

THE ROLE OF THE CHIEF TECHNOLOGY OFFICER

- RESPONSIBILITIES, SKILLS & QUALIFICATIONS AND ORGANIZATIONAL INTEGRATION

FRANK TIETZE, PHILIPP LORENZEN, CORNELIUS HERSTATT

Hamburg University of Technology,
Institute for Technology and Innovation Management
Schwarzenbergstraße 95, 21073 Hamburg, Germany

ABSTRACT

So far the academic community has drawn little attention to leadership functions in technology management. The CTO – the Chief Technology Officer – is such a leadership function expected to combine technology and management issues. This paper analyses how the CTO is understood by corporations focusing particularly on typical responsibilities, key skills and necessary qualifications as well as the organizational integration into corporate structures. To approach these issues a survey among executive recruiting consultants (“head-hunters”) was carried out in Germany and complemented by an analysis of international CTO job offers. The authors found that large companies as well as SMEs associate equal importance to similar responsibilities, skills, qualifications and organizational integration (i.e. central, local, staff) with a CTO, while the hierarchical integration of CTOs being a major difference. Furthermore, the authors found that the CTO has in essence similar responsibilities than the head of R+D, but a more external focus on the business environment and professional networks corresponding to the needs of open Innovation.

INTRODUCTION

Due to the increasing importance and complexity of technologies in corporate environments, a need for linking technology to management and corporate strategy arose in many industries. Durand (2004) formulates this in short “Technology should to be managed”. Meanwhile, many companies share this view and install high level management positions with corporate technology responsibility. Such a position is the Chief Technology Officer (CTO) besides the head of R+D, Vice President for Technology, etc. Surprisingly, although first CTOs already emerged between the 1970s and 1980s, few literature and empirical studies about the CTO are available. In Germany for example the CTO seems to be “uncharted territory” on the scientific map in particular.

This study was conducted as a pre-study to a large survey prepared by the European Institute for Technology and Innovation Management (www.eitim.org) regarding the role of the CTO in Europe, Japan and the USA. We started with a review of existing empirical and conceptual literature concerning the CTO. Building on this, we developed a research design to test prior findings with current practice in industry. Expert opinions were collected through a survey and international job offers for CTOs were analyzed. We concentrated to provide an analysis of CTO functions, skills and qualification as well as the organizational integration.

The paper is organized in four sections. Starting with a literature review, the concept of the CTO and its relevance for companies’ competitive advantage is presented. Section two presents our research approach. Based on this, the third section

presents results from our pre-study, while the final section discusses these and provides implications for further research.

LITERATURE REVIEW

Over the past 50 years R+D expenditures in the US rose from five Billion US Dollar to 300 Billion US Dollar (Cannon 2005). An often quoted reason is the fast pacing technological changes and therewith linked opportunities and risks (Adler and Ferdows 1990). In order to ensure sufficient efficiency in the R+D and innovation process a need for coordinating and linking functions between different parts of the corporation emerged, specifically between R+D, marketing and controlling. Despite the fact that this issue received growing attention in practice already since the 1980s, it was not as widely researched and still today numerous difficulties are still unsolved at the interfaces of these vital functions in a corporation (Chiaromonte 2003).

Often the objectives of these do not harmonize or are even mutually contradictory. E.g. the R+D department needs more time to test increasingly complex products to ensure their reliability while the marketing department intends to maximize revenue streams by bringing products to the markets at the earliest possible date. Also the number of possible situations where different opinions or insights can lead to demoralization is large. Wolfrum (1991) argues that predominantly problems exist in the integration of R+D and Marketing due to the socio – cultural differences between these functions (Wolfrum 1991).

To solve these problems besides others, the need for a management function emerges with good communication skills and the capability to understand and “speak both languages”, the technical and economical, to handle the many of these situations. According to an empirical survey by Souder (1990) the degree of the harmony between R+D and marketing departments has a significant influence on the outcome of development projects (Moenaert, Souder 1990).

Another important issue is the need to ensure the information flow about new technological developments. For many companies it is essential that they are aware of new technological developments and to understand how these can contribute to their competitive advantage. However, to utilize this information in an optimal manner a direct link to the decision makers is necessary - A responsibility that among others a CTO might fulfill.

