the structure of an MOT body of knowledge (MOT-BOK) was discussed several times.

Subsequently a draft was prepared and distributed for comment to individuals and organizations. (See Appendix 1 for organizations). Responses varied. One third of the organizations approached commented, mostly by e-mail. These responses were used to revise the Memo. The present version is the fifth.

We would appreciate a larger response rate, especially as we are aiming for a BOK that has broad acceptance. Voluntary association should be the guiding principle. Some of the organizations approached, especially those abroad, referred to cultural differences and were cautious about commenting. It is clear that special efforts will be needed to ensure a free exchange of ideas. The present paper hopes to contribute to that purpose.

The next step will be to post the BOK on a suitable website, such as that of the International Association for Management of Technology (IAMOT) and Management of Technology Accreditation Board (MOTAB). This step will be widely announced. It will be followed by a process of ongoing revision as the MOT community gains experience of the BOK and engages in a process of continuous improvement.
3. The evolution of management of technology (MOT)

Most initiatives in (MOT) can be traced back to the mid-eighties and a key publication, *Management of Technology: The Hidden Competitive Advantage*. According to this source: “Management of technology links engineering, science, and management disciplines to plan, develop, and implement technological capabilities to shape and accomplish the strategic and operational objectives of an organization (Task Force on Management of Technology, 1987, p. 9).

The striking feature of this initiative is the diversity of backgrounds of the MOT community. Participants include engineers, corporate managers, economists, and S&T policymakers. To allow for this diversity the field initially described itself as “multi-disciplinary”, with no strict unifying focus. An attitude of “creative diversity” ruled.

The report advised: “As described earlier, the knowledge base in MOT is fragmented and undeveloped. What is needed at this time is not overdefinition and restriction, but freedom” (Task Force on Management of Technology, p. 18). Creative diversity ruled the day.

In the ensuing two decades the field grew and adapted to evolving needs. While many of the skills in MOT came from the different backgrounds referred to, the MOT community started developing an own and unique set as well. One example is a procedure for capturing technology-based innovation opportunities at the enterprise-level. This task is illustrated below.

In practice MOT is performed by government and at four levels in a business organization:

- Government
  - S&T policy
- Business organization
  - Enterprise
  - Division
  - Section
  - Specialist scientists and engineers

As is to be expected, practices differ from level to level. At the S&T policy level practices are concerned with the direction of science and technology initiatives and the provision of resources. At the enterprise level they are concerned with identifying new industries. At the divisional and sectional levels they are aimed at improving products and processes. At the level of specialist scientists and engineers they are concerned with advancing commercial acumen.
Pursuing new industries by harnessing technology-based, innovation opportunities required a new, home grown, skill-set.

To reflect the increasingly unique character of MOT, the community looked anew at the definition of the field. In 2009 the International Association for Management of Technology (IAMOT), in consultation with colleagues from other MOT organizations, proposed the following formulation. “Management of technology is a specialized professional practice that harnesses technology-based innovation opportunities. It guides technological progress, assesses the potential of individual technologies and applies this potential to the benefit of business, society and the environment” (International Association for Management of Technology [IAMOT], 2008, p. 19.)

4. The emergence of an MOT-BOK

As the field of MOT evolved, the community sought to establish a body of knowledge to guide education and research. Its history is summarized in Diagram 1. While many root thoughts contributed to the process. (e.g., Hosni, 2003; Pelc, 2002), it has not been possible to picture them all. Figure 1 represents a few key steps only.

Step 1 was the formulation of a Credo for MOT. This was dealt with during two working sessions at international conferences. The Twelfth International Conference on Management of Technology in Nancy France in 2003, and the 2003 Portland International Conference on the Management of Engineering and Technology (PICMET), Portland, Oregon. (Van Wyk, 2004a, pp. 84-89.) Step 2 was an internal study of the Education Committee of IAMOT to explore the feasibility and scope of a BOK. Step 3 was a report by Technoscan® Centre to the said Education Committee: A Template for Graduate Programs in the Management of Technology (MOT). (Van Wyk, 2004b.) Step 4 was the formulation of a widely acceptable definition of MOT in 2009 — referred to above. Step 5 involved a number of research initiatives aimed at producing a fundamental format for the BOK (including Khalil, T. and Yanez, M, 2005, as well as Yanez, M. Khalil T.M. and Walsh, S.T., 2010).
While a high degree of agreement exists around the definition of MOT, there has been an ongoing debate about the nature of the field. Two perspectives exist side by side: (i) MOT should continue as a naturally diversified field of knowledge. In terms of its original formulation, it should be left as a multi-disciplinary field with multiple foci. (ii) MOT should knowingly be organized into a unified field of knowledge. It should have a unifying focus and have unique distinguishing features.

