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TECHNOLOGICAL MANAGEMENT: EXPANDING THE PERSPECTIVE FOR CROATIA

MANAGEMENT LITERATURE RESOURCES

A growing body of literature has focused on the understanding of culture management, so as to unlock the hidden values of knowledge resources available in an organization and its intellectual capital formation (Harvey and Denton, 1999). The causal connections between individuals, organizations and national systems are explored in those theories with the emphasis on public policy, governance, accountability, environment and social and technological change processes. "Organisational culture" becomes both a lever of change and a mechanism for achieving performance improvements, although the validity of these assumptions often takes the form of a self-fulfilling belief, rather than an empirical proof (Legge, 1987; Wilson, 1992). Nevertheless, it is broadly assumed that organisations with a unifying "mission" and a positive set of "core values" emphasising flexibility and innovation will be more responsive to changes in their competitive environment (Tyson, 1995, p. 123; Ulrich, 1997, p. 183).

Various authors have queried the tendency to borrow management practices indiscriminately from the West, proposing instead the development of more appropriate approaches (e.g., Blunt and Jones, 1992, 1997; Jaeger and Kanungo, 1990; Kamoche, 2000; Kiggundu, 1989). By focusing on the concept of knowledge we aim to undertake a critique of the on-going debate on this discipline as well as to point to new research directions in the hitherto much neglected Eastern European context. We aim to contribute to a better understanding of the dynamics of international management by examining this terrain through the conceptual lens of technology diffusion with particular reference to the knowledge that resides in people.

R&D MANAGEMENT

Major recent contributions in regard to the management of R&D are the concepts of: "third generation R&D" brought together by the consultancy firm Arthur D Little

(Roussel et al., 1991), portfolio management theory of R&D projects (Roussel et al., 1991 and Cooper 1997) and the methodology of technology foresight. These provide difficult but convincing tools for managing an activity that has caused much anguish in the past, and they enable constructive dialogue to take place between R&D and the rest of the firm.

The recent trend moving from R&D management to management of technology could be connected to the change in the understanding of the source of technology and therefore of technological opportunities. In the 1960s and 1970s, in-house R&D was considered the main source of technological innovation (Rousset et al., 1991). In the mid-1980s, following hundreds of papers and books related to the economics of innovation and technological change, many sources were identified for innovation: alliance modes (R&D joint ventures, consortia, license swaps, etc.), subcontracted R&D, acquisitions, etc. In the management literature, the concept of technology portfolio emerged (Pappas, 1984).

Also, there has been a change in the status from operational to a more strategic positioning. In the past, top management delegated technical choices within the R&D department (Pavitt, 1984). The only involvement of top management was to set a target of R&D effort as a percentage of the turnover. It was the responsibility of R&D managers to optimize this resource allocation. The management of technology gained strategic content which justified growing involvement of top management in technical decisions.

Rogers (1983) suggests that key influences on the adoption of an innovation are its perceived attributes, its relative advantage over alternatives and its compatibility with current systems. Thorelli (1986) emphasizes the importance of peer networks in the diffusion of innovation, while Teece (1986) underlines respectively the critical importance of complementary assets and management learning in making effective the potential gains of an innovation.

MANAGEMENT OF TECHNOLOGY

> *"MOT is about knowing how to express technology, how to bringideas to work in the world, and how to think about the way technology is designed and how it functions".*
>
> *David J. McGrath*

The management of technology (MOT) has been under the strong influence of the engineering-based disciplines.

The field's structure was inherited from research and development (R&D) management and the mainstream in the literature initially dealt with topics such as project evaluation and selection, R&D organization, technology forecasting, etc. A strong emphasis was put on the management of technological assets. Economists helped to analyze public policy issues and to explore differences in management of technology according to industry, size or country. Management of technology would benefit from a stronger influence of such as accounting and control, finance, marketing, human research management (HRM), organizational behaviour – through a restructuring of the field.

