Technical audit: How to assess the technological standard of a company

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Abstract

The overall evaluation of the technological standard of a company's production system is a fundamental factor of success. This paper deals with a simple procedure for evaluating this standard. The evaluation process will be described as well as organizational aspects of the so called technical audit. One example of an audit sheet illustrates an important part of the method.

Technical audit

There has been much discussion about the decreasing competitiveness of many companies in the last ten years [1]. Many hypotheses have been advanced, but one main reason is certainly the decline of the manufacturing competitiveness. This is caused, in part, by the failure of the companies to implement new technologies into production [2] - because of inadequate traditional internal decision making models - and by the neglect of the production area as an essential part of strategic planning.

One of the main reasons for the increasing importance of the production system is the enhancing change of product and process technologies, so that flexible technology management and controlling become a key factor of success. Most industrial corporations spend 40 to 70 percent of their pretax income on technology [3]. Although technology plays such an important role in a corporation's performance, inadequate attention is paid to its management and controlling. If the sentence 'manufacturing does not matter any more' is considered to be valid and strategic thinking is reduced to 'management by figures', achieving and maintaining competitive advantages will be very difficult.

The production system was and still is considered to be helpful for cost reductions but is not very often seen as a key element for the long term competitiveness and survival of the firms [2]. But relying on cost savings creates a serious problem when implementing computer-based technologies. A major advantage of these new technologies is their ability to influence product characteristics, such as quality, degree of customization, and delivery schedules, which will result in changes in the market demand for the product and will alter future revenues for the firm.

The first step towards a better understanding of technology in manufacturing and its importance for the business and corporate strategy is a general evaluation of the technological standard of a company's production system.

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There exist a lot of indicators and instruments for evaluating technologies and production systems. In general they can be divided into direct and indirect ones (see Fig. 1): Indirect indicators for assessing the technological standard are concentrated on the evaluation of the input, the output or on input/output relations of the production process [4]. Direct indicators are focused on the evaluation of the process of manufacture itself. An overview of the most important indirect indicators gives Fig. 2. Examples for the direct way of assessing technologies are the level of automatization, the complexity of the technical organizational structure or the ‘Systemtheoretische Ansatz’ of Scholz [5].

All these indicators are more or less useful for the evaluation of an individual firm’s technological standard. But they either take account only of single aspects of the technological standard or do not consider the production system itself – especially indirect indicators, that concentrate on the output – and its environment. Sometimes it seems very difficult to work out such indicators (e.g. unit value of exports and imports, innovation shift, technological intensity) and to show the connection of an indicator with the value of the manufacturing system. Finally for most evaluation factors the strategic implications are missing.

A lot of technical audits also have been carried out in the past, but they have focused solely on R&D rather than on technology and the standard of the production system as a whole. Other approaches of a technical audit [6] are mainly concentrated on the corporation’s exploitation of technology and on the construction of so called historiographs. These should show the successes and failures of a company’s and its competitors’ investments.

Therefore we have developed the instrument of a technical audit. It should integrate some of the described indicators as well as approaches with industry specific indicators and support the development of first steps to improve the strategic position of a firm.

The technical audit displays:

1. the present technical standard of a company relative to its main competitors and relative to the international standard of technology,
2. the technical standard required by the strategies at SBU and/or corporate level,
3. ways to get from the present to the planned standard within a given time and cost limit.

The more detailed the technical audit and the sooner implemented, the greater is the chance to achieve and/or maintain a leading market position. We all know that there is a negative correlation between time and exactness or costs of the results of such a process. This is the reason why we should start at a lower level of exactness of a technical auditing process. As time goes by we have to improve the exactness by learning from previous audits.

But what do we mean when we talk about technical audit?

![Fig. 1. Indicators for evaluating the technological standard.](image)
(1) Technical audit is an evaluation, whose results have to be written down in a document. This is the only way to make sure that the results and suggested actions can be controlled after a certain period of time.

(2) Technical audit is a global evaluation, considering all technical, economical, organizational, ecological and social aspects of production. It should also be an independent evaluation by at least two persons in order to reflect different points of view.

(3) The evaluation must be in a systematic order. The used methods have to be consistent and duplicable. Only this procedure can guarantee the pre-conditions for a learning process of the people who are involved into the technical audit.

(4) The evaluation has to be periodical to guarantee the necessary continuity of the process. The stronger the innovation dynamic (the shorter the technology- and product life cycle) and the stronger the competition, the shorter is the time between the technical audits.