The diversified perspective sees MOT consisting of multiple academic disciplines. It accepts that approximately ten different phenomena all carry the name technology, and it would acknowledge all of these. It would favor a book of knowledge that pragmatically reflects the status quo of the field as determined by the broad views of the MOT community. And it would acknowledge a wide variety of technology-related managerial issues without identifying a unique distinguishing feature.

The unified perspective seeks a central academic discipline that can serve as anchoring point for the field. It would favor reserving the label technology for one, single, phenomenon. Similarly it would strive for one, generally agreed to, definition of MOT. It would favor a book of knowledge rooted in a formal theoretical construct. And it would shape the field to meet unique demands of professional practice. In particular it would emphasize skills not covered by other fields – notably the task of technology guidance, i.e., capturing enterprise level, technology-based, innovation opportunities.
These two approaches inevitably influenced the evolution of an MOT-BOK. Various formats were researched. These are covered in the literature and are not repeated here. Suffice to say that a basic format has emerged. (International Association for Management of Technology, 2012, p. 19.) It is illustrated in Figure 2.

![Figure 2: MOT-BOK: Basic format](image)

This format distinguishes four knowledge areas:

- Knowledge of technology
- Knowledge of technology-linked management topics
- Knowledge of general management topics
- Knowledge of supporting disciplines

This format strives for a unified perspective without losing sight of the diversified constituents. The four areas of knowledge are discussed more fully below.

### 5.1 Knowledge of technology

This area deals with an understanding of technology as a phenomenon in its own right. Topics included in MOT programs are:

- Theory of technology
- Language of technology
- History of technology
- Strategic technology analysis
- Technology foresight
- Emerging technologies
The centrality of “knowledge of technology” is a unique feature of MOT. It explores technological phenomena that are not covered in conventional branches of science, engineering, management, economics and S&T policy. In this respect it provides a missing piece in the knowledge needs of modern society. It focuses on the creation of a central language for technology.

There is much potential for research and curriculum development. We return to this theme in the last section of the paper.

5.2 Knowledge of technology-linked management topics

This area draws on materials that are typically associated with high-tech companies, and that may be of limited interest to general management education. Topics include:

- S&T Policy
- Technology-edified strategic planning
- Technology forecasting
- Innovation management
- Techno-entrepreneurship
- Technology auditing
- R&D Management
- New product management
- Project management
- Technology transfer
- Technology commercialization
- Intellectual property management

The area is partially served by home-grown MOT topics that feed on the first field “knowledge of technology”. However it can draw on a wealth of topics developed within existing, dedicated, professional specialties like project management and innovation management. Some of these specialties have even developed their own BOKs.

This area usually contributes the greatest share of an MOT program.

5.3 Knowledge of general management topics

This area draws on knowledge typically rooted in general management degrees. It acknowledges the so-called functional classification of business activities devised in the first quarter of the twentieth century. The functional classification provides the paradigm for most management programs in the world today.
This area is extremely well served by the MBA community and MOT can draw on extensive resources. Frequently MOT will teach the topics in a high-tech context, and sometimes offer innovations slightly outside of the mainstream management concerns. One example is “techno-finance” which deals with technology assessment for investment professional.

Materials from this area are indispensible to ensure the status of a management qualification.

5.4 Knowledge of supporting disciplines

This area of knowledge acknowledges the multiple disciplines underpinning management in general and MOT in particular.

- National policy frameworks
- General systems theory
- Economics
- Accounting
- Human behavior
- Quantitative methods
- Law
- Futures studies
- Industrial ecology
- Environmental studies

These topics vary significantly in their level of development. Some topics are well documented and supported by an extensive literature and even professional associations. Accounting would be an example. Others are in early stages of development, such as futures studies, industrial ecology, and environmental studies.

Major opportunities exist for fundamental research and curriculum development.

5.5 Program composition

MOT programs are populated with contributions from all four knowledge areas. Program directors choose a mix that reflects the particular focus of the school and the availability of resources.
In addition to the academic profile outlined above, most programs also include special assignments. These may be in the nature of:

- Research reports
- Capstone courses
- Business study missions
- Internships

The challenge is to maintain an overall distinctive character while responding to diverse needs.

5.6 Status

At this stage there is a remarkably high level of consensus on the basic structure of the BOK. Virtually all commentators favored the unified approach.

The basic format depicted in Figure 2 drew no adverse comment. There were many comments on the contents of the four knowledge fields. These comments have been accommodated as far as possible.

6. Addressing an unresolved issue

There is one crucial issue that is unresolved at this stage. It concerns the definition of technology. Which of the many phenomena that are all called technology is the subject matter of MOT?