O'Neill and Bridenbaugh (1992) presented a vivid example of these circumstances. Significant technical advancements were becoming a serious threat to Alcoa, where Bridenbaugh was employed as a CTO. For the other executives within Alcoa these changes did not appear to be a threat to Alcoa's business because they were not familiar with the latest scientific developments. Junior engineers, on the other hand, had realized this threat. But due to the lack of experience and, more important, lack of access to senior decision makers this knowledge never made its way up to senior decision makers. Some of these issues, in which the CTO by means of his skills and responsibilities shall have a positive influence, will be addressed in this paper.

So far, to our knowledge, only four papers exist that present empirical work regarding the CTO (Herstatt, Tietze et al. 2006). Three of them were published in *Research Technology Management*, a practical oriented journal, and only one article in the international, peer reviewed *California Management Review* by Adler and Ferdows (1990).

At the end of the 1980s, Adler and Ferdows (1990) conducted a questionnaire study with following in depth phone interviews in Fortune 100 companies in the US. Adler and Ferdows (1990) studied “corporate officers with explicit technology responsibility with titles other than *VP for R+D*” regarding their role in the corporation (i.e. responsibilities) and their personal background and experience. Drawing on 25 data sets, the authors found that all CTOs considered themselves to be the “most senior executive responsible for technical matters in the corporation”. Furthermore, Adler and Ferdows (1990) captured the budgetary authority and the power to approve appointments. Adler and Ferdows (1990) identified two types of CTOs: the “line manager” and the “staff position”. Five out of 25 CTOs had full authority over technical budgets and technology appointments in the business units. These five were the most like “line managers” in the sample. In another five cases, the CTOs were in purely “staff” positions in the sense that they did not have formal authority over budgets or appointments in the business units nor even over corporate research; their influence over technological matters inside the company was more informal. According to Adler and Ferdows (1990) the CTOs mentioned five areas of responsibility: (1) Coordination among business units’ technological efforts to ensure synergy and economies of scale; (2) representation of technology within the top management team; (3) supervision of new technology development; (4) assessment of technological aspects of major strategic initiatives; (5) and management of the external technology environment. Regarding the personal background career development of CTOs, Adler and Ferdows (1990) found that 16 out of 25 had general management experience, 24 CTOs had spent a considerable part of their career in technology functions (R+D or engineering). 15 out of 25 had a Ph.D. Only 5 had experience in manufacturing and none significant experience in IT. Four CTOs were recruited from outside, seven from internal R+D positions, while 11 had come via other roles. Further, 9 companies out of 25 reported positions with broad responsibility for more than on technology domain on divisional level, labelled by Adler and Ferdows (1990) as “technology director”. Adler and Ferdows (1990) further questioned why a CTO position had been created. In seven cases the creation was triggered by the availability of the right individual. They concluded that the “motivations differed depending on whether the corporation had a central R+D organization”. Companies with central R+D organizations reported the “need to foster greater responsiveness on the part of central R+D and greater receptiveness on the part of the business units”, while companies without reported the “need to avoid duplication of businesses’ R+D efforts”. To ensure the “cross fertilization” of businesses’ technology efforts and to “exercise overall leadership” in order to maintain the technological base of the company, in particular, by serving as a “window to outside technologies”.

Sponsored by the Industrial Research Institute (IRI), in 1992, Uttal, Kantrow et al. (1992) conducted a CTO study, by interviewing 24 CTOs in large US companies. Four main findings emerged from their study with the leadership style of the CTO as focus: (1) CTOs play a variety of leadership roles, ranging from the strictly functional leader to the “supra-functional” leader, but often leadership gaps exist. (2) The lack of credibility from the CEO is a fundamental barrier for CTOs who are trying to close leadership gaps. (3) CTOs can improve their credibility by building the technology function in the business, particularly by: acting as “technical businessmen”, making themselves and the organizations accountable to the corporations, particularly by using and reporting on various measures of overall R+D per-

formance, and involving general managers in R+D decision-making. (4) CTOs can gauge the existence of leadership gaps, and start improving their credibility, if necessary, by taking a straightforward set of steps. Furthermore in their paper, Uttal, Kantrow et al. (1992) present a model of three different CTOs leadership styles: Functional leadership, strategic leadership and supra-functional leadership. A major issue of concern to CTOs according to this study by Uttal, Kantrow et al. (1992) seems to be the discrepancy between the type of leadership style a corporations needs and the type it gets. The organizational structure seems to play an important role.