(5) Technical audit has three main investigation topics:
- The analysis of technological developments and trends: This analysis should show the potential chances and dangers (e.g. potential substitutions) which may result out of new technologies. One result of this activity should be a list of key technologies of an industry.
- The integration of technological development within SBU- and corporate strategies: At the very beginning it is important to get knowledge of the technological requirements of the strategies at SBU- and corporate level and to visualize the according technological strengths and weaknesses of a company’s production system. The evaluation has as a reference the competitors’ and the international standard of technology. The latter may be seen as the current state of the art. An important information source would be the data collected by the analysis of the technological developments and trends. The comparison with the main competitor and with the international standard of technology indicates opportunities and threats.
- The management of the production system: The findings of the two previous points have to lead to strategic consequences and new functional policies in the production system.

(6) According to this a final point in a technical audit is a plan of action. This plan shows exactly how priorities are set and responsibilities are distributed within the framework of a detailed and realistic time schedule. Precisely defined steps (and often unusual ones) have to be taken to benefit from the opportunities and to solve problems on time.

The next question that arises is that of the responsibility for the technical audit. Who should be involved into the process and how should it be organized?
Technical audit is carried out at least at two levels which means it has to take into consideration the production manager's point of view and the SBU's and/or general manager's point of view in any case.

Only a dialogue between these two levels can establish mutual integration of both points of view and thus lead to competitive advantages. A 'leave it to the experts' approach can have as severe consequences as if technology and manufacturing is managed only by general management. Frohman suggests that the top managers responsible for running the company or business should have technical education and work experience in their industries. Both, general manager and production manager, should be comfortable with and fluent in technical topics as well as strategic management [8]. In order to achieve that aim the production manager often has to increase his management knowledge and the SBU and/or general manager his basic knowledge about technology and manufacturing. These are the preconditions for an effective dialogue.

At the next stage the communication has to include a dialogue with the chief controller, the marketing manager etc. in order to assure a sufficient coordination of the functional policies and their integration into corporate strategy.

The identification of the technological trends and developments and the international technological standard lies within the range of tasks of the production management. He frequently works in cooperation with a consultant, the R&D department or a staff of technology experts. The main task of the SBU- or general manager in cooperation with the marketing manager is to identify the leading international competitors.

The next step in the process is to evaluate the technological standard of a company's production system relative to its main competitors and relative to the international standard. Therefore the SBU- or general manager and the production manager have to identify the most important criteria for strengths and weaknesses of the production system in their industry.

Afterwards they have to weight the different criteria according to their importance for the competition in the specific industry. The weighting particularly depends on the stage of development of the production system, the strategies aimed at, the resources of the company and the product life cycle. E.g. the flexibility of the system in the stage of diffusion is not so important as in the stage of saturation.

Now the SBU- or general manager and the product manager separately have to evaluate the production system relative to the main competitors and relative to the international standard on a scale from 1 to 10. 1 is the lowest and 10 the highest score to achieve.

The relative score shows the priorities for actions to be taken. We have to note that neither the relative score nor the sum of relative scores is the most important result of the audit sheet but the positions of the profile. They indicate the weaknesses which are to improve and the strengths that should build the basis for a strategic positioning of the company or the SBU.

The role of the technology life cycle

As we have mentioned before, the technology life cycle plays a central role in the evaluation of the production system. It has important implications on the evaluation itself as well as on the generation of the business- and company strategy. For our purposes we have reduced the technology life cycle to the application stages of a technology and excluded the time of invention and development. There exist a lot of assumptions behind the life cycle model (see [9]) which we will neglect here. So new technologies typically undergo a life cycle in three stages (Fig. 3):

1. **Stage of technical innovation**: One competitor introduces a new production technology. Technical problems have to be overcome.

2. **Stage of diffusion**: The 'first mover' has a competitive advantage. The competitors quickly try to imitate and adopt the new technology, which has in the meantime become a key technology.

3. **Stage of saturation**: The new system is generally used by all competitors. The former key technology becomes a basic technology.

In each stage, different actions must be taken to achieve a competitive advantage. By using patents and top security on his technical knowledge, the 'first mover' will try to maintain his competitive advantage relative to his competi-
Fig. 3. Stages of development for new production systems.

tors—who still use traditional production technologies. This will not be possible in every industry. That is why the 'first mover' has to invest in other areas (e.g., in marketing activities) to protect his very short start advantage.

