

# 技术创新与 技术竞争情报

谢新洲 李永进 主编

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PROCEEDINGS OF INTERNATIONAL FORUM  
ON TECHNOLOGICAL INNOVATION  
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# 技术创新与技术竞争情报

## Proceedings of International Forum on Technological Innovation and Competitive Technical Intelligence '2008

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## 内 容 简 介

本书以介绍技术竞争情报的理论、方法、技术和工具的发展前沿和热点为基础,重点论述了技术竞争情报在技术创新体系建设和企业技术创新活动中的作用和应用实践,有助于推动我国产业和企业中技术竞争情报系统的建立,促进技术竞争情报在各行业中的应用,加快我国技术创新体系建设的步伐。

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## Preface

Today, technology competition has become the main theme of international competition. In order to join the international technology competition, China is determined to develop self-innovation capacity with Chinese characteristics and has made self-innovation a national strategy. To complete this national strategy it is necessary and important to build national innovative system and promote the sustainable development of China's technology economy. Through collecting, organizing, and analyzing technical intelligence that an innovation unit needs, competitive technical intelligence (CTI) can provide information and consulting services for technology competition and improve the efficiency of technology innovation.

With more complicated innovation environment, higher innovation input, and more complex relationships among the main bodies of international innovation, CTI plays a more significant role in technology innovation. CTI provides information about the environment, competitors and technology, and help make innovation decisions. Since the mid-1990s, systematic research on CTI has started in developed countries, while Chinese scholars introduced the CTI research to China three years ago, followed with more reviews and original research on CTI in later years. It seems that now is the time to hold a symposium on CTI to advance the technology innovation practice and scholarly research in China and promote its application in technology innovation. Thus, Peking University and Beijing Academy of Science and Technology hosted the 2008 International Forum on Technological innovation and Competitive Technical Intelligence (ITICTI) on October 16-18 in Beijing and had invited CTI experts, scholars and professionals from all over the world to attend the forum.

ITICTI has attracted attention and support from colleges, universities, corporations, and research institutions around the world. Over 100 papers were submitted and 70 papers were accepted after several rounds of reviews. Scholars and experts in the field of CTI and technology management have been invited to this forum to give keynote speeches, including University of Pittsburgh, Georgia Institute of Technology, University of Guam, Manchester Institute of Innovation Research, University of Potsdam, University Paul Cezanne Aix Marseille III, Peking University, Chinese Academy of Science, Chinese Academy of Social Science, Wuhan University, Nanjing University, Renmin University of China, China National Knowledge Infrastructure (CNKI) Net, etc.

Papers submitted to ITICTI deal with diverse topics, such as evaluation and management of technology innovation, construction of innovation capacity, self-innovation practices in technology, CTI theory, methods, technology and applications, etc. Specifically, these papers talk about 1) the convergence of CTI and technology innovation; 2) policies, measures, and management of technology innovation; 3) technology innovation demands of national economy, industry development, and corporate development; 4) the application of CTI in the foresight, management, patent transfer of technology; 5) the use of CTI and CTI system in the policy-making and carrying-out of technology innovation; 6) the status quo, trend, problems and solutions of technology innovation in information, telecom,

steel, electricity, publishing and traditional industries; etc.

As part of the efforts to promote the CTI research and application in the field of technology innovation, the organizing committee of ITICTI published this proceeding. To ensure the quality of the proceeding, all the accepted manuscripts have been edited for the spelling and grammar without changing its editorial content.

I would like to acknowledge all the people and institutions who have made the publication of this proceeding possible. Specially, I want to thank Xianneng Ke and Xiuli Wang, who have helped a lot with the paper submission, editing, typesetting and publishing process. I hope readers of this proceeding will find it useful in their research of CTI and technology innovation.

