BENCHMARKING IN COTTON SPINNING BY ISO 14 000

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Abstract

The European Community prepares a procedure for evaluation of environmental performance, called Best Available Technology (BAT) in companies. Restrictions due to environmental law are already as great that companies decline further mandatory requirements. Many of the companies are ready for proactive operations and implementation of an environmental management system. A worldwide operating private organization, proposes the standard ISO 14000 by obligating companies to continual improvement, based on their own designation. This standard requires legal compliance as well as identification of significant environmental impacts of the business activity to certify. An environmental program has to be formulated according to the company's declared environmental policy. Certified auditors certify compliance to the standards.

However, many small and medium sized companies can hardly afford the costs of the building of an environmental management system. Therefore a generic solution, integrating quality, safety and environmental management is proposed here for spinning mills. By this, cost for implementation of ISO 14 000 can be cut considerably. Since the generic solution is process oriented, it allows optimizing of processes as well as allocations of costs – a new way to se benchmarks in spinning.

The Situation in Europe

Since the mid eighties there is a growing general awareness of environmental issues by the consumers, and this is consequently taken up by the suppliers. Years ago, the perception of environmental stresses and risks on nature found it's representation in the release of national environmental laws. Because of the considerable differences between "Northern" and "Southern" countries in environmental requirements, the European Community agreed to an equal legislation on a high level, now to be enforced by the individual member nations.

Applying modern process technologies operated by highly educated technicians is typical for most European companies. Consequently wages in Western Europe are considerably high. Legal compliance of a company's environmental performance therefore goes along with considerable costs that impede competitiveness with products from countries with lower requirements. This situation caused closures of many companies in the textile business in Europe, mainly operating in mass production so far.

Best Available Technology (BAT)

Now, the European Community aims to enforce environmental performance of companies by means of additional codes of practice, such as specifying "Best available technology" (BAT) for the textile business (EURATEX, European Apparel and Textile Organisation). The general procedure includes the following steps:

1. Auditing of textile companies by EC commissioners (inventory of applied process technology).
2. Central administration of these data in Brussels.
3. Evaluation of BAT on this data base.

Further requirements for companies not operating according BAT are not described yet. However, such data warehouse threatens to impose additional mandatory or voluntary measures in the industry, causing additional costs.

Does BAT Guarantee Superior Environmental Performance?

Spinning mills are highly specific in their product. Therefore, comparison of process technology in spinning is only feasible for equal end products and equal yarn counts. How would companies be categorized according BAT requirements? Fig.1 gives an example for energy consumption of two yarn counts 10 tex and 40 tex, calculated by computer simulation program taking in account the most efficient production, based on modern spinning technology (RIETER 1999). The dependence on yarn count is clearly visible.

From a practical standpoint there are questions concerning criteria for environmental data and methods for evaluation. As interpreted in BETTENS 1999, weighting factors of a proposed "Integrated Environmental Index", a method developed by Euratex, would still be missing due to the lack of their further research. Surprisingly the generally accepted tool of Life Cycle Assessment (HEIJUNGS 1992, SETAC 1996) for impact assessment was considered to be insufficient (BETTENS 1999), although this very precise method is hardly practical in industry due to the effort required for data collection. Evaluation of BAT therefore is proposed to be elaborated by experts by means of guidelines. Such guidelines are mainly based on environmental indicators. For spinning processes energy consumption is by far the most important indicator and an external expert would mainly compare energy consumption of machinery, regardless of the product. Yet the question arises, how this energy consumption would be evaluated in terms of environmental impacts.

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Modern technology often bases on higher energy consumption going along with higher productivity. The introduction of new spinning systems, e.g. compact spinning could be judged as inferior, due to the added energy use regardless of the improvements in yarn quality and in sizing processes (STAHLECKER 1999). On the other hand, older equipment would have to be generally judged as not BAT, although gray energy is lower compared to new machinery.