Figure 1. suggests that over the time, the scope and the field has expanded to increasing range of managerial issues and include more and more topics.

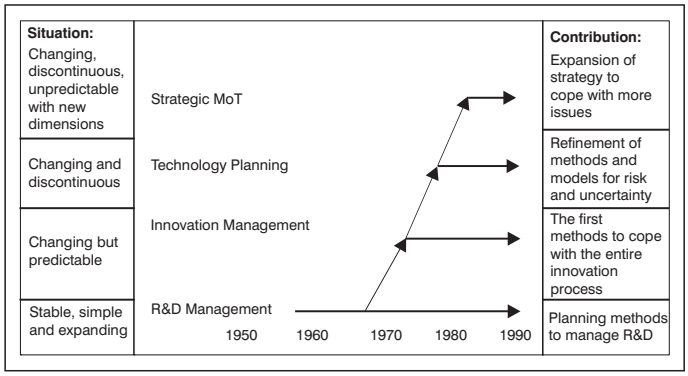


Figure 1
Conceptual framework for the evolution of MoT

Figure 2
Summary of the four schools of MOT

	School 1: R&D management	School 2: Innovation management	School 3: Technology planning	School 4: Strategic MoT
Perceived situation in business environment	Stable, simple and expanding	Changing but predictable	Changing and discontinuous	Changing, discontinuous, unpredictable with new dimensions
Scope	Manage R&D resources	Manage innovation in the entire company	Manage technology across the company	Manage and integrate technology with other aspects
Issues	People, ideas, funds and culture	Conception, invention and exploitation of technology	Analyse and plan the complex process of technological development	Deal with all the dimensions of technological evolution
Elements	Technology forecasting budgeting	Delphi forecasting, technology forecasting, project management and the innovation process	Scenario forecasting, technology analysis and planning	Strategic MoT, organisation technology, approach to MoT and integrated MoT

What is important to note is the interaction among individuals as an important element in the mechanism of MOT. The first question that should be addressed is why firms look for MOT. Recall that our assumption is the inducement to introduce a MOT is related to the inadequancy of the old technology to solve technological problems – from the economic and technical point of view – faced by the firm.

THOUGHT ON TECHNOLOGICAL MANAGEMENT

Badawy (1998) defines technological management as the practice of integrating technology strategies with business strategies in a firm. This definition is focusing on the strategy field, especially the resource-based view and positioning, with business operations and dynamics. A broader definition of technological management is used in the Master of Technology Management program at the University of California, Berkeley, and defines technology management as a set of activities associated with bringing high-technology products to the marketplace. Technological management can be described as the ways in which markets change due to the influence of technology, how innovative ideas are developed and introduced to the market, and how managers can increase the innovation performance of their organizations.

Dankbaar is using "technology management and management of technological change as synonymous expressions". According to Chanaron and Jolly (1999), R&D management, the management of technology and technological management differ through their "stakes, stakeholders and scope" – they suggest the name the 3S model. Stakes assumes that any management function should take technology as an input shaping both its strategic vision and its operational procedures and methods. Those terms also differ in terms of the type of firm, the people involved in daily practice or involved in decision making. Finally they differ through managerial issues.

According to Antonelli (1999, p. 245), the technological knowledge used by firms draws upon four different forms of knowledge. There we can have four components of technological knowledge: internal and external tacit knowledge and internal and external codified knowledge. An important contribution to the subject comes from knowledge management. In the "new economic growth theory" various scholars (Aghion and Howitt, 1998) shifted their focus from traditional, tangible capital assets in the neo-classical model to intangible knowledge assets accumu-

lated through science and technology investments. Technological knowledge was thought to be a source of strategic competitive advantage to a firm (Drejer, 1997; Hamilton, 1997). These studies focused on firms' operations, including cost efficiency; technological diversity and trajectories (Dosi, 1982; Dussauge et al., 1994); operational efficiency, product and process management (Davenport, 1993; Kfir, 2000); technology marketing, competitive strategies (Prahalad and Hamel, 1990); technology diffusion and transfer (Rogers, 1983; Dabić and Banerjee, 2003; Harvey et al., 2002); and strategic alliances (Dussauge et al., 1994).