Xinzhou Xie

Professor, School of Journalism and Mass Communication  
President, China Center for Competitive Intelligence and Competitiveness Research  
Peking University

January 2009

# CONTENTS

## Session 1 Evaluation and Management of Technological Innovation

### 主题一 技术创新的评价与管理

Strategic Foresight in Biotechnology Firms Practice and Requirements .....	Dana Mietzner , Guido Reger (2)
Complex Socio-Technical Systems: Innovation Patterns and Knowledge Management .....	Li Ning (23)
Innovation and Modernization .....	He Chuanqi (36)
Soft Technology and Technology Innovation .....	Jin Zhouying , Bai Ying (43)
IT-Supported Agile Supply Chain .....	Li Gang , Lang Ying (50)
Study on Risks and Countermeasures for Technological Innovation of Chinese Information Enterprises .....	Lu Xiaobin (57)
Research on Permanent Innovation .....	Zhang Xinmin , Yang Yang (62)
The Efficiency Evaluation of Technical Innovation in China Based on CCR/BCC Models .....	Zhao Shukuan , Lu Shiyu (68)

## Session 2 Practice of Independent Technological Innovation

### 主题二 自主技术创新的实践

Scenarios on Technological Innovation and Knowledge Production by Multinational Enterprises .....	Dana Mietzner , Guido Reger (74)
An Empirical Study of China's CIO Leadership Based on the Characteristics of IT Workers .....	Huo Guoqing , Liu Sifeng , Zhang Hui (89)
Informationization and Economic Development .....	Wang Sujian (100)
A Comparison of Technological Innovation Capability in Steel Industry: the Case of Posco and Baosteel .....	Wang Weijun , Liu Rui , Gao Shuang (108)
National Strategy and Policy of International Technology Transfer .....	Zhao Gang (115)
Analysis of the Technical Competitive Strategy of Main Competitors in the Field of Wind Power .....	Duan Liping (124)
The Research on Patent Technology Transfer Model in Beijing .....	Jin Xiaohong (130)
The Study on the System Frame Design of the Agri-knowledge Service .....	Zong Nansu , Zheng Yelu , Qian Ping , Li Ze (135)
Application Research of the Robust LS-SVM Regression Model in Forecasting Patent Application Quantities .....	Zhang Liwei , Zhang Qian , Zhu Donghua , Wang Xuefeng , Yu Bo (141)

## Session 3 Theories, Methods and Tools of Competitive Technical Intelligence

### 主题三 技术竞争情报的理论、方法和工具

Signal Analysis: An Important Area for Studying Competitive Intelligence—A

Brief Survey .....	<i>Shen Guchao</i> (148)
Competitive Technical Intelligence. Methods and Tools , Application to Innovation, SMEs, Poles of Competitiveness, Research Institutions and Large Companies .....	<i>Henri Dou</i> (155)
A Research on the CTI Process of the Internet Industry .....	<i>Li Gang , Li Yi</i> (171)
Public Policy Evaluation Methods Used in CTI Evaluation ——A Kind of Approach of CTI Evaluation Methods Study .....	<i>Jiang Guixing</i> (178)
Research of Competitive Technical Intelligence Collection Based on Technology Transfer .....	<i>Li Zhinan , Xu Yanling</i> (182)
Research and Design on Knowledge Management-Based Enterprise Competitive Intelligence System .....	<i>Liu Tong , Jiang Jiya , Li Ying</i> (187)
Analyzing Patent Information for Competitive Intelligence .....	<i>Liu Wenyun , Wang Jinglei</i> (191)
Analysis on the Required Qualifications of the Talent of Competitive Intelligence from the Aspects of the Definition and Theory Origin of Competitive Intelligence .....	<i>Liu Yanjun , Wu Chensheng , Xu Yanling , Wu Qiong</i> (196)
An Open System-based Intelligent Competitive Intelligence System in the Internet Environment .....	<i>Lu Zhijian , Cui Xia</i> (206)
A Study on Methods of Patent Portfolio Analysis for Competitive Technical Intelligence .....	<i>Sun Qing , Tao Xinquan , Weng Jingnong</i> (212)
The Evaluation of the Threat from Competitors Based on Fuzzy Information .....	<i>Wang Yinghui , Yang Ping</i> (221)
A Model of the Key Intelligence Topic Process Management .....	<i>Xia Chenxi</i> (226)
Expressions and Characteristics of Needs for Competitive Technical Intelligence in Enterprises .....	<i>Yan Hai , Zhao Guangqiang</i> (230)
Study on the Legal Protection of Competitive Technical Intelligence .....	<i>Yang Guancan , Zhang Yuan</i> (237)
Intelligence Consciousness and Intelligence Thinking Used in Technological Competition .....	<i>Zhao Jing</i> (243)
Competitive Intelligence between Government and Enterprises .....	<i>Zhen Lihong , Zhang Guoliang , Liu Wen</i> (248)