From a more general standpoint there are three reasons why BAT is not appropriate to improve environmental performance in industry: First, there cannot be a global standard for BAT, because boundary conditions like resources, public waste management, economy, human resources are different even within the European Community (EURATEX 1997). Second, the application of BAT will not assure superior environmental performance, since only adaptation of the set up of machinery on the basis of a complete spinning set up (according to the average yarn count manufactured) provides both an ecological and economical benchmark. Third and maybe the most striking point: setting standards for BAT would inhibit introduction of new technology to the market and thereby disable innovation.

The Industry's Alternatives

Enhanced requirements by environmental laws in Europe have forced companies to make considerable investments for environmental performance. Additional pressure by BAT would require additional investments. Due to the awareness of customers, environmental performance has become a competitive factor and many companies are facing this chance by setting their own environmental standards in a proactive way by setting targets in accordance with their economic goals, and thereby setting benchmarks.

The Environmental Management System ISO 14 000 enables companies to act in this direction. The system has been developed by a private organization, based on British Standards 7750. It has been approved by means of a consensus of national Technical Committees worldwide.

The Environmental Management Audit Scheme (EMAS) bases on governmental auditing and can only be applied in plants situated in the European Community. Since companies try to reduce governmental influences, this attempt is not very common. On the other hand ISO is a well-known organization for (textile) quality standards worldwide - an essential asset for textile companies operating in a global market.

This paper presents specific requirements of ISO 14 000, as well as a business solution that is developed at our institute for textile companies.

Goals of the Environmental Management System ISO 14 000

The International Standardization Organization

ISO is a private organization that has set up worldwide identical standards for management systems. Fig. 2 shows the national organization for Switzerland. If a company seeks for certification according ISO 14 000 it has to build up an Environmental Management System, that thereafter is audited by two external auditors. Certified companies that are permanently supervised by a national office (the Swiss Federal Office of Metrology) as well as the European Center of Norms (CEN) provide education for system management as well as for auditing.

The special requirement of the Environmental Management System (ISO 14 000), compared to the Quality Management System (ISO 9000), is continual improvement based on a defined environmental policy. Other elements like planning, implementation and operation as well as checking and corrective action can be identical in both systems (see Fig.3). However, the management review indicates environmental management as a responsibility of the management, but also as a management tool for business excellence.

Scope of ISO 14 000

Indications on scope given by ISO are quite precise. As a whole, they require a company to assure the environmental responsibility in all production and business processes, and to communicate activities to the outside.

- To implement, maintain, and improve an environmental management system
- To assure the conformance with its stated environmental policy
- To demonstrate such conformance to others
- To seek certification / registration of its environmental management system by an external organization
- To make a self-determination and self declaration of conformance with International Standard

Environmental Policy (EP)

Unlike any quality control policy of a company the environmental policy has to make statements to specific issues given by ISO 14 001. First, the policy has to be "appropriate to the nature, scale and environmental impacts of it's activities and services". Second a commitment to continual improvement and prevention of pollution as well as legal compliance and compliance with other (further[1]) requirements are compulsory. Not only all levels of environmental laws have to be proved, but also how the company keeps tracks on them and on their changes. Third, EP has to provide a framework for setting and reviewing environmental objectives and targets. Forth, the EP is

documented, implemented, maintained and communicated to employees and the public. In practice the activities of point four are very challenging and time consuming and therefore often underestimated by the management.

Environmental Significance

There are detailed and helpful indications in the system how to identify environmental impacts (see Fig. 4). This normative approach facilitates the procedure by selecting the activity, product or service first. All possible (not necessarily occurring) environmental impacts of the processes, like emissions to the air, releases to water, waste management, contamination of land, use of raw material and natural resources as well as other local environmental and community issues, have to be listed. It is essential to include operating conditions as well as start up and shut down conditions. Thereafter the actual environmental impacts are identified. The company itself evaluates the significance of impacts. This procedure allows setting of priorities in agreement with other goals of the company, and focussing on impacts that are both environmentally relevant and economically beneficial. The relevance matrix represents the key database for definition of improvements and the set up of environmental programs. Environmental goals as use of resources (energy and cleaning chemicals) reduction of emissions (selection of energy prime source) have to be implemented, maintained and improved.

