ABSTRACT
From November 2000 until June 2001, TECTEM, the Transfer Center for Technology Management at the University of St. Gallen, conducted the benchmarking project “performance measurement and controlling in R&D”. A questionnaire was sent to 153 companies to identify potential benchmarking partners. The results of the survey also gave valuable insights into actual R&D controlling practices like the level of implementation of R&D controlling, new requirements, success of R&D controlling and fostering conditions.

INTRODUCTION
For a long time management and control techniques, as they were used in other parts of the organization, were considered inappropriate for R&D. R&D was seen as a creative, unique, unstructured and therefore not controllable process (pre-stage and first generation of R&D management). During the seventies and eighties, first R&D controlling systems, focused on financial success of R&D-projects, were established (second generation of R&D management). These controlling systems neglected the role of R&D in business strategy implementation. The third generation of R&D management, emerging at the end of the eighties, was devoted to the strategic fit of R&D projects and R&D controlling systems were adjusted to this aspect. [1, 2]

Even though now diverse surveys on R&D controlling have been published [3, 4, 5], many companies are still looking for tools and structures that meet their specific needs. One way of finding these is by analyzing examples of successful R&D controlling practices in companies. This can be accomplished using a variety of tools, one of them being benchmarking.

RESEARCH OBJECTIVE AND METHODOLOGY
TECTEM, the Transfer Center for Technology Management at the University of St. Gallen, executes various benchmarking projects in the field of innovation and technology management to help companies improve their management practices by experiencing successful practices in other companies. From November 2000 until June 2001, TECTEM conducted the benchmarking project “performance measurement and controlling in R&D”.

The project was sponsored by R&D managers of 19 companies. The main objective of the project was to answer the questions of the sponsor companies. The benchmarking project consisted of five phases:
- A kick-off meeting (phase 1) was used to conduct the need analysis of the participating companies.
An international screening (phase 2) comprised the design of a questionnaire that was sent to 153 companies (62 companies answered, response rate of 40.5%). Additionally, 12 of the responding companies were interviewed by telephone to compose case studies.

Based on the 12 anonymized case studies, the sponsor companies selected the seven most interesting companies for on-site visits (phase 3).

These visits (phase 4) included a one-day presentation at each of the companies' sites and an in-depth discussion of the companies' R&D controlling practices.

The last (fifth) phase of the project consisted of a conference with all the visited companies and the sponsor companies. At this conference, the most important highlights of the practices were discussed in a number of workshops.

This paper describes the project's first two phases and their respective results: the need analysis and the screening phase.

KICK-OFF-MEETING RESULTS

At the kick-off meeting (phase 1) representatives from R&D of the sponsor companies collected in-depth questions concerning actual practices and experiences of other companies. These questions were clustered into four main topics: “strategic controlling in R&D”, “controlling of R&D projects”, “controlling of the innovation process” and “cultural aspects”.

SCREENING RESULTS

The questions collected during the kick-off meeting served as a basis to compose a questionnaire that contained 52 questions. The questionnaire was sent to a purpose sample of 153 companies. For each company in the sample, database research indicated that the company had potentially successful practices in the area of R&D controlling. 62 companies answered the questionnaire (reply rate of 41%). The headquarters of these companies were located in Europe (35), North America (14) and Asia (3). Many industrial sectors were included in the survey: Pharmaceuticals/Chemistry/Biotech (8), Telecommunications (2), Information Technology/Software (2), Computer/ Hardware (1), Automobile Manufacturer (1), Automotive Supplier (3), Mechanical Engineering (11), Instruments /Machinery (9),

![Figure 1: Industrial sectors included in the survey](image-url)
Consumer Goods (2), Aviation/Aerospace (1), Metal Industry (2), Banking/Insurance (2), others (4) and companies with multiple business units (16) (figure 1). The survey included a wide range of companies sizes: from under 200 employees to over 200’000 employees (figure 2).