## Session 4 Practice of Competitive Technical Intelligence

### 主题四 技术竞争情报的实践

Tech Mining: A Key Tool to Bolster Innovation .....	<i>Alan L. Porter , Nils C. Newman</i> (254)
The Development of Intelligence Analysis in China .....	<i>Bao Changhuo , Wang Xiuling , Li Yan</i> (271)
Analyzing Competitive Technical Intelligence of Cell Phones with Self-organizing Map .....	<i>Li Gang , An Lu</i> (276)
Analysis on the Building of Publishing Enterprises' Competitive Intelligence System .....	<i>Jiang Chun Yan , Wang Ying Hui , Guo Ping</i> (288)
The Study on the Competitive Intelligence in Cross-board M&A Practice of Chinese Enterprises .....	<i>Lü Shiguo , Xia Lixin</i> (294)

The Development of Intelligence Mediums in China .....	<i>Wang Dasheng</i> (298)
Current Status and Academic Trend of the Development of Domestic and Overseas Competitive Intelligence .....	<i>Wu Chensheng, Liu Yanjun, Shang Yongbing, Zhang Luji</i> (304)
Science and Technology Information Institutes of China and Competitive Technical Intelligence .....	<i>Yi Tiemei, Song Hui</i> (312)
Dialog Application in Enterprise Competitive Intelligence Research .....	<i>Zhang Wenyu</i> (317)

## Session 5 S&T Novelty Search in R&D Activities

### 主题五 科研活动中的科技查新服务

Study on the Standardization of Retrieval Words in Novelty Sci-tech Retrieval .....	<i>Zhang Baiqiu, Kong Chuipeg, Bu Hongjie, Zhao Yingmin</i> (322)
The Role of Novelty Retrieval in Innovation Evaluation of R&D Institutions .....	<i>Chen Anqi</i> (326)
Mashup—the Combination of Sci-tech Novelty Search and Corporation Competitive Intelligence System .....	<i>Liu Hongjun, Qin Xue, Chen Tao</i> (331)
A Study on Improving Information Retrieval Effectiveness for Scientific and Technical Novelty Retrieval .....	<i>Liu Ying, Tang Yonglin, Zeng Yuan</i> (338)
Analysis and Abstraction of Innovative Points Based on General and Personality Questioning Model .....	<i>Ma Qiaohuan, Ji Shujuan, Li Ruilong</i> (348)
The Advantages of Library Staff Majoring in Social Sciences to be S&T Novelty Searchers and Advice on Pertinent Training .....	<i>Shen Ying</i> (353)
Studies on New Service Model of Sci-tech Novelty Search in Technological Innovation .....	<i>Wang Shiwen</i> (357)
Development Strategy of Technology Innovation-oriented Science and Technology Novelty Search .....	<i>Xiao Wen</i> (363)
A Study on the Audit Mode of Novelty Retrieval .....	<i>Zhang Manling, Wang Yuejie, Wang Chao</i> (373)
Sci-tech Innovation Analysis of Beijing Based on the Statistical Analysis of the Sci-tech Novelty Search Projects Finished by Beijing Academy of Science and Technology .....	<i>Zhang Wei</i> (381)
An Ajax-based Sci-tech Novelty Retrieval Management System .....	<i>Zhang Yunkun, Zhang Zhiping</i> (386)