With increasing experience the 'first mover' will be able to produce at lower costs than the others. He will try to increase his advantage by applying the new technology to other products within his range. The 'late mover' will try to imitate and improve the new system, or to push ahead his own innovations in order to restore his competitiveness.

In the stage of saturation, when all competitors have access to the new technology, emphasis has to be laid on flexibility. Economies of scope are as important as economies of scale.

The advantages with regard to technology of the first mover in the stage of diffusion are steadily losing significance. Entrance barriers for new competitors decrease, whilst competition increases.

It is important to note at this point that each stage of the technology life cycle requires a different technical audit. Especially the key criteria of success will change according to the stage in the life cycle.

The technical audit also influences the stages of management [10] (see Fig. 4). Especially the stage of the 'strategy formulation' and the 'functional policies' are strongly determined by the results of the audit, as we have seen before. But the technical audit is an integrated part of the general controlling and management audit of a company or SBU, too.

Now let us have a look at an example of an audit sheet.

The SBU and/or general management's attitude towards the production system may be different compared to that of the production manager. They have to consider all relations between the company and its environment or between the SBU's and their environment.

The SBU and/or general manager has to examine the strategic fit of the manufacturing system. Figure 5 gives an example of a technical audit from the SBU's and/or general management's point of view. Different criteria are selected and then weighted according to their importance. These criteria have to be verified against the criteria set by the Delphi method.

On the other hand operation managers and engineers often consider only the production system as an instrument to achieve a high performance and productivity in the most effective way. This attitude is too narrow-minded. Nowadays,
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weighting* (1-10)</th>
<th>Evaluation</th>
<th>Relative score: International standard</th>
<th>Relative score: Main competitors</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utilisation of machinery</td>
<td>6</td>
<td>6</td>
<td>36</td>
<td>54</td>
<td>Improve utilisation</td>
</tr>
<tr>
<td>Flexibility of machinery</td>
<td>5</td>
<td>5</td>
<td>25</td>
<td>30</td>
<td>Increase flexibility</td>
</tr>
<tr>
<td>Quality assurance system</td>
<td>4</td>
<td>4</td>
<td>20</td>
<td>24</td>
<td>Adopt quality control system</td>
</tr>
<tr>
<td>Int. of automation</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>13</td>
<td>Priority 1: Increase automation</td>
</tr>
<tr>
<td>Profitability</td>
<td>4</td>
<td>4</td>
<td>16</td>
<td>28</td>
<td>Increase production</td>
</tr>
<tr>
<td>MRP/MPS</td>
<td>2</td>
<td>2</td>
<td>10</td>
<td>12</td>
<td>Improve MRP/MPS</td>
</tr>
<tr>
<td>Potential for innovation</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>12</td>
<td>Integrate supplier</td>
</tr>
<tr>
<td>Environmentally friendly</td>
<td>8</td>
<td>8</td>
<td>72</td>
<td>72</td>
<td>No action</td>
</tr>
<tr>
<td>Failure modes and possibilities</td>
<td>3</td>
<td>3</td>
<td>18</td>
<td>18</td>
<td>Contingency plus prevention</td>
</tr>
</tbody>
</table>

| sum relative scores (max: 430) | 212               | 268               |

* International standard
* Main competitors

* The weighting particularly depends on:
  - the stage of development of the production system
  - the strategies aimed at
  - the resources of the company
  - the product life cycle

Fig. 5. Audit sheet for SBU or general manager (example).
Often it can be introduced and supervised by a controller, the general management, or an external consultant.

The way the suggested method is handled is flexible and not restricted to the one way shown above. As the method is only one element in the process of strategic management it has to consider the corporate policy and corporate culture, too. The most important advantages of this kind of technical audit are the integration of the production system into the corporate strategy, the discussion of the very complex technological interdependences on two managerial levels, the simple procedure for collecting and summarizing relevant data and the visualization of the decision process. This process encourages debate on strategic issues.

We can state that the production system is more and more worth to be considered as a strategic weapon for achieving competitive advantages. Technical audit brings the technical specialist's and the general manager's perspective together, thus reducing risks and creating new opportunities for sustainable competitive advantages.

The conclusion is that a technical audit is an integrated part of strategic planning. At the same time it is a tactical instrument for improvements in the production system. It can support the company's goal of being a leading competitor in every market segment in which it operates. One caveat: The comparison with the competitor however should not preclude the possibility for discovering new technological opportunities.

References