Although the main purpose of the screening was to identify potential benchmarking partners, the results of the survey already gave valuable insights into actual R&D controlling practices. Regarding the classification “second generation of R&D management” and “third generation of R&D management”, one may ask how many companies do employ a second or third generation R&D management. Our survey can give at least a hint by showing the level of implementation of R&D controlling. We use the following indicators:

- the number of companies that conduct project controlling (second generation of R&D management),
- the number of companies that conduct innovation process controlling and strategic controlling (third generation of R&D management).

Some of the questions collected in the kick-off-meeting concerned controlling needs, which exceed the notions of “second” or “third generation of R&D management”. We are going to present these questions and the respective answers, since they might show us new requirements in R&D controlling.

In order to address the discussion on the intensity of R&D controlling (how much R&D controlling is necessary and when does it become counterproductive?), we are going to include answers regarding the level of success of R&D controlling. Furthermore, the success of R&D controlling does not only depend on controlling tools or practices, but also on what may be called fostering conditions.

Therefore we focus following presentation of the survey results on the three aspects:

- level of implementation of R&D controlling (project controlling, single and multi-project, innovation process controlling, and strategic controlling),
- new requirements
- success of R&D controlling and fostering conditions.
Level of implementation of R&D Controlling

Project Controlling

Concerning the level of implementation of single and multi-project controlling, the survey showed following results:
- 56 companies (90%) pursue systematic single project reporting,
- 57 (92%) pursue a structure process in the development of R&D programs,
- 44 (71%) pursue systematic multi-project management,
- 43 (69%) pursue a cross-functional resource management for innovation projects and
- 54 (87%) manage to adapt R&D resources quickly to programme changes.
Most of the companies employ single project controlling and a structured process to develop R&D programmes. The majority of companies pursue multi-project management and cross-functional resource management for innovation projects.

Project Controlling Tools

Even though the overwhelming majority of companies pursue single project controlling, one third of the companies do not use predefined criteria for project evaluation:
- only 42 (68%) assess their innovation projects according to a defined list of criteria
- only 41 (66%) plan and control their innovation projects using portfolios
- and only 32 (52%) have an effective evaluation system to analyze and control project data.

![Survey results IT tools](image)

**Figure 5: Survey results IT tools**

The survey shows that many companies have satisfactory or even excellent IT tools for project management, multi-project management and resource management. However, there is improvement potential for IT tools in some companies for resource management, multi-project management and even for project management:

- 53 (85%) use IT tools satisfactorily or in an excellent manner for project management, 8 (13%) use IT tools insufficiently for project management, 1 company (2%) uses no IT tool for project management,
- 33 (53%) use IT tools satisfactorily or in an excellent manner for multi-project management, 18 (29%) use IT tools insufficiently for multi project management, 10 companies (16%) use no IT tool for multi-project management, and
- 35 (56%) use IT tools satisfactorily or in an excellent manner for resource management, 18 (29%) use IT tools insufficiently for resource management, 9 companies (15%) use no IT tool for resource management.
**Innovation Process**

<table>
<thead>
<tr>
<th>clearly defined innovation process</th>
<th>company-wide/division-wide innovation process</th>
<th>defined innovation process for all innovation projects</th>
<th>active improvement of innovation process</th>
</tr>
</thead>
<tbody>
<tr>
<td>does not apply</td>
<td>tends to not apply</td>
<td>tends to apply</td>
<td>applies</td>
</tr>
<tr>
<td>-60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60</td>
<td>-60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60</td>
<td>-60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60</td>
<td>-60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60</td>
</tr>
</tbody>
</table>

**Figure 6:** Survey results innovation process

Although some companies (16%) do not have a clearly defined innovation process, most of the companies try to improve on it (94%):
- the innovation process is clearly defined in 52 companies (84%),
- the innovation process is used company-wide/division-wide in 51 companies (82%),
- all innovation projects adhere to the defined innovation process in 48 companies (77%), and
- 58 companies (94%) actively improve their innovation process.