## Session 6 Competitive Technical Intelligence Services in Technological Innovation

### 主题六 创新活动中的技术竞争情报支撑

Content Analysis of Competitive Technology Intelligence in Technology Innovation .....	<i>Xie Xinzhou, Ke Xianneng</i> (392)
Competitive Technology Intelligence in Technology Innovation of China's Telecom Industry .....	<i>Liu Xiwen, Ke Xianneng</i> (403)
Research on Technology Crisis Forewarning Management of Enterprises Based on Competitive Intelligence .....	<i>Xia Lixin, Wang Jun</i> (415)



Industrial Technology Innovation and Industrial Competitive Technical Intelligence .....	<i>Zhao Xinli, Zhang Zhixiang, Gao Wenfei</i> (424)
Raising Enterprise Technology Innovation Capability Based on Competitive Technical Intelligence with Organizational Learning .....	<i>Li Yan, Zhao Xinli</i> (436)
Problems and Solutions of Company Competitive Intelligence Serving Government Decision-making —Based on the Similarities and Differences between Novelty Search and Company Competitive Intelligence Service .....	<i>Li Ming, Liu Baisong, Dan Wang, Hu Youhua</i> (444)
Building a System of Competitive Technical Intelligence Oriented towards Enterprise Innovation Ability .....	<i>Tang Ning, Wu Qin, Ma Qing</i> (451)
Competitive Intelligence: An Effective Tool in a Supply Chain Context .....	<i>Zha Xianjin, Chen Minghong</i> (458)
A Study of the National Technological Transfer Strategy Based on the Competitive Technical Intelligence .....	<i>Gai Hongbo</i> (464)
The Technological Innovation Pattern Choice and the Strategy Research of the Small and Medium-sized Enterprise by Using CTI .....	<i>Guo Ping, Wang Yinghui, Jiang Chunyan</i> (475)
Competitive Intelligence and Risk Control in Technological Innovation .....	<i>Guo Shufen, Fan Yajuan, Zhao Guohao</i> (482)
Effects of Competitive Technical Intelligence on Enterprise Technology Strategy .....	<i>Guo Yanyan</i> (489)
On Essence and Relationship of Competitive Technical Intelligence and Technology Innovation .....	<i>Song Tianhe, Jia Shumei, Wang Ying</i> (493)
Exploring the University Library in Constructing the Resources Sharing System for Local Corporation .....	<i>Yang Weiping, Zhou Yutao, Lü Juan, Zhu Shiqing</i> (498)

**Session 1**  
**主 题 一**

**Evaluation and Management of Technological Innovation**  
**技术创新的评价与管理**

# Strategic Foresight in Biotechnology Firms

## Practice and Requirements

Dana Mietzner<sup>①</sup>, Guido Reger<sup>①</sup>

### 1 Research Focus

Investigations about the process design and degree of application of strategic foresight methods is still less investigated and discussed in the literature, especially for SMEs. Investigations about the degree of the implementation of foresight methods refer predominantly to large-scale corporations (cf. Weber, 1990; Meyer-Schönherr, 1992; Burmeister, Neef, Albert, Glockner, 2002; Kreibich, Schlaffer, Trapp, Burmeister, 2002). Whether, and in what form, e. g., scenario analysis is used in small and medium sized companies, generally remains unanswered by the investigations. To bridge this gap, 30 small and medium sized biotechnology companies were examined, within the scope of case study research. The goal of the investigation is to determine the practice of strategic foresight in these firms. How important are strategic foresight activities in the biotechnology firms? How is the early recognition of new markets and new technological developments and change carried out in the biotechnology firms? Who is responsible for strategic foresight issues and do companies use a systematic process for the early identification of new business opportunities? Which methods are used for strategic foresight? How are these methods implemented?

#### 1.1 Definition of Main Terms

Foresight is conducted in order to gain more knowledge about things to come. Today's decision can be based more solidly on available expertise than before. In this sense foresight is more than prognosis (cf. Cuhls, 2003, 97). Strategic foresight approaches, as discussed today, are based on the realization of necessary change in strategic planning as a consequence of unexpected appearance of opportunities and threats (discontinuities). Change is not occurring suddenly; change is indicated by "weak signals" (cf. Ansoff, 1976). Weak signals are mostly qualitative information, intuitive sentences with many possibilities of interpretation.