An MIT survey by Roberts (2001) investigated R+D management in 209 international corporations on global scale. Questions regarding the CTO were just a part of the whole study and the focus was mainly on regional differences. Over 90% of Japanese companies have their CTO on the main board, while in Europe this applies only to 35% and in the US to eight% of the corporations. However, on a lower lever, CTOs are quite well represented in the company's senior management committee, e.g. the executive committee. While Japan has still the highest share with above 90%, above 60% of all European and US companies report to have a CTO on that corporate level. As a further piece of his study, Roberts (2001) analyzed the CEO's involvement in technological strategy decisions and thereby the relationship to the CTO. He notes just briefly, that "technically trained CEOs show no special bias in regard to appointing CTOs either to the company board of directors or even to the firm's senior management committee". Further, Roberts (2001) reports that in general CEOs are highly involved in five aspects of technology management: (1) technology strategy development, (2) overall R+D budget, (3) project selection and prioritization, (4) internal technology resource allocation, (5) selection of outside technology investments. This involvement might influence the relationship and thereby the role of the CTO.

As fourth empirically study, Thurlings, Bert et al. (1996) reported in a paper of just two pages, some very few findings from a survey. Based on semi structured interviews and an iterative survey approach with 25 corporate CTOs and 22 academics they identified four trends in managing industrial innovations. The CTOs were not in direct focus of this study as research object, but rather their opinions of the future technology management agenda. However, implicitly these issues revealed some important issues regarding the role in the organization. Firstly, CTOs pointed out that "design will be the incorporation of the full context of the application, meaning the interrelation with other products in that application, and the change of the customer's perception. Obviously, products will still be developed, but only as part of interrelated products and services". Secondly, CTOs highlighted the "evolution of the innovation process", i.e. that technical specialists will become more and more substituted by cross-functional experts and this change will deeply influence the organization for innovation. Thirdly, CTOs pointed out that the "strategic management of innovative activities will become increasingly value chain focused, i.e. integrating competitors and key players in the company's innovation strategy. Further, academics and CTOs agreed on three important issues on the agenda for managing technology: (1) the role of technology in corporate strategy, (2) understanding the efficient and effective organization of intra-company innovation processes, and (3) an improved understanding of the management of large and complex projects.

RESEARCH APPROACH

The literature review in the previous chapter proves that so far no solid understanding of the role of the CTO exists. The purpose of our study was to shed some light on the CTO-concept regarding the understanding of the CTO concept with the focus on the CTO's responsibilities, skills and qualifications as well as its organizational integration. Responsibilities were defined as responsibilities that CTOs are hold responsible for and measured against the success. Skills are understood by the author as abilities and competences, whereas qualifications are understood as being rather a comprehensible and provable status like the record of achievement or the grade of experience. This study further intends to contribute to the wider concept of "bringing technology into the boardroom" (Herstatt, Tietze et al. 2006), since the idea of the CTO links with the concept of a closer integration of technology, management and overall strategy.

A twofold approach has been applied in this study. On the one hand a questionnaire survey was conducted and sent to experts, namely large German executive head-hunters. Executive head-hunters were surveyed to generate results regarding responsibilities and the organizational integration of CTOs in German companies. The obvious benefit of gathering data from executive head-hunters with CTO experience lies in the aggregated amount of data. Since all participating head-hunters had placed CTOs, they had built up a knowledge pool and possess distinct insights into the corporate landscape regarding the CTO. On the other hand, international CTO job offers have been analyzed from a database as it was perceived that these explicitly express what corporations demand from potential CTOs especially regarding responsibilities, skills and qualifications.