The continuing move towards technological management is connected with understanding that technology has impact on all management functions.

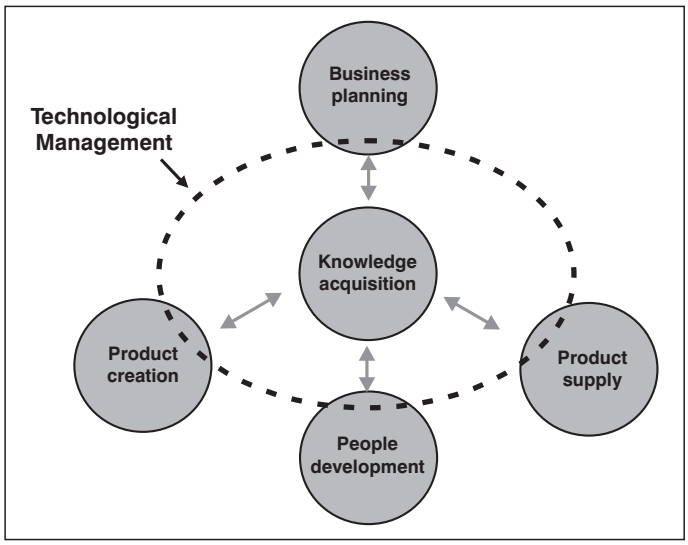


Figure 3
Technological Management and the five key business processes

CROATIAN' BUSINESS ENVIRONMENT

There is a general consensus that macro-environment variables have a major impact on the development of knowledge management policies and practices (Mills, 1998; Sissons, 1999). The collapse of communism in 1989 gave rise to a period of dramatic political and economic change, which has been an uncertain time for the countries in transition. The process of change from command to market economy in the transition states has been compelling – certainly, for its participants, but not less so for the western agents who have tried to provide expertise and assistance; clearly, for management practitioners in general, but particularly for specialists in technology and knowledge management.

This paper focuses on Croatia, as a former socialist republic, because it offers some of the greatest opportunities of all transitional economies. Further, continued legislative efforts to open Croatia to foreign investment are increasing its attractiveness to foreign businesses resulting in a stream of significant investments since its post-war independence, reaching over 1 billion U.S. dollars in 2000 alone (Ministry of Economy, 2000; UN, 1999). The investment in Croatia has been driven in part by the country's industrial growth that has been 6% for the past 3 years (the industrial sector employs 25% of the workforce and accounts for 95% of exports) (Ministry of Economy, 2000).

Since declaring independence on June 25, 1991, Croatia has struggled through years of war and United Nation protection in its movement from a planned economy to a market economy. From an economic standpoint, Croatia has officially embarked upon economic reforms aimed toward the development of a market economy.

After years of research in a variety of industries and on several continents, some modern managerial principles are emerging. It doesn't matter where firms begin (e.g., quality, reengineering, benchmarking, systems thinking, learning networks, restructuring, etc.) But there needs to be one compelling force which binds the entire organization together – one that creates a common language and shared purpose. More often than not, however, change management strategies have been met with covert tactics which undermine long-term progress. Moreover, people are not inclined to share their ideas and expertise with others if they feel that their own jobs are in jeopardy. While the formal constraints governing the market have been relaxed, Croatia's economic transition is far from complete. While market transaction mechanisms, free competition, limited governmental intervention and open access to information are characteristic of developed Western markets, barriers to these key economic aspects remain in Croatia.

Pressure for change has come from the deep worldwide recession of the early nineties causing firms to look closely at all classes of expenditure, and also from rather belated recognition of technology and innovation as competitive elements. It has been recognised that although competition does indeed take place on the classic grounds of efficiency, price, promotion and marketing, ownership of a technology can also give a profound advantage. The task of R&D is to continuously renew firm profitability through technical advances.