In the literature methods and processes of strategic foresight are often discussed as *Technology Foresight* (cf. e. g., Reger, 2001a) or *Technology Intelligence* (cf. e. g., Lichtenthaler, 2000; Savioz, 2002). Technology foresight is defined as the systematic monitoring of current and upcoming technologies and markets, change in customer and competitor behaviour, very often indicated by weak signals (cf. Reger, 2001b). A similar approach, discussed as Technology Intelligence by Savioz (2002, 36 et. sqq.) describes all activities supporting technological as well as general management decisions. All technological information and trends (opportunities and threats) in the company's environment

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are collected, analysed and circulated. However, a common definition is not existing not in scientific nor in practice. Foresight is often focusing on a certain domain, e. g. , on technology as Technology Watch or Technology Scouting; or on rivals as Competitor Intelligence, and not interpreted and implemented as an integrated approach of technology, market, competitor and customer foresight.

In this study strategic foresight is defined as an integrated approach of early recognition of new technologies, upcoming competitors, new markets, changing customer requirements and changing societal phenomena and the systematic integration of early recognition results into strategic planning. This definition emphasizes the link from foresight to strategic planning; in this sense foresight can be used for strategic planning (cf. also Cuhls, 2003, 22 et sqq. ).

The definitions of strategic planning vary and are influenced by different schools. Welge, Al-Laham identified two main streams of strategy approaches; the “classical approach” and the “widened strategy approach”, the Mintzberg School. Representatives of the “classical approach”, e. g. , Alfred Chandler, understand strategy as a planned package of activities for the achievement of long-term objectives. In this sense strategy is the result of a formal and rational planning process. Based on the approach of Chandler (cf. Chandler, 1995) Andrews defines strategy as “... *the pattern of decisions in a company that determines and reveals its objectives, purposes, or goals, produces the principal policies and plans for achieving those goals, and defines the range of business the company is to pursue, the kind of economic and human organization it is or intends to be, and the nature of the economic and none-economic contribution it intends to make to its shareholders, employees, customers, and communities*” (Andrews, 1992, 52). Criticism of the “classical strategy approach” is especially expressed by Mintzberg. From his point of view, strategies are not only the result of formal and rational planning. He emphasizes a more broaden spectrum of different strategy types. Mintzberg identified five different strategy approaches based on case studies: strategy as plan, strategy as a ploy, strategy as pattern, strategy as position, strategy as perspective (cf. Mintzberg, 1987, 11-17; Mintzberg, 1994, 23-29; Welge, Al-Laham, 2003, 16 et seqq. ). Mintzberg also emphasizes the complementarities of the two different approaches rather than the competition of the two (cf. Mintzberg, 1987, 20).

Strategic planning is not applicable without foresight of new technologies, markets or upcoming competitors. Foresight supports the identification of trends, drivers, uncertainties, influence factors, allows the participation of future developments, risks and assumptions in order to develop relevant strategies, which are robust, and consistent in different, possible future environments. Many authors already combine scenario, a typical foresight tool, as parts of strategic planning (e. g. , Schwartz, 1996; Ringland, 1998; Schoemaker, 2002; van der Heijden, Bradfield, Burt, Cairns, Wright, 2002).

In the scope of this study are German biotechnology firms, offering products and service, which can be outdated quickly. The firms are positioned in small market niches with limited chances of growth in the local market. This situation requires early internationalization activities. In order to develop competitive advantages companies need to assess and analyse their own competencies, strategies of competitors, they need to assess the impor-

tance of new technologies and need sound information for the assessment and analysis of new business fields. The aim of this study is to investigate how biotechnology firms apply foresight activities in order to deal with the high complexity of the environment and high speed of change.

