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Towards a model for contingency of Management of Technology

A. Drejer *

Center for Industrial Production, Aalborg University, Fibigerstraede 16, Aalborg East, DK-9220 Denmark

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Abstract

The foundation of this paper is a discussion of how different traditions and approaches to Management of Technology (MoT) at the company level can be divided into schools of thought based on a rich view of the environmental challenges facing companies today. Obviously, contingency factors should be related to empirical challenges of firms, thereby enabling technology managers to apply MoT theory pragmatically. It is argued that the existing mappings of MoT theory are, indeed, not sufficiently related to empirical contingency factors. Thus, the main purpose of the paper is to discuss such empirical contingency factors that could be applied to MoT theory and make it more useful for technology managers in practice. The well-known distinction between technology exploitation and disruptive technological change is discussed and dismissed as too simplistic. Instead, three situations for technology management are formulated and briefly related to the MoT theory to round up the paper. The latter forms the main contribution of the paper. © 2002 Elsevier Science Ltd. All rights reserved.

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1. Introduction — relevance and accessibility of MoT theory

The theme of this paper — Management of Technology (MoT) in a changing environment — could hardly be more timely or *relevant*. Changing conditions have increasingly become an inevitable and inseparable part of every day life, of world economics and politics and of the present state of the natural environment. Further, most changes (social, economical, environmental, etc.) are directly caused by and/or related to the development, perception and use of technology. Key traits of the technologically related changes are that they tend to transgress physical, organisational as well as disciplinary boundaries.

The notions of the technological life-cycle (Bhalla, 1987) and its relationship to the creative destruction of industries and individual firms (Freeman, 1982) are well-known parts of the foundation of MoT theory. Their implications, most notably the strong links between technological innovation and organisational change (Voss, 1988) and the implied normative statements that organisational change theory should — and could — be based on technological changes in the environment of firms (Hurst, 1995) are more recent, but no less well known. In the recent years, the fast and turbulent changes related to Information Technology has served to emphasise these notions even further and open the eyes of many to the fact that MoT should be a substantial part of managing a firm.

Also there is a market-pull from the forces of the so-called new economy which is partly based on the decreasing life cycles of products and technologies, the emergence of new information technologies, as well as a number of other notions from management and organisational theory. Some speak of a new economy where competitive advantage will be based on knowledge workers and new organisational forms, like flexible networks, and management. Nonetheless, the market-pull does little to diminish the relevance of MoT in firms, as the coming organisational forms will be based firmly on inventions in information technology and other technological fields.

In light of this relevance, it is reassuring to know that an ever increasing body of knowledge regarding management of technology is being developed by an active scientific community. However, the discipline of MoT is characterised by a vast number of contributions

* Tel.: +45-9635-8987; fax: +45-9815-3030.

E-mail address: andersi@iproduct.auc.dk (A. Drejer).

emerging in a divergent manner rather than a convergent one (Drejer 1996, 1997). The number of publications related to MoT — depending on search engine used — can easily amount to 25 000+ these days, yet there are almost as many definitions of key terms of MoT — e.g. technology and management — as there are authors within the field (Drejer, 2001). This points towards the need for a contingent model of MoT theory for technology managers to access the theory easily which is the subject of this paper.

In the next section, we will establish that the traditional approach to contingency thinking about management theory is too simplistic to be of practical use, when it comes to MoT. This will be followed by a discussion about what can be learned from the traditional technological S-curve for technological life cycles and, further, a look at some new empirical and theoretical evidence. This leads to the formulation of three different situations for MoT and, thus, a richer view of the contingent environmental factors that should guide the choice of MoT theory in practice.

2. The traditional approach to contingency and its problems

The notion of contingency — that the application of theory depends on certain contingency factors that guides the choice of the right set of theories (solutions) to the right problem — has long since become household within management theory. Starting within the organisational theory (Galbraith, 1973) contingency theory has replaced fruitless discussion over which theory is *the* best theory, with discussions about when which theory should be applied and why. In organisation theory this has been supplemented with the division of theory into a distinct set of schools — with different ways of thinking about organisations and management — and, to some extent, a common model on how environmental dynamics should guide the choice between different schools of thought. Mintzberg (1983) has been instrumental in dividing the theory into a small number of schools and modelling how a two-by-two division of a firm's environment, according to a stable–unstable and simple–dynamic dimension, can be used as a key to contingency thinking with organisation theory (Mintzberg, 1983). Since then, this has almost become a standard thinking within the organisation theory (Daft, 1999).

We find the same way of thinking within the strategy theory — much of it also inspired by the ever industrious Mintzberg (1994, 1999)— as well as within the MoT theory, where only a few attempts to devise contingency models have been attempted. Two reviews are commonly referred to (Adler, 1989; Drejer, 1996) with the latter to a large extent based on the same kind of thinking as the traditional approach from the organisation theory.

Drejer (1996) even divides the MoT theory into four schools of thought, albeit based on historical considerations, and relates these schools of thought to an environmental model much similar to the one used in the standard thinking of organisation theory. Therefore, I will assert that the existing thinking on contingency within MoT research is very much in line with what I would call the traditional model for contingency within the management theory.

All of this is just fine, but what are the problems of this traditional approach? For the purposes of this paper, we shall argue along two lines:

- The traditional model is too simplistic in the sense that there are several more schools than the four that need to be considered.
- The traditional model is based on a biased hindsight when it comes to the environmental challenges of the past.

2.1. *The traditional model of contingency is too simplistic*

Obviously, a two-by-two model of a firm's environment (with just four corresponding schools of thought) is a very simplified model. Furthermore, in some instances it has been argued that Mintzberg's two-by-two model could be reduced to just two situations — simple–stable versus complex–unstable — and, hence, the choice between the traditional bureaucratic hierarchy and the new network organisation (Daft, 1999).

However, as Mintzberg has found just five (!) schools is far from enough to cover the complexity of organisation theory (Mintzberg, 1989). Thus, Mintzberg has proposed more and more schools of thought about organisation theory over the years. The same goes for Drejer within MoT theory. In his original literature review, the last school of thought is really consistent of several schools that are hard to distinguish because the literature is so relatively recent (Drejer, 1996). Therefore, it is chosen not to distinguish between more than four schools from the beginning. Furthermore, a recent book has also admitted that some aspects of MoT theory has been omitted from previous research (Drejer, 2001) but can be added now, as a more coherent picture emerges of a school of thought based on more power–social thinking than the other schools. In other words, a revision of the model for MoT theory as divided into four schools is about to be due.

2.2. *The traditional model is based on biased hindsight*

Within strategic management and MoT, the contingent models are often based on a historical view of the litera-

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