NATURE OF THE TECHNOLOGY-DIFFUSION PROCESS TO AND FROM THE CROATIA

Croatia has not featured much in the mainstream management debate, and not surprisingly, this has been repeated in the debate on technology with regard to the Central and Eastern European (CEE) context. In this section we define the constitutive constructs of our conception of technology and proceed in the following section to set out the nature of the technology (knowledge)-diffusion process to the CEE context. Rather than use the word "transfer" that in common parlance refers to a uni-directional approach, we view the process as one of bi-directional diffusion. In developing a model of technology-creation and diffusion we recognize that the coherence and eventual success of such a model will depend on a number of factors, which we discuss in the sections that follow.

The main problem for mostly firms in transition countries, as well as for firms in Croatia, comes from answers how to know what they actually know and to exploit this knowledge in a systematic way (Hibbard, 1997). Many experts on the transition processes of CEE economies to free-markets feel that technology transfers from outside these economies will play a major role in speeding up the transformation process (Salvatore, 1993; Cheney and Kozlowski, 1994; Peng and Heath, 1996; Witt 1998). Orlowski, (1998) argue that foreign ownership has a positive effect on innovation because of the resources that foreign parties are able to draw upon and contribute to the domestic firm. These resources consist of finance, technology, knowledge and managerial expertise. For the most transition countries technological integration is a priority job in the "catching up process" (Radošević, Dyker, 1996). As they point out, technological integration is a process whereby the given economies are assimilated into dynamic learning patterns of international firms. Technological integration therefore means that the host economies and their constituent firms are not just passive recipients, but rather active adapters and sources of technological knowledge.

In reality, the diffusion of technology is governed by a variety of systems ranging from highly sophisticated ones in some CEE countries with well-established mechanisms for attracting and managing foreign direct investment to the more chaotic (and often non-existent) ones in more centrally controlled countries. This section considers the directionality of the diffusion and learning process, and the circumstances under which the diffusion of

knowledge between CEE and foreign organizations can be made more mutually beneficial. Beamish (1994) notes that there has been little research into the performance problems of joint ventures in developing countries, and how they can be improved. We find this neglect applies as well to other forms such as part or wholly-owned subsidiaries, in particular within the Eastern European context. This view is a legacy from the earlier days when the emphasis was on technology transfer and the resource-dependency perspective that cast transition country subsidiaries as dependent on the parent for nurturance (Kamoche, 1997). As we have argued above, however, CEE presents serious risks for investors who ignore its complex legal, cultural and social context.

This leads us to the following proposition:

Proposition: The neglect of the CEE context in the knowledge diffusion debate in part reflects a mistaken belief that you can copy Westerners model and apply it effectively in transition countries.

This is often broadly described as local knowledge and is an important ingredient in successful business relations. Similarly it is useful to consider mutual long-term need while assessing the success of knowledge-diffusion activities just as it is important in assessing the viability of strategic alliances (e.g., Lane and Beamish, 1990). While this mutual need is mainly viewed in terms of what the joint partners hope to gain from each other, we argue for the need to recognize what they can also contribute to the partnership. In a similar vein, Grant (1996:111) argues that knowledge transfer involves both transmission and receipt. This shifts the discussion away from "appropriative learning" (see also Loveridge and Mok, 1979) whereby one party extracts benefits while offering little in return, to what we might call "symbiotic bi-directional learning". For this to be sustainable there should be a firm commitment by both parties to contribute to the learning process.

Research has identified various obstacles to the knowledge diffusion process. For example, citing the case of Italian firms, Kogut and Zander (1993) contend that outward direct investment is hampered by the difficulty of transferring social knowledge – knowledge grounded in close ties within networks. While it appears plausible to argue that it will be more difficulty to transfer social knowledge (which includes tacit knowledge) than more codified forms, their findings showed that the more tacit and the

more complex the technologies, the more likely the transfer to wholly-owned subsidiaries. As the technologies become more codified and more easily taught, the more likely the transfer is to third parties.

