Technology marketing: a new core competence of technology-intensive enterprises

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Abstract: Even in the area of technology, firms are increasingly contracting in from external sources, or contracting out their own work to third parties. This involves the areas of licensing, R&D cooperation, production and OEM briefs and commerce in technologically demanding components and part-products. The carrying out of such technology business, here christened 'Technology Marketing', is dependent upon new processes and concepts, because known marketing methods do not sufficiently take into account the knowledge-defined uniqueness of technologies as the object of commerce. This paper is the result of a cooperative research study carried out by the ETH Center for Enterprise Science (formerly BWI, Section for Technology and Innovation Management) and the Research Institute for Sales and Commerce of the University of St Gall.

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1 Acquisition and use of technologies: current examples

Companies are already demonstrating, in various forms, how they acquire and utilize technologies. There are many different examples.

1.1 Honda

Honda Motor Co. and General Motors Corp. commented on their recent agreement as follows: "There is no precedent in the auto industry for two companies that differ so much in size and corporate culture to maintain close cooperative relations without capital ties" [1]. The core of future intensified cooperation is to be the mutual exchange of key technologies. As a complementary extension of its present offering in drive technologies, Honda will receive diesel motors from Isuzu Motors Ltd. (a GM company); Honda will make its own low-emission technologies available. (In the latter area Honda is a leader, as indicated by its development of a 'Zero-level Emission Vehicle' (ZLEV)).

This agreement may also be interpreted in the light of long-term technology strategy: it is estimated that fuel-cell technology – also of main development emphasis for Honda – will be ripe for commercialization from the year 2004. After this it is predicted that traditional fuel-burning technology will very quickly diminish in importance. For this reason Honda seized the opportunity, while it was still possible, to make use of

accumulated know-how concerning low-emission drives. At the same time Honda has focused its efforts on fuel-cell technology, also supported by the cooperation with GM.

1.2 CERN

The European Laboratory for Particle Physics (CERN) is at present being forced to make budget cuts [2]. While in 1980 3,800 people were employed there, today the number is 2,800, and in the year 2005 it will be 2,000. In order to answer the current demand for technologies in spite of this restructuring, industry has been called on to cooperate in development projects under an initiative entitled 'Call for Technology'. According to this cooperative model CERN will provide its accumulated technological and scientific expertise, while its industrial partners deliver specific development know-how and personnel and material resources. Already several firms of various sizes have made use of this opportunity for technology transfer. In many cases a major attraction of the arrangement is the possibility of obtaining new technological expertise and using it to launch new products on the traditional market.

A typical example is the small firm Lemo SA in Ecublens, Switzerland which specializes in electronic plugs. As early as the end of the 1950s Lemo developed a miniaturized plug for co-axial cables for CERN. A world standard emerged from this development, and today the company has a product range of over 40 models, in use not just in particle physics but also in telecommunications and medical electronics. In the meantime Lemo's offering to CERN has also extended significantly, today involving a turnover volume of around Sfr. 300,000 and ranging from high voltage plugs to miniaturized plugs for glass fibre technology. Cooperation with CERN and the know-how it has gained there has so far generated profits of around Sfr. 100 million for Lemo.

1.3 Patent E-commerce

A growing number of companies in the USA are involved in widening Internet patent commerce [3]. The firm Patent & License Exchange (Pl-x.com), in which the audit and consulting firm Ernst & Young holds a 30% share, is found in Pasadena. Its director is Bruce A. Lehmann, formerly an officer of the Federal Office of Patents and Trademarks. Yet2.com is an enterprise supported by 3M, Boeing, and Monsanto. Its executive head is Ben DuPont, a member of the DuPont Co. family dynasty. Also to be mentioned is Intellectual Property Technology Exchange (techex.com). Behind it is Arthur Scully, a former member of the J. P. Morgan management.

Nir Kossovsky, President and co-founder of Pl-x.com, is a former Professor of Physics at the University of California, Los Angeles, and a holder of several patents of his own. He bases his entire enterprise on the circumstance whereby there exist, simultaneously, parties seeking new products for already established sales channels, and inventors who possess patented product ideas but have no desire to realize them. At present, in aid of market efficiency, a novel business process is being developed. Firstly the reliability of the patent to be traded is assessed, in order to provide insurance cover for potential risks; with this in mind cooperation has been set up with Chicago Title Co. and Swiss Re New Markets. In addition, a computer model is under development which should facilitate the pricing of patented knowledge.