The need for clarity in this area is emphasized by recent texts outlining a deep dichotomy in the structure of technological knowledge.

- Knowledge of individual specialties is brilliant
- Knowledge of overall structure is non-existent

Arthur states the case most succinctly: “But we have no agreement on what the word ‘technology’ means, no overall theory of how technologies come into being, no deep understanding of what innovation consists of, and no theory of evolution for technology. Missing is a set of overall principles that would give the subject a logical structure, the sort of structure that would help fill these gaps.”

And later: “Missing, in other words, is a theory of technology — an ‘ology’ of technology.” (2009: p.14.) When he comes to choosing a definition, Arthur resorts to three. These are not pursued further here.

Other authors confront the same issue. For example, in a recent anthology Li-Hua provides a useful overview of different definitions of technology (2009: pp. 18-22). The editors of the anthology come to the conclusion: “A single definition

The paradox is that, over the past thirty years, many of these issues have had to be dealt with in the professional practice of MOT. They are part and parcel of STA. Professional practice simply could not proceed midst prevailing uncertainty.

After much deliberation the creators of STA chose to define technology as: Competence, created by people and manifested in devices, procedures and human skills (Van Wyk, 2004, p. 23.) Perhaps the probings of STA offer the basis for a debate.

This definition contains a number of conventions:

- The word “competence” implies an ability to execute. The definition therefore refers to the means of execution and not the ends. Final creations such as artistic expressions, literature and pure scientific insight are excluded.
- The word “created” indicates artificiality. To exist, technology has to be made by someone. It does not occur in nature. This definition therefore excludes natural phenomena such as silicon, DNA, and naturally occurring electricity. When these phenomena are deliberately altered to serve as means, the altered states fall within the ambit of technology.
- The word “people” limits our scope to human creators. We exclude devices, procedures and skills produced by animals. This does not mean that the artifacts of animals, like the termite-gathering sticks of chimpanzees, the nests of birds and wasps, or spider webs, do not constitute some of the most technologically interesting devices on the planet. We do study them as a source of ideas. But we exclude them from the list of items for which we seek a formal collective structure.
- While human skill is included in the definition, humans as such are not.

It is important to note that this definition lays no claim to superiority. It simply states which technological phenomenon is regarded as the province of STA. As such it has gained acceptance within a small circle of experts only. Arthur’s and Li-Hua’s concerns still call for resolution.

7. Next steps

After noting comment on the fifth revision, the BOK will be referred back to IAMOT and MOTAB for publication on a suitable website. It will be available for further, ongoing, discussion.
The BOK will be continually refined and consolidated. Of particular importance will be the issues of conceptual clarity involving definition and the need for a language of technology.

IAMOT/MOTAB will also encourage research and curriculum development in knowledge areas where further effort would be beneficial.

8. References


Pelc, Karol, 2002 “A knowledge mapping approach to consolidation of technology management as a discipline” *Proceedings: Eleventh International Conference on Management of Technology*

Van Wyk, R.J. 2002 “The academic positioning of MOT”, *Proceedings: Eleventh International Conference on Management of Technology*

Van Wyk, R.J. 2004a, *Technology – A Unifying Code*, SMG, Cape Town,
Van Wyk, R.J. 2004b, A Template for Graduate Programs in Management of Technology (MOT), Report to the IAMOT Education Committee, Technoscan Centre, MN.


Yanez, M. Khalil TM and Walsh, S.T., 2010, IAMOT and education: Defining a management of technology and innovation management (TIM) body-of-knowledge (TIM Bok) Technovation, doi: 10.10.16/j.technovation. 2010.03.007
APPENDIX 1

ORGANIZATIONS RELATED TO MANAGEMENT OF TECHNOLOGY (MOT)

1. Academy of Management: Technology and Innovation Management division (AOM-TIM)
2. Association of Technology, Management and Applied Engineering (ATMAE)
3. Association of University Technology Managers (AUTM)
4. Canadian Association for Management of Technology (CANMOT)
5. China Association for Management of Technology (CAMOT)
6. European Institute for Innovation and Technology Management (EITIM)
7. Industrial Research Institute (IRI)
8. Institute for Operations Research and the Management Sciences (INFORMS)
9. International Forum for Technology Management (IFTM)
10. International Society for Professional Innovation Management (ISPIM)
11. Portland International Center for the Management of Engineering and Technology Management (PICMET)
12. TechAmerica
13. Technology Management Education Association (TMEDA)
14. Technology Management Council (TMC) of IEEE

Rias J van Wyk  
President: MOTAB  
E-mail: vanwyk@technoscan.com  
Website: www.technoscan.com  
Telephone, office: 952.885.1979

2012-02-13