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An intelligent management system for technology management

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Abstract

Current approaches to technology management express the need to manage technology systematically from both strategic and operational perspectives. However, considerable ambiguity seems to prevail over the exact way of managing it. This paper presents an object-oriented intelligent management system for technology management by using the methodology of Intelligent Engineering. A hierarchical model is proposed to manage the complex and ill-formulated technology management process. The design and implementation for the Intelligent Management System for Technology Management (IMS-TM) using the hierarchical model are described. A meta-system, which serves as IMS-TM kernel to manage and control the operation of the systems, is presented. This intelligent management system framework has been implemented in a government technology supervision bureau to assist the management of their technology development policy and project management. © 2000 Elsevier Science Ltd. All rights reserved.

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1. Introduction

Technology management is a process, which includes planning, directing, control and coordination of the development and implementation of technological capabilities to shape and accomplish the strategic and operational objectives of an organization (Task Force on Management of Technology, 1987). As new technology becomes available at an ever-growing rate, technology management becomes increasingly important. It has been recognized as a crucial activity for both industry and government organization. Rubenstein (1994) pointed out that the most potential but

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still weak research area in technology management is the use of artificial intelligence (AI) in technology management. Up to five to six years ago, applications of AI in technology management were few. However, the applications in this area are slowly emerging (Alawa, 1991; Pel, 1991; Reminder, 1991). We are still in the "gee whiz" expectation stage for many of the management applications which have been touted to date, but the trend is clearly established (Rubenstein, 1994).

Technology management includes: (1) planning for the development of technology capabilities; (2) identifying key technology and its related fields for development; (3) determining 'to buy' or 'to make', i.e. whether importation or self-development should be pursued; and (4) establishing institutional mechanisms for directing and coordinating the development of technology capabilities, and the design of policy measures for controls (Wang, 1993). Clearly, technology management should not only fulfill the management need of a specific set of technologies within a domain and inter-domain relationships, but also develop the implementation strategies, according to the available resources, current technologies, future markets, and socio-economic environment. Therefore, how to manage technology systematically, how to achieve more effective data processing and how to make intelligent decisions on technology implementation are the three bottlenecks to an effective technology management.

The accumulated experience and recent development of knowledge in technology management have created a very good environment for the applications of expert systems. The hardware and programming technologies have reached their maturity. Thus significant research interest has been focusing on the intelligent technology management system, which encompasses the theory and application of both AI and technology management.

Intelligent Management System (IMS) is the new generation of computer-aided management system providing forms of intelligence and integration. The two new approaches to IMS are intellectualization and integralization. Intellectualization has two implications. One intellectualization includes the ideas, methods and techniques, which are used in design and implementation of the various IMS's. Expert systems, knowledge engineering, pattern recognition, image processing, natural language understanding and neutral network are some examples. The other intellectualization is the various intelligent functions, such as: self-learning, self-adapting, self-organizing, self-optimizing, and self-coordinating, for a management system. Integralization also has two aspects. One aspect is the intelligent integration of different methods and techniques for design and implementation of a management system, for example: knowledge model, mathematical model and network model, database, knowledge base, model base and way base, etc. The other aspect of integralization is the integration of various intelligent functions for different management systems, such as: Management Information Systems (MIS), decision support systems, and expert systems (Tu, Li, Sun, & Lin, 1992). The IMS is a good starting point in bringing intelligence into technology management arena. This paper presents a system, IMS-TM, which uses the technology of IMS to cope with complex technology management process. In the rest of sections, the key issues, which an intelligent technology management must address, are explored in Section 2. The architecture of IMS-TM and its key element are presented in Section 3 and its implementation is described in Section 4. Section 5 briefly introduces a real-world implementation of IMS-TM and Section 6 concludes the management system development.

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