Yet2.com is trying to make the matchmaking process between buyers and sellers as user-friendly as possible. To this end a comprehensive inventory of inventions available from the founding firms – including Ford and Procter and Gamble – is being compiled. It is also intended to include state-financed inventions: in this connection an agreement has already been made with the National Institute of Health.

Intellectual Property Technology Exchange, finally, focuses on the Life Sciences and will set up a 'one-stop site' for firms and venture capital representatives interested in biomedical technologies.

1.4 Swiss Re New Markets

Since April 1999 Swiss Re New Markets (a subsidiary of the reinsurer Swiss Re) has offered two new services which cover risks in connection with the possession and transferral of patents ('Intellectual Property Risks', or IP). One 'product' covers breach of patent rights in connection with third parties, and the other insures against the invalidity risks of transferred patents.

These offerings correspond to three trends. The first is a rapid increase in the number of patents granted yearly in the USA: these jumped from 52,498 in 1979 to 163,208 in 1998. The second involves an increase in the annual number of patent disputes in the USA, from 843 in 1982 to 2,244 in 1998. The third trend has to do with the rapidly growing commerce involving patents, which increasingly takes place over the Internet. The second Swiss Re New Markets insurance product has arisen in this connection out of the above-mentioned cooperation with Patent and License Exchange (Pl-x.com).

1.5 IBM

An agreement has recently been made between IBM Corp. and Acer (Tapei, Taiwan) based upon an \$8 billion technology transfer [4]. According to the deal Acer will, for the next seven years, for its own servers, desktops and notebook computers, take over usage rights from IBM in the area of hard disc drives and network and display technologies. In return, IBM will purchase \$1.3 billion worth of 13.3 inch LCDs, manufactured by Acer using IBM production technologies (already transferred by a regulated licensing agreement in the year previously). In the context of this collaboration it is planned to cooperatively develop products which will be distributed by Acer in Asia and the Middle East.

Other, similar, agreements have been made with Dell, EMC, Apple and Nintendo. With the help of such OEM (Original Equipment Manufacturers) alliances, the number of which has steadily grown since 1993, IBM can spread its internally-developed technologies far faster than would be possible via its own product range.

At the beginning of 2000 it was announced that IBM, with 2,756 patents, stood at the top of the list for patents granted in the USA in 1999 [5]. Gerald Rosenthal, Vice-President of Intellectual Property and Licensing, describes IBM's patent policy as follows:

"We do not intend to use patent portfolio to prevent companies from using our technologies as long as they are willing to pay the license fees. Our patent portfolio not only generates large license revenues but is also a strategy in terms of winning new businesses."

Indeed, at present IBM's annual intake from licenses amounts to around \$1 billion. In 1999, in addition, turnover of technology group components brought in more than \$30 billion. A further use IBM makes of its strong patent position involves cross-technology licence agreements with other computer manufacturers, which selectively allow direct access to its technology know-how. IBM invests over \$5 billion in research and development annually.

1.6 4M

The firm 4M SA recently made headlines in the business press [6] due to its spectacular start on the stock exchange. But at the end of 1998 4M was struggling with the effects upon it of the Asian crisis, and was forced to declare semester losses of Sfr8.1 million. In addition, the company was in a weak technological-strategic position. It lacked a suitable process for the metalizing of CD surfaces. Then, the opportunity arose to acquire this technology from the Oerlikon-Bührle subsidiary Leybold AG. In the course of this acquisition 4M took over the entire development department at Leybold which had worked on this process technology, and also the sole usage rights to the transferred know-how. Together with technology enabling it to apply photosensitive paint and spin it off again after the processing of the rotating disc, 4M with its bought-in metal layering technology now possesses a distinct competitive advantage over its main rival, Singulus.

1.7 Mosaid

Mosaid Technologies Inc. has introduced a program involving the active licensing of patents which, in the 1999 business year, has already brought in ca. \$13 million [7]. This involves around 60 patents which provide direct access to the so-called 'system-on-a-chip' design of microelectronic components. The first contracts were finalized with Fujitsu Ltd., NEC Corp. and Toshiba Corp.; the whole initiative involves over twenty companies.