Environmental Performance of Spinning Mills

The obligation for continual improvement keeps the system constantly optimizing. As the example in Fig. 5 shows, environmental activities have a history in a company (LAUFFENMUEHLE 1997, 1999). However, a certification can only be achieved, if legal compliance is proved. In the given example this was the case in 1992, when the company reduced nitrogen oxides (NOx) to the legal limits[2]. With the same measure, using natural gas instead of oil as prime heating resource, a tremendous improvement in reduction of sulfur oxides (SOx) and dust particles was achieved.

Quantitative and qualitative improvements have to be documented e.g. energy, effluents and emissions (see Fig.6). The increase of energy consumption in the years 1997 and 1998 is due to the introduction of air jet weaving machinery and increased production.

One of the most challenging goals in practice is information and educational training of employees. On the other hand this environmental training is an excellent tool for the creation of a corporate identity of the company.

The Swiss Business Solution for the Textile Industry

The Situation in Swiss Spinning Mills

In central Europe spinning mills have developed different kinds of quality management since they are operating in a high quality sector. Most of the Swiss spinning mills are working now with ISO 9000, promoted by the Swiss Federation of Spinning Mills, that gave financial support for each company introducing ISO 9000. Yet, beginning with 2000, the same system has to be based on production and management processes[3]. So far ISO 9000 required twenty chapters, which had to be documented in a handbook in any format. The new process oriented procedure introduces fundamental changes in the quality management system by defining all processes, but it also will provide the basis for benchmark setting. These changes, although costly, allow perfect compatibility of ISO 9000 and ISO 14000. However, this requires a huge amount of education for personnel in small and medium sized companies and causes additional costs.

National safety requirements, that have to be met in the next two years, represent another part of the management system to implement. In order to allow companies to evade annual audits by government according safety of machinery and occupational health, the ETH developed a business solution[4], the Safety Guidelines (EKAS 1999) for the textile industry. The ETH provided a system (by means of checklists) as well as educational programs for evaluation and maintenance of safety requirements. Being aware of the acceptance of the EKAS Guidelines by the governmental offices, the Swiss Federation of Spinning Mills and the ETH do now another step towards an integrated management system of quality, safety and environment under ISO 14000 (TOBLER 1999) (see Fig.7).

Database for an Integrated Management System

Spinning mills are in a good position for this requirement in production, since spinning process specifications have generally to be elaborated for quality reason. The example shown in Fig. 8 defines parameters of the ring spinning process but also of the sliver preparation (previous process) as well as the chain of machinery optimized for a given production. These quality data represent a suitable tool for quality benchmarking:

1. All parameters for yarn quality are optimized.
2. The machinery set is optimized for the average yarn count and for productivity.
3. Recycling and waste management is documented on line and can be used for ISO 14 000.
4. Energy use can be calculated for each product.

Now environmental information has to be added, indicating the environmental impacts of all processes (see Fig. 9). The

procedure follows the directions of ISO 14 000 as shown in Fig. 4. Working with the same units facilitates data inventory especially since data are not allocated to either the quality, environment or safety management system (see Fig. 10). Processes of maintenance are very critical for environmental reasons but also for production performance and therefore for quality reasons. This systematically approach also allows allocation of costs on individual processes.

Process Modeling Based on Spinning Process Specification

In order to facilitate the integrated procedure and to make it affordable for small and medium enterprises a model is developed for the business solution. As shown in Fig. 11, the data on quality, environment and safety are introduced into a single system of production processes. The business solution is not a theoretical approach. It has to meet the industry's practice and needs. The model processes are elaborated by integrating data from individual processes on a generalized level. For implementation the model has to be adapted to the situation.

As an example Fig. 12 presents three different yarns: a 16.7 tex (Ne 40), OE, 20 tex (Ne 30), OE and 11.76 (Ne 40) tex, ring spun. The 20 tex (Ne 30) OE yarn passes first a double head draw frame, while the 16.7 tex yarn (from a different manufacturer) passes two draw frames. Both slivers have equal count at the end of the draw frame process, although different machinery was used. Data on energy consumption of individual processes (Fig. 13) is not always available in quality management systems. However, there is environmental and economical improvement to achieve for air conditioning as shown in Fig. 14. Injection and suction points for air can be adjusted as well as the use of the chiller. In many cases consumption of compressed air can be reduced considerably. As mentioned above such general options for improvement have to be adapted to the plant's productivity and to climatic conditions.