## 1.2 Definition of the Concept “Services in Red Biotechnology”

The choice of the companies occurred on the basis of a compilation of data from 321 service companies of “red” biotechnology in Germany who were registered in a database. The definition of the goal of the investigation “services in red biotechnology” arises from the exact definitions of the concepts “services”, “red” and “biotechnology”. An additional parameter of the goal of the investigation follows through their purpose of the services in red biotechnology (here: firms oriented to profit). The profit orientation is ascertained with the help of the legal form of the service firms, i. e. the examined companies are stock corporations and partnerships. In the end, the goal of the investigation is still limited concerning its localization. Only services provided in Germany are taken into consideration. In addition, the production location of the service is relevant, not the head office of the service firms.

### Definition of the Concept “Service”

The definition of the concept “service” is extremely different in the literature (cf. e. g. , Meyer, 1998, 5-9). An often used definition is the combination of three different definitions, one oriented to process, one oriented to potential, and one oriented to the result of the service (cf. Meffert, Bruhn, 2006, 27). The integration of external factors is viewed in this investigation as the constructive indication of the service which is supported by many authors. The external factor *“is the performance feature on which is have an effect in the course of the service”*, i. e. external factors are *“material and immaterial goods of the buyer, its participation in the form of working production and time”* (Frietzsche, Scheuch, 2001, 14, 75).

### Definition of the Concept “Biotechnology”

The definition used here of biotechnology is used according to the definition of the OECD (cf. OECD, 2005, 9). The OECD gives two definitions: a general, descriptive definition of biotechnology (single definition) and a list definition in which all methods of biotechnology are named (list-based definition). The single definition describes biotechnology as *“The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services”* (OECD, 2005, 9). The OECD developed these definitions in order to standardize the statistical elevation of biotechnological activities in the member states. Here, the definitions of biotechnology of different other organizations coincide (cf. DFVA, 2005, 2; Ernst&Young, 2005, 132; Statistisches Bundesamt, 2005, 10).

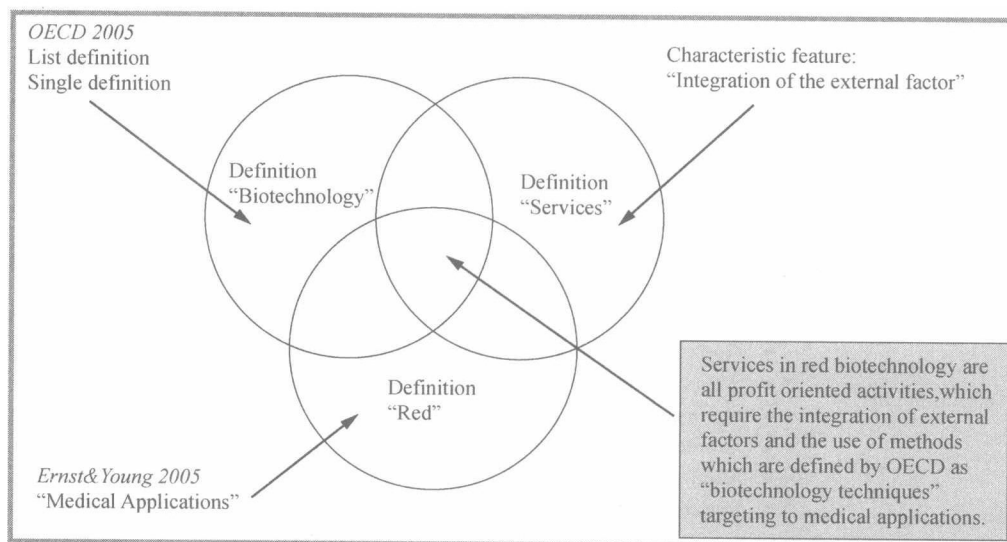
### Definition of the Concept “Red”

In the German language, the divisions of biotechnology are defined according to colours, and the concept is not primarily defined as “red”, but the concept linking “red bio-

technology". With Ernst & Young "red biotechnology" is defined as "application in the medical area (human medicine and veterinary medicine) with the sub-categories therapeutics / active substances, drug delivery, molecular diagnostics and tissue engineering" (Ernst&Young, 2005, 23). The definition of this concept relies upon "red" in this investigation with the definition from Ernst & Young; nevertheless, it is shortened to "applications in the medical area (human medicine and veterinary medicine)". With this interpretation of the concept, all activities which can provide a contribution for medical applications are included.