This leads us to the following proposition:

Proposition: The heightened levels of interaction in wholly or partly owned subsidiaries provide opportunities for the transfer of tacit knowledge.

It cannot be taken for granted that the diffusion process will necessarily result in the partner firms absorbing the new knowledge and successfully applying it to commercial activities. Obstacles include resistance to change by managers: Croatian managers may resist the perceived imposition of ideas – the Not-Invented-Here (NIH) syndrome (Katz and Allen, 1982). The Western partner in turn may be reluctant to share because of concerns about inadequate intellectual capital protection, the risk of knowledge spillage or the belief there is little to learn from the Croatian or CEE partner. Appleyard (1996) argues that firms are more inclined to justify inter-firm disclosure if they expect the partner firm to reciprocate with useful knowledge or some other form of compensation such as a licensing fee. Barriers can also result from ignoring the various dimensions of the institutional context. The "stickiness" (von Hippel, 1994) of the knowledge can also present barriers to diffusion, particularly where the tacit form is highly firm or context-specific, and where there is an arduous relationship between the source and the recipient (Szulanski, 1996). Lane and Beamish (1990) note that managers in East Eastern Europe complained they were denied promotion opportunities in MNCs, and opted for parastatals, local firms and starting their own businesses.

HARNESSING TECHNOLOGY TO ENHANCE THE (FUTURE) COMPETITIVENESS OF THE FIRM

Developing a keen understanding of individual transition European countries and firms would be difficult in and of itself, but to develop an operating system for the entire set of transition countries would be an inordinately difficult process to undertake. But, without such an institutional perspective each transfer of technology with knowledge would be relegated to an *ad hoc* one-of-a-kind decision process. Developing a frame-of-reference to transfer knowledge is imperative in such institutionally complex cultures.

Thus, an MNC unfamiliar with the challenges of investing in CEE is likely to encounter significant obstacles in recognizing learning opportunities and acknowledging the value of new knowledge. This might explain the tendency to fall back on familiar routines resulting in the adoption of inappropriate practices. Similarly, the CEE partner with little experience of strategic alliances with foreign investors (or for that matter local managers with little or no prior contact with foreign investors) may fail to benefit from what appear to them like esoteric knowledge. There is further evidence for this contention is Dyer and Singh's (1998) finding that even though Toyota had a well-established partnering capability; it encountered serious difficulties working with US suppliers who had not developed such a relational capability.

Cohen and Levinthal's (1990) concept of "absorptive capacity" is useful in helping to elucidate the way firms actually benefit from new technology acquired or generated through their internationalization processes. We suggest that HRM managers in Croatia can and do retain sufficient discretion for strategic choice under the institutional pressures in a country. Thus, the more congruent are HRM strategies and technology diffusion processes with the institutional expectations of firm, the higher the probability of their successful implementation (see also Scott, 2001; Oliver, 1991; Powell, 1990; Goodstein, 1994).

They argue that the development of absorptive capacity is history or path-dependent, which implies that the ability to recognize and utilize new technology is a function of pre-existing levels of knowledge; again "C" space can be useful here. This is consistent with Dierickx and Cool's (1989) notion of "time compression diseconomies", which shows how a firm can derive a competitive advantage from having invested in resources over a period of time. Hence, an MNC unfamiliar with the challenges of investing in Central Eastern Europe is likely to encounter significant obstacles in recognizing learning opportunities and acknowledging the value of new technology.