These few examples might give an idea of the synergetic benefits of an integrated management system. The business solution implements all requirements of ISO 9000 / 14000 and occupational health & safety in procedures. Business specific checklists and structures facilitate the documentation as shown in Fig. 15. Business relevant procedures are a perfect tool for management decisions, perfectly suited for benchmark setting. Other company specific procedures can be set up either by the company itself or by an external-consulting partner. As environmental knowledge in small and medium companies is mostly not a core competence cooperation with an external partner (environmental consultant) is very common. In general for ISO 14000 implementation two thirds of the activities are done within the company and only one third by the external partner. With the business solution the ratio is inverse in time and costs.

ISO 14000 and the Value Added Chain

Even if optimizing of a spinning mill is easy to achieve, the management of the value added chain is still a demanding goal. According to the environmental policy of ISO 14000 also business processes have to be defined. These processes integrate cotton producers (suppliers) as well as weaving plants (customers) in sustainable business activities (see Fig. 16). The requirements are very comprehensive and new by integrating a long term strategy of the company as well as life cycle thinking (Life Cycle Assessment in ISO 14030[5]) in product development. Actual tendency in business administration mainly focuses on short-term changes and turn over. A commitment for environmental policy bases on sustainability, a business Excellency of economy, ecology and social aspects on long term consideration. Integrating suppliers and customers in environmental responsibility will promote building of long term, stable business relations. New products will be developed based on environmental and economical defined process technology. A "Cotton Convention" (Fig.17), created in cooperation of European companies could provide a tool for ecological grading of cotton. Another important aspect is communication of environmental efficiency that will become more a more a competition factor, if we consider the growing awareness of consumers.

Conclusions

In the present situation the integrated management system with ISO 14000 in combination with a business solution is a promising approach against BAT. European companies do not want any further mandatory requirements. Some of theses companies are ready for a change. They will have the benefit of all "first movers", especially in communication towards authorities, in financial and insurance matters.

Because Switzerland is not part of the European Community, requirements of Euratex (European Apparel and Textile Organization) have a lower priority, although they have to be considered. The Swiss Federation of Spinning Mills recognizes the advantages of the recently developed business solutions on safety requirements. Now that their most commonly used quality management system ISO 9000 has to be reorganized on the base of processes, the proposed business solution, integrating quality, safety and environmental aspects, has a good acceptance.

Besides in Europe, where ISO 14000 considerably grows textile companies of Asian countries shows a remarkable growth of ISO 14 000 implementation in textile companies. This is another reason for European companies to meet ISO standards in the future, when environmental performance becomes a competitive factor. In comparison with other businesses, like electronic consumer goods, again the Asian

countries show the greatest increase in ISO 14000 certified companies.

What today might begin in specific parts of the word will be standard in tomorrow's global market. Additionally the same pressure will occur first on finishing companies and wholesalers that will expand on the value added chain.

Notes

[1] Industry codes of practice e.g. Responsible Care, International Chamber of Commerce codex on sustainability.
[2] Limits of the newly implemented clean air act have to be met within a given time
[3]The new system has to be implemented by the first re-certification after 2000. Certification is renewed if the auditing results meet the general standards and individual goals off a company
[4] In commission of the Swiss Textile Industry Federation
[5] As an option ISO 14000 provides detailed information of tools for Life Cycle Analysis (LCA) of products, evaluating the environmental impacts of products.

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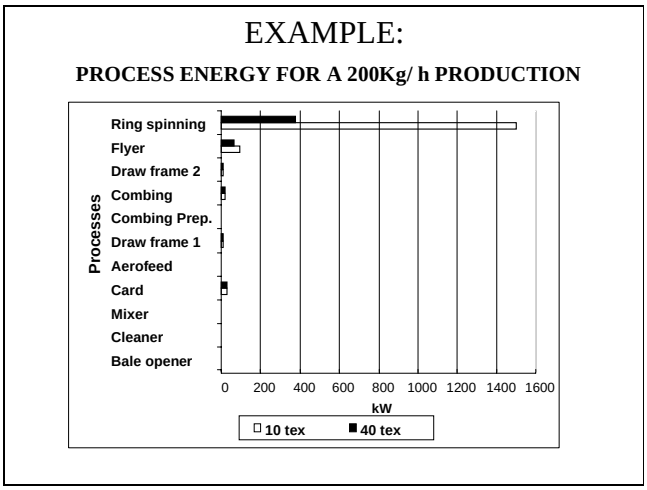