1.8 Nelm

Nelm AG is an enterprise based in Ticino (Italian Switzerland) which specializes in quality electronic production. It was founded in 1973 and in 1976 was taken over by Cerberus AG as a subsidiary, originally with the task, complementary to main production in Volketswil, of manufacturing large series of fire and intruder detectors. During the 1980s Nelm AG progressively underwent a successful strategic change [8]. This basically involved the extension of core competences enabling the firm to provide a broad spectrum of services to other companies, such as product and manufacture engineering, component procurement and process planning, conductor plate manufacture, electronic assembly and quality control, and finally supply chain management [9]. To this end, in 1987 the Altimex Network was created as a technology pool for electronic manufacture. It consists of Altimex AG, focusing on project management, engineering, product design, and procurement and logistics, and Nelm AG; manufacture is concentrated in the latter, which is today in a position to fill both prototype and large series orders.

Today Nelm employs around 500 people. Half of the firm's business involves filling manufacturing orders from the Cerberus division of the new (1998) Siemens Building Technologies, and the other service orders for third parties.

This successful in-sourcing strategy involves a specific form of technology transfer: production process technologies mastered by Nelm AG are made available to other firms. This, however, takes place not via the transfer of technical knowledge and facilities but via the material results of the technologies used. Such an explicit definition points to the fact that in the case of Nelm AG the 'commercial units' are technologies which are traded in their applied form.

2 Technology marketing: the second level of company trade activities

These examples illustrate how enterprises procure or make use of their technologies. In the future those offering them will make more conscious use of them. Important stimuli here are firstly the unchanged pressure of time – development delays must be avoided at all costs – and secondly the need to make efficient use of resources, i.e., to make the best use possible of a given R&D budget.

In order to understand the wide variety of options in the procurement and use of technologies the *trilogy of strategic technology decisions* is a useful tool (see Figure 1). First, the decision must be made as to which technologies are today and will in the future be important for the company. This decision is based upon comprehensive analyses, which encompass first the technology needs of several current and planned products and services, and second the assessment of not-yet-deployed or perhaps to-be-developed technologies with an eye to their function as substitutes or as new applications.

Figure 1 Trilogy of technology decisions [10]

Second, it must be decided how far the technologies assessed as necessary should be developed internally or acquired from outside. This is the 'make or buy?' decision, and includes all types of cooperation in the development of product or process technologies, as well as all conceivable forms of utilizing external R&D and production process

technologies. Third, at a given point in time companies are confronted with the question as to which technologies should be reserved for a firm's own exclusive use, and which should be made accessible to external parties in a different form or even for direct use. This is the 'keep or sell?' decision.

In the future companies will be faced with significantly more 'buy or sell?' decisions than previously. The next question then arises: with what business forms are they best to be realized? For the moment we will, in the comprehensive sense, term the professional buy-and-sell process 'Technology Marketing'.

Figure 2 Various forms of technology marketing

The above figure illustrates both forms of technology marketing and of traditional marketing. It presupposes that traditional marketing also *formally* covers *many of the company's acquisition and turnover-oriented activities*. This presupposition is compatible with the marketing concept as, for example, described by Kotler & Bliemel [11]: "Marketing is a process within the economic and social structure via which individuals and groups satisfy their needs and desires by manufacturing, selling and trading products and other things". Obviously marketing has a connection with, for example, the acquisition and turnover markets. But the transactions of the parties concerned may also involve several complementary activities. A type of cooperation whereby, for example, partners are simultaneously both customers and providers is thinkable. Classical marketing, however, deals only superficially with the application of this within acquisition marketing; its focus is on turnover markets [12]. Access to a more comprehensive partnership, however, provides new approaches in problem-solving and ways of achieving success for customers, in partner systems involving customers or dealers, or in key account management [13]. Such arrangements affect comprehensive

forms of cooperation in business to business marketing in general or in terms of complex activities (e.g., investments, financial services, etc.).

The task of technology marketing is thus to explicitly, and with equal weight, integrate acquisition and turnover. Considerable synergies may arise between these areas, and cooperation be established. Many know-how partnerships exist quite happily without large amounts of cash flow, and still provide sustainable advantages to the parties involved. This is already the case in the buy-and-sell activities illustrated in Figure 2: they extend well beyond the licensing of technologies to include the establishment of partnerships in the area of external R&D and production activities, and cover R&D cooperation, the researching of technology-strategic relevant acquisitions and disinvestment, the entry into OEM procurement and turnover business, the grouping of partners for system business and the setting up of business in technology-intensive components and interim products. Table 1 illustrates the very different sequences of events in technology business and traditional marketing.