### Resultant Working Definition

The definition arises from the overlapping of three single definitions "services in red biotechnology", which is described in the following figure 1. Services in red biotechnology are defined as all profit oriented activities, which require the integration of external factors and the use of methods which are defined by OECD as "biotechnology techniques" targeting to medical applications.



**Figure 1** "Services in Red Biotechnology" (cf. Reger, Mietzner, von Gizycki, Nolting, 2007)

The choice of cases is completed with the help of the working definition. After the identification of the firms on the basis of the created compilation of data, the implementation of half-standardized interviews occurred. In addition other available material (e. g. , business information, workshop minutes, appropriate websites, biotechnology newsletter, special interest magazines, patent search, consulting reports) is used for the implementation and assessment of case studies.

#### 1.2.1 Qualitative Content Analysis in the Practice of Strategic Foresight in Biotechnology Service Companies

The analysis of the material occurs through a qualitative content analysis. In qualitative content analysis data is taken from texts (extracted raw data) which is processed in the next step and are then evaluated. Based on the original texts (interview transcripts), a da-

ta base is established, therefore, which contains only information which is relevant to answer the research questions. In addition, the information base is structured by a search grid, which was used for the extraction of the information. Extraction means “*the text to read and to decide which of information contained in it is relevant for the investigation*” (Glaser, Lauder, 2004, 194). This information is associated with the categories of a search grid (see table 1). The category system is based on theoretical pre-considerations and helps, therefore, to answer the research questions. However, the category system is also open at the same time, i. e. it can be changed if in the text information appears which is relevant. This extraction is also the first interpretation step. The extraction of the data occurs with the help of the software tool, Atlas TI. This software helps to assign so-called codes to the passages by which an extraction of the prior anonymous text becomes possible.

**Table 1 Search Grid of the Data Extraction “Strategic Foresight”**

Area	Search Grid (Code)
Company in general	<ul style="list-style-type: none"> <li>● Foundation idea</li> <li>● Time of the foundation</li> <li>● Business model</li> <li>● Customer groups</li> <li>● Management characteristics</li> <li>● R&amp;D budget</li> </ul>
Tasks and importance of strategic foresight	<ul style="list-style-type: none"> <li>● Importance of innovation</li> <li>● Tasks of strategic foresight</li> <li>● Importance of strategic foresight</li> <li>● Application example of strategic foresight activities</li> <li>● Areas of strategic foresight</li> <li>● Success factors in strategic foresight</li> <li>● Sources of information</li> <li>● Monitoring objects</li> <li>● Requirements of a New-Market-Intelligence-Tool (foresight tool)</li> </ul>
Organisation of strategic foresight	<ul style="list-style-type: none"> <li>● Decisive structures in strategic planning</li> <li>● R&amp;D division</li> <li>● Organization of strategic foresight</li> <li>● Sources of strategic foresight</li> <li>● Motivation to strategic foresight</li> </ul>
Action in strategic foresight	<ul style="list-style-type: none"> <li>● Action in the early diagnosis / strategic foresight</li> <li>● Systematization of early diagnosis and strategic planning</li> <li>● Linkage of foresight and strategic planning</li> <li>● Approach of strategic planning</li> <li>● Time planning horizon</li> <li>● Satisfaction with the action in strategic foresight</li> </ul>
Application of methods	<ul style="list-style-type: none"> <li>● Use of methods</li> <li>● Role of scenario analysis as a main method of strategic foresight</li> </ul>

### 1.2.2 Results: Practice of Strategic Foresight in Biotechnology Service Companies

After the analysis of the processed information with help of the search grid, six different approaches, which describe the action in strategic foresight, could be identified in the biotechnology firms.