Figure 1. Calculation of energy use for a production of 200 kg yarn per hour, based on a computer simulation model with modern spinning technology

Figure 2. Certification by the non-governmental organization ISO 14 000.

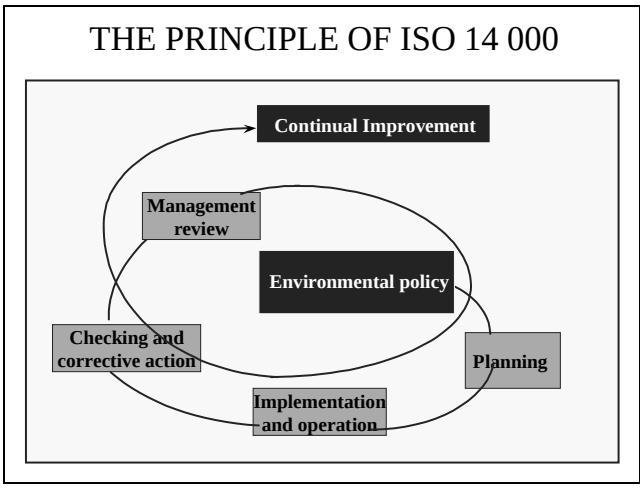

Figure 3. Steps of the Environmental Management System ISO 14 000.

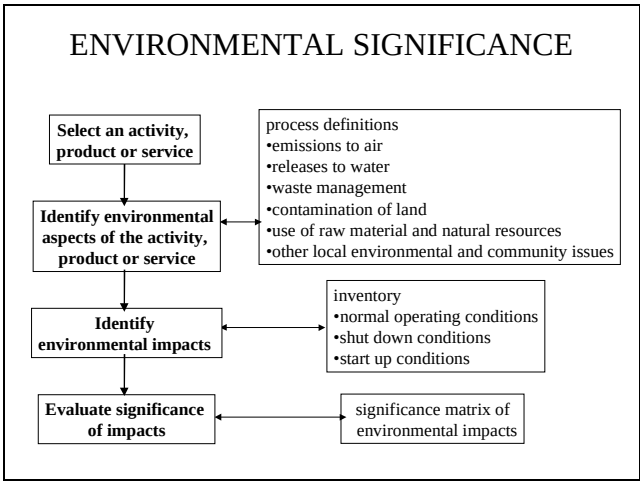

Figure 4. Requirements by ISO 14 000 for Environmental Significance of a company's activities, products or services.

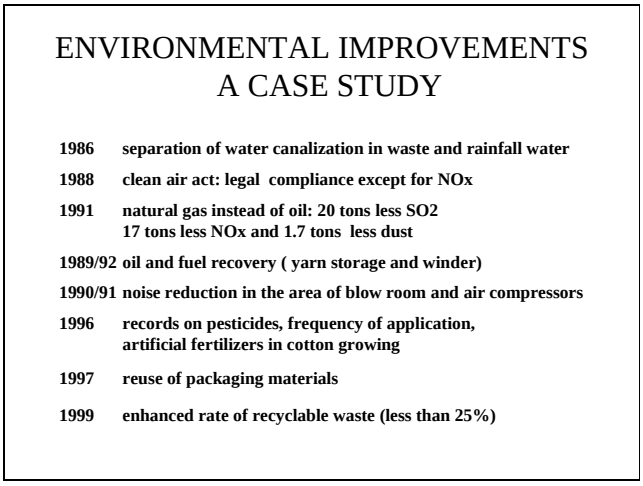

Figure 5. Lauffenmuehle's history on Environmental Improvements: A spinning/weaving mill on its way to ISO 14 000.