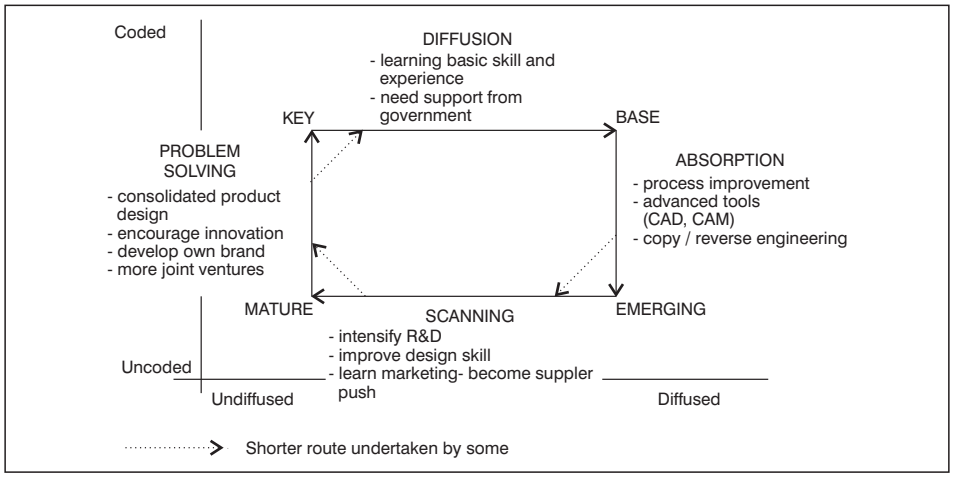
The second key point in Cohen and Levinthal's analysis is that lack of investment in an area of expertise might prevent the future development of a technical capability in that area. In practice it means that neglecting to invest invites the sort of "decay" that Dierickx and Cool (1989) suggest afflicts all asset stocks if they are inadequately "maintained". Investing in some organizational capability, be it technical, production or human resource management ultimately helps strengthen the firm's absorptive capacity in that particular area of competence. Training is a

good example. Over the last decade, in line with the notion that the management of people can be a source of competitive advantage (e.g., Schuler and Jackson, 1999), people are now increasingly thought of as a resource. By investing in individual and team-based skills that expand the organization's knowledge base, the organization in turn enhances it ability to create and absorb new knowledge through the better skilled workforce in a virtuous cycle. In conceptualizing partner firms' absorptive capacities, it is worth bearing in mind Lane and Lubatkin's (1998) contention that their ability to learn from each other is jointly determined by their relative characteristics.

As such, a more appropriate heuristic might be "relative absorptive capacity" (Lane and Lubatkin, 1998). This has important implications for Western-CEE partners with potentially vastly differing knowledge, knowledge-processing systems and dominant logics. While these considerations might appear to present substantial obstacles to knowledge diffusion to-and-from CEE countries, we hope that this discussion and the propositions we have put forward will pave the way for further research into how such diffusion and learning activities can best be accomplished.

Based on a study undertaken at the University of Strathclyde (Greenwood, J. C., 1996) the following is a brief summary in this regard:

Figure 4
Stages of Technology in the C-Space



Source: Banerjee and Abidin, 1997

Evidence suggests (Kim, 1997) that firms improve their technical knowledge further in the next stage of the C-space (absorption) by employing advanced manufacturing tools and technologies. For example, in an effort to start on product development, many firms attempt copy-

ing and reverse engineering. This mainly internal-learning process helps to re-design systems.

In the next stage (scanning) firms can further intensify their research and development. They can improve their design skill and begin their own marketing by becoming supplier-push. Within the final stage of problem solving, firms consolidate their product design further, foster innovation, develop their own brand of products by coding technology and engage in joint ventures on an equal footing.

Some transition economies have achieved a shorter route to the north-west corner of the "C-space" (Kim, 1997), but external agency supports have been vital for such quick migration.

Another important fact here is the support from external agencies such as government, academia, R&D institutions and other local and international agencies which has been available to precipitate the migration of these firms along the technology value chain towards the north-west corner of the "C-space". External agency support played a significant role in this process – examples of these may include government encouragement and sponsorship of initiatives such as "Chaebols" in Korea and technology parks and technology clusters found in many (Carrie, 2000) developed and developing economies. The primary aim of many of these initiatives is to accelerate the learning cycle of the human capital of the participating industrial firms.