- (1) Science-driven Approach (“foresight per se”)
- (2) Network-oriented approach
- (3) Market-driven approach
- (4) Gatekeeper approach
- (5) Financial controlling-based approach
- (6) No strategic foresight

#### (1) *Science-driven Approach* (“foresight per se”)

Four of the 30 investigated cases could be associated with the science-driven approach of strategic foresight. Early diagnosis occurs in these firms, per se, because new technological trends and weak signals, conditioned by content and spatial proximity, are perceived in a scientific environment, early, and are a part of the daily work. The persons active in these firms are, as a rule, scientists who are active in scientific networks. Also, the customers of these firms are scientists or scientific institutions in large parts. The firms are, or were, involved in publicly financed research projects. Strategic foresight is answered by the head of the firms. Methodical elements of strategic foresight are regularly taking place through R&D meetings, as well as publication analysis. “*Foresight is part of the business model, because scientists always observe new developments, customers are in the academic market, so that new developments are recognized early.*” (P31<sup>①</sup>) The strength of this approach lies in the early recognition of newer technological trends; a weakness is to be seen in the missing linkage to strategic planning, or in insufficient strategic planning. Therefore, this is a process of early diagnosis rather than actual strategic foresight, as defined earlier.

#### (2) *Network-oriented Approach*

The approach oriented to a network, which is used for strategic foresight could be observed in nine of the 30 cases. The information procurement occurs preferentially in informal and also through formal networks of the employees, in development departments or in business development units, through marketing and management. The information exchange within the firms occurs primarily informally (*information exchange on call*). The activities within the scope of strategic foresight are strongly experimentally-driven. Strategic foresight is in the responsibility of the head of the company. The linkage of early diagnosis with strategic planning occurs, e. g. , within the scope of strategy meetings taking place annually, or every six months. In this approach, one already succeeds in combining the information accumulated on networks with strategic planning. Clear strengths are networks in which one also succeeds personal contacts in being based

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① The interpretation of data is carried out anonymously. P (number) = hermeneutic unit.



with pharmaceutical companies. A weakness of this approach is seen in a lack of future orientation.

### (3) *Market-driven Approach*

Ten cases could be associated with the market-driven approach of strategic foresight. This approach is characterized by a strong focus on the collection and systematization of customer data, and also from competitive information. "... belongs to gaining in the market that one knows to every time and always what the competition is doing." (P10) The compilation of data occurs through sales employees, regular customer inquiries are carried out, growth in customer inquiries are observed, as well as selected web sites of the customers which are regularly screened. Within the scope of this monitoring system and market research, data bases like customer relationship management (CRM) systems are used. The marketing or business development unit is responsible for the early diagnosis and reports to the management board, which is responsible for strategic foresight. "*Customer conversations, the very best to 95% are customer conversations.*" (P30). In this approach, supplies the marketing unit data and information which flows into strategic planning. An advantage of this approach is the clear market orientation of strategic foresight. But technological changes are only somewhat screened, because the prevailing part of the information is from customer data.

### (4) *Gatekeeper Approach*

Companies which are associated with the gatekeeper approach use key persons in the business. They supply the company with information, which is collected outside the company in both formal and in-formal networks. Three cases could be associated with the gatekeeper approach. Gatekeepers are strongly networked, e. g., in committees, within the scope of the networks; they screen trends and also form trends. The activities within the scope of strategic foresight are strongly experienced-driven. An essential difference to the network-based foresight is to be seen in the sophisticated information processing. The information flows into an intuitive scenario analysis, which is combined with SWOT analysis and portfolio management. Knowledge management systems support the process of systematic information collection. The gatekeeper approach is characterized by a strong focus on observation of new and existing technologies and markets and marked as well by a relatively high future orientation in the strategic planning trial. The gatekeeper approach describes a concept which fits best into the integrated definition of strategic foresight as mentioned above. On the other hand, it can also become a risk if the foresight activities are only carried out by the gatekeepers, who manage the process of information access about risks and opportunities and develop a strong information power basis (cf. Roll, Weber, 2006, 205-206).

### (5) *Controlling-based Approach*

The controlling-based approach of strategic foresight could be observed in one of the examined cases. The goal of strategic foresight is, in this case, to contribute to the risk management, to recognize, i. e. risks early, and to initiate corresponding measures. Early