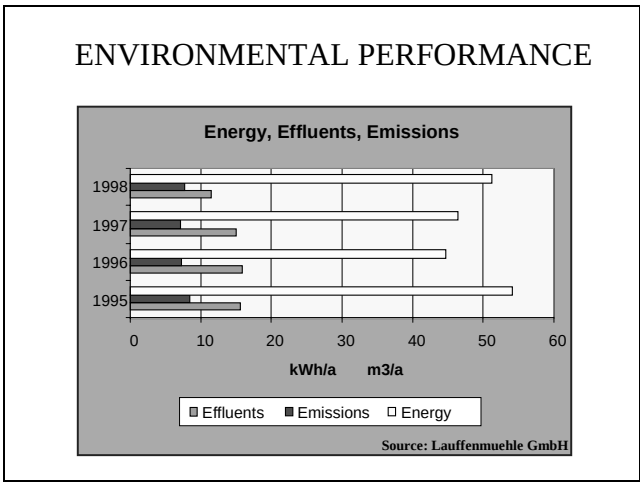

Figure 6. Environmental performance of energy use, effluents and emissions of Lauffenmuehle GmbH.

Figure 7. The overlapping systems of environmental, quality and safety & occupational health systems create synergies.

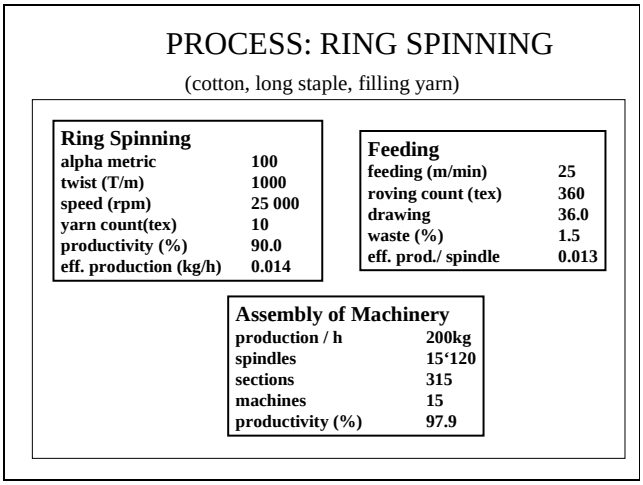

Figure 8. Quality specifications for the ring spinning process of a cotton filling yarn, optimized on a productivity of 200 kg / h.

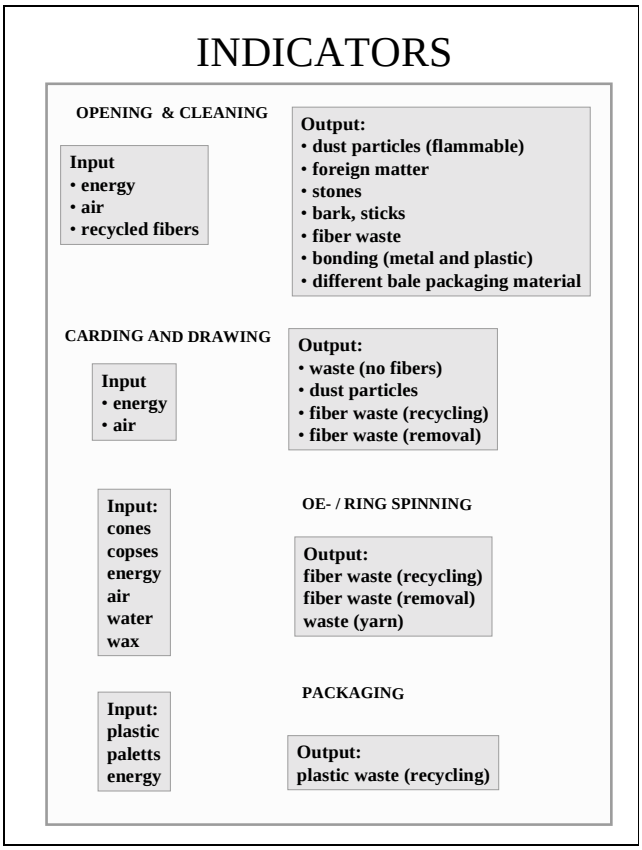

Figure 9. Model of environmental indicators for determination of environmental significance.