THE TECHNOLOGY MANAGEMENT CORE CONCEPT

Researchers will have difficulty in searching for an appropriate model of MOT in Transitional economies such as Croatia, as the underlying assumption is that these countries have a substantial background in engineering/ management and business. Shenhar (1991) provides more insight in his "research model" which identifies six subsystems on which research in MOT may be focused. These subsystems (human, project and process, organizational, resource, technology and strategy) provide appropriate categories to model technology management at any level. The role of managers of technology help define the learning outcomes of a model in technology management. Observations such as "managers of technology are greatly concerned about properly utilising the existing technology and future technology advantages" (Andrade, p. 79 in Crocco, 2003) emphasise the need for adaptability in a changing technological environment. Another consistent

theme is the need for strong leadership of multifunctional teams which cut across traditional boundaries of an organisation (Cardullo, 1996; Khali, 1993; Hauck, 1999).

CONCLUSION

Taken all together, it can be concluded that technology management is more than just the interdisciplinary intersection of engineering and business. Technology management is a balancing act. To be effective, managers of technology must demonstrate not only solid knowledge in engineering and business but they must also possess basic skills in human interaction, leadership, teamwork and problem solving. Therefore, organisations are beginning to recognise that technology-based competitive advantages are transient and that the only sustainable competitive advantages they have are their employees (Black and Synan, 1997). This development has forced steep learning curves as organisations struggle to adapt quickly, respond faster, and proactively shape their industries (Bhalla, 1987). Critical MOT knowledge and skills required for a modern business include: designing, planning and introducing new product and process; organization of business functions, including inter-departmental relationships, customer services, supply chains, quality services and manufacturing operations; and manufacturing and operations management; knowledge of strategic management of technology; innovation management in relation to technological, business, international and national environments. Therefore, new technology and the transfer of such within the organization to its divisions are of utmost importance in transition country like Croatia. Obviously, the key for a successful "catch up" strategy will be how to manage knowledge and technology across a related set of business activities (Hamel and Prahalad, 1990; Harvey et al., 2002).

Therefore, we would like to emphasize main implications for our paper:

1. While the mission of traditional management disciplines is to deal with an array of specific resources, technological management does not have to allocate resources. It rather aims at capturing and mastering the shaping effects of technological variables on businesses.
2. Technology is not restricted to the field of technical functions. Technological management is targeting a much broader view. It deals with stakeholders who so far have not employed and are even scared of technological variables, such as marketers and finance experts.

3. A firm does not necessarily need an R&D department to have to manage technical issues. Therefore, technological management is not only a high-tech business fashion but it also concerns low-tech businesses where the diffusion of new technologies might have a significant impact.
4. When adopting such an approach to technological management, we are stating that managers as well as practitioners and academia should be educated and trained in such a way that they should be able to identify, analyze, understand and evaluate the co-evolution of technology and management. They should also be able to fully integrate technological change in their decision-making process at both strategic and operational levels. Technological management includes multiculturalism and diversity education and in particular in both engineering and management schools. It calls for an integrative and systemic approach in graduate and post-graduate education with enough technology-oriented disciplines in business schools and enough managerial education in engineering schools. It might require the co-development of programs by engineering schools and business schools.
5. The transfer process involves not only communications and learning among firms but also management and culture creation within the firms. The development of technological competence takes time to accumulate and support of other intangible factors such as absorptive capacity, infrastructure and organisational culture.
6. MOT is seen from different viewpoints such as learning or acquiring from partners to achieve a specific strategic goal(s). As results from discussions with senior management in Croatians firms suggested that senior managers are not always directly involved in MOT, more emphasis is given to HRM and marketing planning.
7. With their limited resources, the survival of local firms in CEE/Croatia will largely depend on their technological development.

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