Table 1 Basic differences between traditional marketing and technology marketing [14,p.303]

<i>Determining factors</i>	<i>Traditional marketing</i>	<i>Technology marketing</i>
Strategy	Increase competitiveness Improve ROE	Optimize technology potential Set up alliances and networks
Target groups	Product user	R&D specialists Production management Original equipment manufacturers (OEM)
Market segmenting (examples)	According to various criteria: geographic, geodemographic, psychographic, behavioural End-users, product users, key and smaller customers	Technology products to be substituted Similar process functions New product and process functions Core competence strategies and readiness to outsource Production capacities
Marketing instruments:	Products, services, systems	Know-how, patents,
Market performance	Price according to market rules	prototypes, projects
Price and conditions	Advertising, purchasing	Case-specific pricing
Market administration	stimuli, sales	Reputation among specialists
Distribution	Distribution channels	Situation-specific technology transfer
Body of knowledge	Marketing (& technology)	Technology and marketing

The strategies involved are different. Traditional marketing is oriented towards competitiveness; technology marketing may be primarily concerned with the financial

and access-oriented optimization of technology potential, or with the targeted creation of a network serving technology-relevant knowledge. There also exist significant differences with regard to the competences required for successful technology marketing, for which expert technology knowledge concerning technology trends, technology development and application and production is vital. Both types of marketing, however, have the same goal: to increase the firm's profitability.

The situation of market segmenting is similar. While known marketing makes use of geographic or behavioural (etc.) criteria, technology marketing also emphasizes technological criteria in various forms. Thus it may be reasonable to carry out a market grouping according to substituting technologies (e.g., is so-called 'Bubble-Jet' technology capable of replacing quartz printing and laser technology, partially or wholly?). Or it may be useful to consider (this is a cross-industry question) which product functions may be realized via certain technologies (for example: in the case of a highly efficient soldering technology, suitable for the manufacture of vacuum containers, the potential market segment lies not in the variety of vacuum apparatus but in the number of products whose manufacture requires the production process function of binding metals securely). In the end fertile hunting ground for in-sourcing business to make full use of production includes every enterprise whose value creation and thereby share in its own production is comparatively high.

In traditional marketing, instruments are supported by describable products, systems and services whose prices are set according to market rules and which reach the customers by market means and via real distribution channels. Technology marketing, in contrast, primarily involves complex knowledge the value of which is difficult to estimate, which becomes known via its reputation, and whose distribution takes place in the form of situative technology transfer.

These differences reflect company tasks in fully separate market areas. Figuratively speaking, technology marketing involves what is carried out on the 'second level of company activities' (see Figure 3).

Figure 3 Technology marketing as the second level of company trade activities [14,p.302]

3 Structural solution: functional integration of buying and sales

In order to implement active technology marketing, suitable structures are also required. Firstly, it might be thinkable, analogous to usual organizational forms, for technology

business also to set up buying and sales units. In the case which follows this would not, however, be suitable, for the following reasons:

Looked at more closely it becomes apparent that the three decision-making areas represented in Section 2 have, despite their varying subject-matter, a significant amount in common. For key decisions the same knowledge is required. Each of the three areas should be based upon at least three areas of information. These include, firstly, information concerning the current status of functionality, performance and application of those technologies which are important to the enterprise at a given point in time or might be so in the future. Secondly comes information about the future development of these technologies and the presumed advent of new technologies. Thirdly – and of increasing urgency – information is required which covers, case-wise, the current state of development and use of product and process technologies in other firms.

In other words, the competence required for, respectively, the processing and running of acquisition and turnover-related technology business is more or less identical. For this reason it follows, in the realization of technology marketing, to select a structure which integrates both buying and selling tasks. As today companies of all sizes are under pressure to find external solutions to information-gathering, it is also expedient to allocate to this unit, additionally, responsibility for the design and running of an appropriate information procurement system. Here one speaks of ‘technology intelligence’.