The selection of the head-hunters and the appropriate contact details emanated from a freely available head-hunter database (<http://www.consultants.de>; data extracted 16/12/2005). The database lists the largest executive head-hunter firms in Germany that work in the executive search branch and are located in the largest German cities (Berlin, Hamburg, Munich, Cologne, Frankfurt, Dortmund, Stuttgart, Essen, Düsseldorf, Hannover and Duisburg). 255 head-hunter firms were identified from the database and were pre-contacted per phone in order to separate the head-hunters with experience in CTO placements mad that were willing to participate in this study.

After questionnaire drafts were tested and validated with five head-hunters during a pilot phase, the final version was sent to 77 head-hunters between December 2005 and January 2006. After two weeks a reminder was send out to the head-hunters that did not respond so far. 18 head-hunters¹ answered the questionnaire by end of February, leading to a response rate of 23%. Respondents were categorized regarding the industry and company size for which they were active in the past. 15 of these respondents had no particular industry focus, two respondents focused primarily on telecommunication and IT, and one head-hunter on the medical device industry. The 18 respondents were further classified with regard to the size of the clients company. Seven respondents had worked exclusively with SMEs in their past

¹ 1. ACON; 2. BGPM; 3. Dr. Senbert Mangmt. Cons. GmbH; 4. Dwight Cribb Personalberatung GmbH; 5. E3-Cons. Mangmt. & Exec-Beratung. Search GmbH; 6. Egon Zehnder Int. GmbH; 7. GEMINI Exec. Search GmbH; 8. HRglobal International; 9. I.I.C.; 10. JLP Consulting GmbH; 11. JSP Jutta Schlieck Personalberatung; 12. Kienbaum Exec. Consultants GmbH; 13. mbg Mangmt-Beratungs-Gruppe; 14. Omega consulting; 15. pro search Schlichter&Partner; 16. PVM Mangmt. Cons. Group; 17. Topos Personalberatung GmbH; 18. Trainer, Utermann, Jansen

(‘group A’). The remaining eleven head-hunters had predominantly placed CTOs to large companies and corporations listed at the stock exchange (‘group B’).

The questionnaire was designed based on a review of the current CTO literature. In total, the questionnaire contains 12 questions and is structured into five different sections. The first three questions comprise descriptive data on the CTO placement experience of the particular respondent (e.g. since and when, for which branch and which company size is the head-hunter primarily acting). Thereafter three questions attend to the responsibilities of the CTO. The following three questions examine the CTO definition, the difference to the CIO (Chief Information Officer) and German synonyms for the CTO, which are not discussed in this paper for inappropriate response rates. The last three questions deal with the hierarchical levels for which companies seek CTOs (e.g. central staff function or divisional integration), a topic that was surprisingly so far not investigated in literature.

The second part of this study applied a dataset that emanated from the international job database monster.de (data extracted: 11/27/2005; 2:23pm) with more than 500 of the largest worldwide corporations from America, Asia and Europe having subscribed to it. This dataset was used for an explorative analysis. Lists with items regarding three categories (responsibilities, skills and qualifications) were extracted from these job offers. Using the search string “Chief Technology Officer” a search yielded more than 800 results. After a first analysis of the data it appeared that only a small share could be classified as “real” CTO job offers. In more than 90% of the job offers the term CTO was just mentioned, e.g. when the position “will report to the CTO”. After the data was cleaned 34 turned out to be “real” job offers for CTO positions. Almost two-third of these job offers are from US based companies, one-fourth of them are from Asian corporations (e.g. India, China), and the rest from Switzerland, UK and Ireland.

RESULTS

Since responsibilities of CTOs were investigated in both parts of the study, these results are presented firstly in a comparative manner. The results regarding this particular issue are further presented separately for two different company types (group A: SMEs / group B: large companies). Further, the results regarding the organizational integration of CTOs derived from the questionnaire survey are presented. Finally, the results of the explorative job offer analysis are presented with regard to skills and qualifications of CTOs.