**Strategic Controlling**

<table>
<thead>
<tr>
<th>clearly defined innovation strategy</th>
<th>matched with corporate strategy and area strategies</th>
<th>systematic implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>does not apply</td>
<td>tends to not apply</td>
<td>tends to apply</td>
</tr>
<tr>
<td>-60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60</td>
<td>-60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60</td>
<td>-60 -50 -40 -30 -20 -10 0 10 20 30 40 50 60</td>
</tr>
</tbody>
</table>

**Figure 7:** Survey results innovation strategy

Nearly all companies have and implement an innovation strategy, which indicated that there is a good basis for strategic controlling:
- Most of the companies say that they do have a clearly defined innovation strategy (57, 92%),
- that this innovation strategy is matched with corporate and area strategies (58, 94%),
- and that it is systematically pursued (55, 89%).
The survey specifically asked whether companies used a balanced scorecard in their R&D controlling. 18 companies (26%) indicated that they have an innovation measurement system based on the principles of the balance scorecard.

**New Requirements**

At the kick-off-meeting, the sponsoring companies expressed the wish to get specific information in the areas of partner assessment, risk assessment and idea generation and evaluation.

**Partner assessment**

![Survey results partner assessment](image)

There could be a general need for methods and tools for the assessment of external R&D partners, because:
- 49 companies (79%) maintain intensive cooperation with external R&D partners,
- 44 (71%) assess the technology developments of their component supplier,
- 41 (66%) systematically assess the performance of external R&D partners.

**Risk Assessment**

![Survey results risk assessment](image)
The survey indicates that
- risk controlling is an important part of project controlling in 43 companies (69%),
- and 38 companies (61%) pursue systematic risk assessment of current R&D-projects according to defined criteria

**Idea Generation and Evaluation**

![Figure 10: survey results idea generation and evaluation](image)

- 36 companies (58%) pursue specific idea generation (for example the GAP analysis),
- 37 (60%) carry out detailed assessments of (early) technology developments,
- 38 (61%) say, that their selection process for development ideas is highly efficient.

**Success of Innovation Controlling**

![Figure 11: Survey results improvement of innovation process](image)

- 51 (82%) companies indicate that the success rate of their innovation projects is higher than it was three years ago
- 41 (66%) reduced the cycle time (up to 80%)
- 36 (58%) achieved a higher innovation rate (up to 200%)
- 33 (53%) increased market success of new developments (up to 200%)

Totally 48 companies (more than ¾) improved their innovation process regarding at least one aspect. We can attribute this success at least partly to R&D controlling,
since 40 companies (65%) say, that their R&D controlling has made a significant contribution to improving the efficiency of their innovation projects. 43 companies (69%) say that they successfully manage the field of tension between freedom of creativity and controlling of innovations. This clearly indicates that for a vast majority of companies, R&D controlling increases R&D efficiency and does not hinder creativity.

**Figure 12:** Survey results: significant contribution of controlling on innovation process?

**Figure 13:** Survey results: “we manage to control tension between freedom of creativity and controlling of innovations”

Systematic approaches, clear responsibilities and understanding through transparency are speeding up the innovation process at all levels – this is shown in the answers summarised in figure 14. Companies’ responses summarised in figure 15 show starting points to enhance innovativeness. The aspects listed in figure 14 and 15 represent valuable experience that should be considered when the question arises, whether a specific R&D controlling method or tool could speed up the innovation process or disturb creativity.

**Figure 14:** Quoted methods to speed up the innovation process
CONCLUSIONS

The analysis of the questionnaire responses provided valuable insight into the actual state of the art of R&D controlling on an international basis:

- Level of implementation of R&D controlling: Most of the companies employ single project controlling and the majority of companies pursue multi-project controlling – but there is still an improvement potential for IT tools in some companies for resource management, multi-project management and even for project management. Although some companies do not have a clearly defined innovation process, most of the companies try to improve on it. Nearly all companies have and implement an innovation strategy.

- New requirements: The benchmarking sponsoring consortia stated special needs in partner assessment, risk assessment and idea generation and evaluation – the survey verified these requirements.

- Success of R&D controlling: Even though success of controlling is not easy to measure and improvements also depend on other fostering factors, at least 65% of the companies stated, that R&D controlling has made a significant contribution to improving the efficiency of their innovation projects.

Screening results gave good basis for benchmarking partner selection. The benchmarking consortia used the following site-visits to see successful tools and structures and experience the respective company culture.
REFERENCES