Our proposal is to set up an organizational unit, entitled ‘Technology Intelligence and Marketing’ (TIM), which has the following tasks [14,p.324]:

- Establishment and maintenance of intensive contacts to internal technology bearers and external technology experts
- Systematic patent analyses
- Setting up and operation of a ‘technology intelligence’ system oriented towards all company-relevant technology fields
- Drawing up of ‘technology road maps’ of core technologies
- Compiling of experiences on the establishment and operation of technology cooperation and strategic alliances
- Initiation of technology business and the project responsibility for carrying it through
- Periodic elaboration of technology strategy
- Organization of interdisciplinary functions to promote decision-making
- Elaboration of information in the area of technology assessment

In terms of personnel, TIM should be supported by a core team involving (depending on the size of the firm) a small number of experts. In addition, the part-time collaboration in TIM tasks of all company units affected by technology decisions should be foreseen (see Figure 4), in order to effect a company-wide standard information level regarding technology matters and increase identification with results. The TIM unit would logically be placed under the supervision of the CTO (Chief Technology Officer) or the general management member responsible for technology.

Figure 4 Structure of the Technology Intelligence and Marketing unit in the structure chart of an industrial company [14,p.323]

4 Technology marketing: an opportunity for more development experience

The performance progress of a technology in correspondence with the accumulated means invested in it follows an S-curve. It is worth asking whether it is possible to influence this process. In other words, would it be feasible to bring about an *R&D learning curve* analogous to familiar production-process learning curves?

Figure 5 Thesis for the existence of an R&D learning curve [14,p.242]

An approach to this issue has been elaborated by Teichmann [15]. His starting-point was the premise that an important learning process also takes place in the R&D area. He refers to the number of applications which are realized in the course of technology improvement (see Figure 5).

An example is the improvement of speech recognition technology in telecommunications applications bringing it up to the level of 100 words. According to Teichmann's thesis this level could be reached more quickly if applications are first realized at the level of technology involving just a few words (e.g., elevator programming). From these applications, according to the thesis, knowledge may be gathered which will stimulate increases in performance. If one regards the often astounding variety of technologies observable in Japan, this seems at least plausible.

With this in mind the activities of technology marketing take on additional significance. They are strategically important, and may, via technology business, also be oriented towards acquiring experience of the early applications of important technologies. This may lead to a situation where licensing agreements concerning the use of a technology are not based solely on monetary factors: information on the customer's application experience or of further developments may be brought into the mutual arrangement.

5 Example: the new technology options of Schulthess Maschinen AG

Schulthess Maschinen AG, a middle-sized firm in the machine industry, pursues a niche strategy and focuses its product offering primarily on high-quality washing machines. The production of high-quality products makes investment in modern production plant necessary, whereby, however, comparatively low turnover volume means that available production capacity may only be partly used.

Looking for ways to better utilize its available and unused internal production plant capacity, the company is concentrating on the acquisition of external production contracts. While the marketing activities surrounding technologies in most firms primarily concern product technologies, at Schulthess the emphasis is on the marketing of production process technologies. It must be noted, however, that no technologies leave Schulthess: external parties may only make contractual use of its technologies internally.

Schulthess Maschinen AG has in its production concentrated on its core competences – the processing of fine sheet metal, steel and casting material, surface treatments and assembly – and has systematically expanded and optimized them. Supporting these competences are around 20 production process technologies with marketing potential.

The goal of Schulthess' technology marketing activities is to establish solid partnerships with companies for which it carries out production contracts, thereby ensuring that its internal plant is better utilized. In this a long-term contractual relationship is advantageous. The search for appropriate partners is not only exclusive to Schulthess' own branch of industry: one of the company's great advantages lies in its range of offers in a comprehensive value creation chain.

5.2 Evaluation of the technology portfolio

The question of which production process technologies are actually suitable for marketing, in the sense of fulfilling external production contracts, must firstly be

investigated via a comprehensive evaluation of all the individual technologies.

Here achieving an overview of the production process technologies available in the firm rather in the form of a technology portfolio is unavoidable. Technology portfolios are two-dimensional illustrations which represent the competitive positions of enterprises. One dimension of technology attractiveness concerns influencing factors which cannot be affected by the firm itself ('look outwards'), while factors which determine relative technology strengths or market position lie within its control ('look inwards').