Responsibilities

The respondents of the questionnaire survey weighted nine different responsibilities derived from the literature on a five point Likert scale, whereas five means the highest relevance. All 18 head-hunters answered this question (see Table 1). With an average of 4.2, the highest ranked responsibility is the “observation of the technical surroundings to search for important innovative technologies for the company”, closely followed by three equal important responsibilities (4.0), namely the “observation of development activities and technology portfolios of competitors”, “consulting the CEO and other members of the executive board in strategic topics” and “strategic, cross-sectional management of the technology portfolio (incl. technology acquisition, technology utilization and development co-operations)“. Two further responsibilities rank above median, which are “coordination of R+D pro-

jects” (3.7) and “building and maintaining networks to experts, universities and other CTOs” (3.3). Finally, three responsibilities rank below median: “coordination and realization of due diligence during merger and acquisitions and buying of companies (incl. Start-Ups)” (2.9), “communicational and representational responsibilities e.g. presentation of new products in media” (2.9) and, ranking lowest the “development of IT – infrastructure“ (2.7).

Importance of CTO responsibilities	SME (Group A)	Large corporations (Group B)	Average
Observation of the technical surroundings to search for important innovative technologies for the company	4,29	4,09	4,19
Observation of development activities and technology portfolios of competitors	3,86	4,09	3,97
Consulting the CEO and other members of the executive board in strategic topics	3,86	4,09	3,97
Strategic, cross-sectional management of the technology portfolio (including technology acquisition, technology utilization and development co-operations)	3,86	4,09	3,97
Coordination of R&D projects	3,71	3,64	3,68
Building and maintain networks to experts, universities and other CTOs	3,43	3,18	3,31
Coordination and realization of due diligence at Merger & Acquisitions and buying of companies (incl. Start-Ups)	3,00	2,91	2,95
Communicational and representational tasks e. g. presentation of new products in media	3,00	2,82	2,91
Development of IT – infrastructure	2,86	2,64	2,75

Note: Scale from 1=no importance to 5=highest relevance

Table 1 - Responsibilities of CTOs based on executive head-hunter survey (n=18)

To be able to interpret the results accurately, the responses of the executive head-hunter survey were divided into two groups according to the size of the head-hunters’ clients. One group of head-hunters mainly serves SMEs (group A; n=7), while the other mainly serves large company clients (group B; n=11).

Analyzing the results of the two groups it appears that in both groups the importance of responsibilities is ranked very similarly (see Table 1). Furthermore, none of the responsibilities scored much less than the median of the rating scale, but the responsibilities are weighted rather heavy with a weighted average of 3.52. ‘Group A’ weighted the responsibilities with a smaller standard deviation (0.47) then ‘Group B’ (0.59). Another legit pattern was not observed, like for example a systematic over- or under-assessment of one or the other group.

Additionally, respondents enumerated further responsibilities of the CTO. However, only two of the seven ‘group A’ head-hunters and five of the eleven ‘group B’ head-hunters mentioned additional responsibilities, and none of the responsibilities was mentioned multiple times: Identification of technical trends; to develop innovations; be the highest decision maker in technology related questions; technical compliance; security; quality management; benchmarking of extern service providers; accomplishment of price negotiations; leading and motivating employees; coordination of new projects and developments.

Responsibilities were tested as well through the analysis of job offers. Table 2 presents the responsibilities mentioned in the 34 job advertisement by order of frequency. Table 2 shows that no particular responsibility was requested in the majority of the job offers. However, two responsibilities rank highest as requested similarly often in each 13 out of 34 job offers or by 38.2% of the companies. These

responsibilities were “observing and analyzing new applications and products” and “strategic planning”. Ranking second, the responsibilities of “developing strategic relationships” was mentioned in ten offers or by 29.4% of the companies. “Ensuring IT security/ licensing/ upgrading/ integrity” was respectively mentioned in nine offers (26.5%) and ranks thirdly. Respectively, seven of all offers (20.6%) mentioned the “development, evaluation, coordination of IT technology” and “providing leadership in technology related infrastructure”. The responsibilities “establishing technical standards” and “representing the company in the business” were mentioned in five offers (14.7%). Finally, ranking lowest, mentioned in four offers (11.8%) was the responsibility “managing disaster plans”.

Responsibilities of CTOs	count	% (n=34)
Observe/ interpret/ analyse new applications & products	13	38,2%
Strategic planning	13	38,2%
Develop strategic relationships	10	29,4%
Ensuring IT security/ licensing/ upgrading/ integrity	9	26,5%
Communication with providers, distributors, customers	9	26,5%
Development, evaluation, coordination of IT-technologie	7	20,6%
Providing leadership in tech-related infrastructure	7	20,6%
Establishing technical standards	5	14,7%
Representing the company in the business	5	14,7%
Managing disaster plans	4	11,8%

Table 2 - CTO responsibilities extracted from job advertisements (n=34)

The existing literature (e.g. Fisher (2000), Grochow (2003) and Melymuka (2003)) discusses that companies often encounter difficulties drawing a sharp line between the understanding of CTOs and CIOs (Chief Information Officer), a question in our survey was included about the head-hunters’ perception of the key differences between the responsibilities of CTOs and CIOs. 16 candidates (one out of each group did not answer this question) responded and interestingly, 15 of these answers were nearly similar in stating that the CTO has the responsibility for technology, external products/customers and R+D topics. In return, the CIO is responsible for the management of the internal planning, information technology selection and operation of IT. In addition, one respondent from ‘group B’ stated a deviating answer. He concluded that the CTO is oriented rather creative, whereas the CIO is oriented rather administrative.

Organizational integration

Two questions in the head-hunter survey addressed the hierarchical level for which CTOs were searched by German corporations. Respondents were asked to assess the approximate share of CTOs, which they had placed in executive committees. All 18 candidates answered this question, and the results appeared to be very uniform. ‘Group A’ respondents, who primarily assign job positions for SMEs, had never placed a CTO directly in an executive committee, whereas the ‘group B’ respondents stated, that at on average 24.2% of their clients were seeking CTOs for a position in the executive committee. Remarkable seems that only one ‘group B’ respondent placed none CTO in an executive board. Furthermore, one candidate, who acts exclusively for corporations which are listed on the stock exchange, states

a rate of 95% of direct executive committee placements. Without this candidate, the remaining ten head-hunters still stated an average rate of 17.2% for placements directly for executive positions.

In addition the executive head-hunters were asked for the type of the organizational integration, namely whether CTOs were searched for central, local and or staff functions. All 18 candidates answered this question and again the results of the two groups are very similar. Both groups stated that approximately 60% of the CTOs are searched for central positions. For local and respectively staff positions CTOs are searched by only nearly 20% of the companies. ‘Group B’ searches CTOs slightly more often for local positions (22%) than staff positions (16%). For ‘group A’ this applies vice versa (15% in local positions and 23% in staff positions). This particular issue seems to be the only in which certain variations between the head-hunters out of ‘group A’ and ‘group B’ could be observed.

Skills and qualifications

From 34 CTO job offers skills and qualifications have been extracted and classified which companies request from their potential CTOs. Table 3 shows the results.

Skills of CTOs	count	% (n=34)
Broad based technical background and knowledge in business area	20	58,8%
Strong verbal/written communication skills	17	50,0%
Team/people leadership skills	13	38,2%
Language skills (not communication)	6	17,6%
Project management skills	5	14,7%
Ability to be the top technical role for engineers	5	14,7%
Visionary skills	4	11,8%
Problem solving/analyting skills	4	11,8%

Table 3 - Skills required from CTOs (Source: job advertisements; n= 34)

“Broad based technical background and knowledge in business area” were mentioned as important skills in almost 60% of all job offers, wherefore this can be attributed to be a key skill for CTOs. “Strong verbal/written communication skills” rank second and were required in 17 offers, i.e. by 50% of the companies seeking CTOs. Thirdly ranking “team/people leadership skills” were requested by 13 companies or almost each third company. Besides these top three ranking skills, further skills that were mentioned in the job offers scored significantly lower. It appears that these were rather requested by individual companies. Six companies requested the CTO to have “language skills”, five companies requested “project management skills” and the “ability to be the top technical role for engineers”. Four companies requested “visionary skills” and “problem solving/analytical skills”.