The practical use of portfolio matrices lies firstly in the transparency of individual competitive positions that it creates, providing a basis for the elaboration of strategies. Portfolios are secondly useful in providing easily-understood communication of the results of strategic planning to those who have not been directly involved with the planning work. Above and beyond this, a mutually elaborated and analysed technology portfolio represents the results of a successful process of integration of development, production and marketing concerns.

Technology portfolios convey a primarily static picture of the company, as the idea is to assess only those technologies that are already supplied by a larger or smaller complement of resources. On the other hand, it is precisely technology-intensive enterprises that are confronted with the task of including in strategic decisions technologies which are seen to be significant, but are not yet deployed in the firm.

Figure 6 Dynamic technology portfolio of Schulthess Maschinen AG

Figure 6 takes this into account by positioning the process technologies of Schulthess in a dynamic technology portfolio. Here are included, in an additional column, 'New technologies', where both technologies required in the future and those already assessed for their technology attractiveness are listed. An additional row entitled 'Obsolete technologies' lists technologies which are no longer used by the firm.

In this dynamic technology portfolio several technologies are included which are significant for the company, those already in use and those which will make demands on future resources. At the same time this type of representation also provides an overview of technologies which have in fact been abandoned but may still be of worth to the company.

The application of a dynamic technology portfolio is very advantageous for Schulthess in making an inventory of production process technologies for application by third parties. At this point, under 'New technologies', new production methods under discussion may also be brought in.

5.3 Criteria for a technology marketing strategy

Other decision-making criteria come into play for Schulthess in addition to the criteria surrounding the technology and market position of production process technologies. Firstly the question arises as to how far the revealing of core competences inherent in the marketing of its production process technologies endangers the company's competitive capabilities. By core competences are meant, in this context, abilities available at only a few companies which generate additional benefits for customers and are not, or are only in a limited sense, capable of imitation or substitution. In completing production assignments for third parties this danger is minimal. Schulthess masters these production technologies marvellously, but in fulfilling external contracts usually deploys those production process technologies identified as core competences only for the material realization of the product functions of the contracting party.

In addition, in order to take on external production contracts sufficient plant capacity must be available. On average Schulthess' production resources are only used at ca. 70% capacity; thus in some areas the firm is able at need to increase its production capacity considerably.

The expenditure and internal costs generated by technology marketing activities in the context of contract acquisition and fulfilment should be known factors, and must never exceed the profits generated by the arrangement.

Flexibility is a further important decision-making criteria: conversion and preparation time in production, and personnel expenditure on external contracts, need to be kept to a minimum; the completion of an external contract naturally has only an indirect connection with Schulthess' core business. In this sense it is partly and fully automatic production technologies which demonstrate a high level of flexibility, and for this reason these are the most suitable for deployment in external contract assignments.

If regarded as dependent on the above criteria and their expression, technology marketing strategies may be applied to production process technologies in the context of external contract assignments. Here the marketing dimension is determined by the external contracting party:

- *vertical*: the production contract either precedes or follows in the value creation chain

- *horizontal*: the contracting party comes from the same branch of industry and may be a competitor
- *lateral*: the contract assignment is carried out for a party from a different branch of industry

For Schulthess the possibility is opening up to begin technology marketing activities in all dimensions, i.e., within the value creation chain as well as within or without the branch of industry. In some cases, however, it is expedient to follow a selective procedure in contract acquisition from partners within the value creation chain and/or from parties outside the industry. This strategic policy is especially to be recommended in the area of production process technologies whose technology effects are important for Schulthess' competitive capacity.

6 Conclusion

The phenomenon of external technology acquisition has been given a lot of attention in theory and practice during the last years. So far research has been limited to an analysis of the situation of the buyer in the technology trade. In this paper it is argued that only through integrated consideration of the trilogy of technology decisions, especially the integrated analysis of procurement and sales of technologies, effective technology decisions can be made. To support the buying and selling of technologies a new type of marketing is needed which goes beyond traditional marketing. This new discipline of technology management called technology marketing is focused on the acquisition and turn over markets of technologies. Through its integrated approach technology marketing generates new strategic options. To ensure that these options can be realized, structural solutions for the functional integration of technology buying and selling are needed. As a whole this research shows that the new field of technology marketing will rise in importance in practice and theory over the next years. Further research seems inevitable to take up this challenge.

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