Qualifications required from CTOs	count	% (n=34)
Specific long time experience in business area	33	97,1%
Experience as a CTO or senior project manager	8	23,5%
Long term experience in team management	6	17,6%
Experience in negotiating with supplier & 3rd parties	6	17,6%
Record of achievement	3	8,8%
International experience	3	8,8%

Table 4 – CTO qualifications (Source: job advertisements; n= 34)

As illustrated in Table 4, almost all companies (97.1%) require potential CTOs to have “specific long term experience within the business unit”, for which the company is seeking a CTO. This qualification ranks by far highest, while the second important qualification was mentioned in far less job offers. Eight companies (23.5%) require potential CTOs to have “experience as a CTO or senior project manager”, and respectively six companies (17.6%) mentioned “long term experience in team management” and “experience in negotiating with supplier and third parties”. A “record of achievement” and “international experience” was mentioned only in three offers (8.8%). Besides these six qualifications, no other repetitive qualification was mentioned. But also noteworthy seems that 50% of the companies expect relevant experience between five to ten years, whereas the remaining 50% of the companies expect more than ten years of experience.

FIRST CONCLUSIONS AND MANAGERIAL IMPLICATIONS

This study investigated three areas related to the CTO: (1) the CTOs’ responsibilities, (2) organisational integration and (3) skills and qualifications. Based on findings from prior empirical studies a questionnaire survey was conducted with 18 executive head-hunter through which a set of four major responsibilities was identified: “Observation of the technical surroundings to search for important innovative technologies for the company”, “observation of development activities and technology portfolios of competitors”, “consulting the CEO and other members of the executive board in strategic topics” and “strategic, cross-sectional management of the technology portfolio (incl. technology acquisition, technology utilization and development co-operations)”. This set of responsibilities was cross-checked through an analysis of 34 international CTO job offers. Within this study three major responsibilities of CTOs were identified, namely “observe/ interpret/ analyse new applications and products”, “strategic planning”, and “develop strategic relationships”. Concluding on the overlap of both studies two key responsibilities seem to be relevant for CTOs: (1) observing and analyzing the technical environment and (2) strategic technology planning.

Although, these findings have to be very carefully interpreted in the light of the small sample-sizes, one observation seems obvious: In addition to traditional responsibilities in combination with managing R+D, a CTO is expected to be highly external oriented. Screening for new technology applications and products, monitoring technical surroundings, building and maintaining networks/relationships and supervising due diligence are such typical responsibilities. This observation is supported by the growing perception of open innovation in industry.

Looking at typical skills required from CTOs three categories could be found to be prevalent through the explorative approach by screening job offers: “broad based technical or interdisciplinary knowledge and experience”, “excellent communica-

tion and leadership skills”, and “strategic and conceptual orientation”. Not surprising is the mandatory qualification for a CTO, to have a long time experience in the particular business environment, as requested by almost 100% of all companies.

CTOs are found in companies of different sizes; hence their placement in general seems not to be dependent on a specific company size. Only the hierarchy level at which CTOs enter the companies varies. One possible explanation why CTOs in SMEs are not placed in top management positions from beginning may be that CTOs are promoted by demonstrating their value to the firm first (“all the way up principle”). In addition, in most small and medium sized corporations the number of executives is not as great as in larger corporations. Throughout the research it became further obvious that CTOs are still very rare in German companies in comparison to the USA, where CTOs are employed even at hospitals and universities (Brandi and Cram, Nick 2004).

However, some limitations of our approach have to be highlighted. First, the explorative analysis of job offers might be of limited validity, since this type of investigation does not gather data from a primary source. Second, the statements of head-hunters may have some bias in results. Moreover, no personal interviews had been conducted. Furthermore, for an empirical survey the dataset with just 18 records obviously is of restricted value, because of the heavy influence of outliers. But to double the number of respondents alone, the sampling number of head-hunters had to account over 500 under the assumption of equal return rate, which would have gone far beyond the possible effort for this study. Besides, the number of head-hunters, active in executive search in Germany, is restricted, as the list of German cities cited above indicates.

However, since systematic and large scale research of different leadership roles in technology management is still limited today, from this study at least some first observations can be taken. A more extensive survey regarding the diffusion and functions of the CTOs in corporations at various corporate levels and subsidiaries is needed and will lead to a richer and solid understanding. Such an approach would also provide a better basis to examine and compare cultural differences regarding the CTO concept. Moreover, better insights are needed to understand how the CTO contributes to the performance of a company.

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