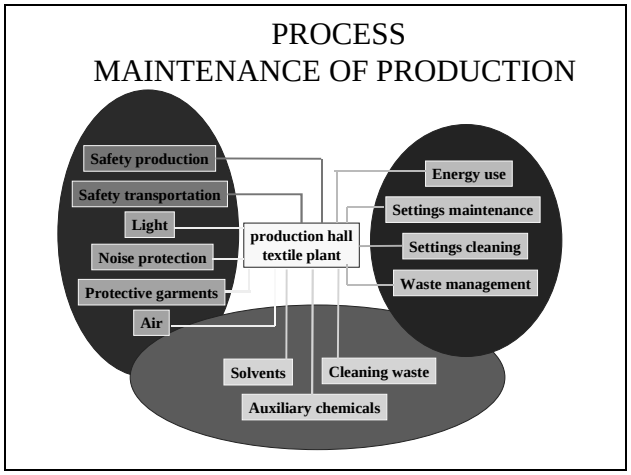

Figure 10. Quality, environmental and safety & health aspects of a process.

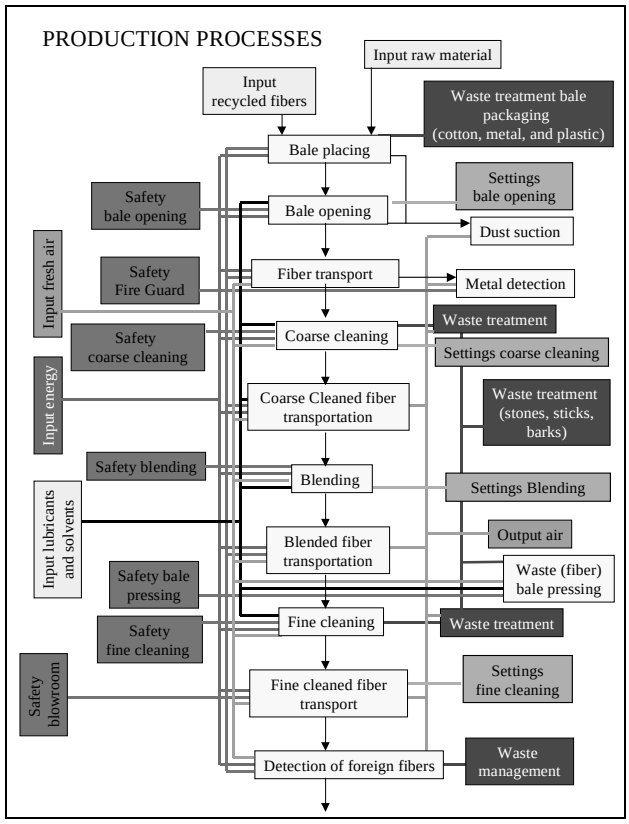

Figure 11. Model for quality, environmental, and safety aspects of blow room processes.

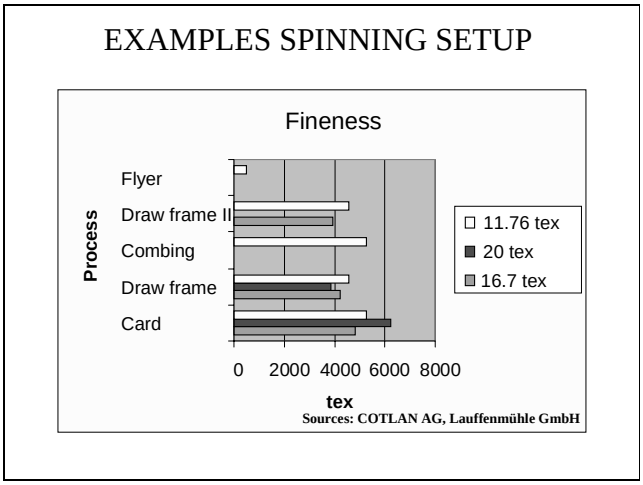

Figure 12. Base for modeling of specifications in yarn fineness using different technology and machinery.

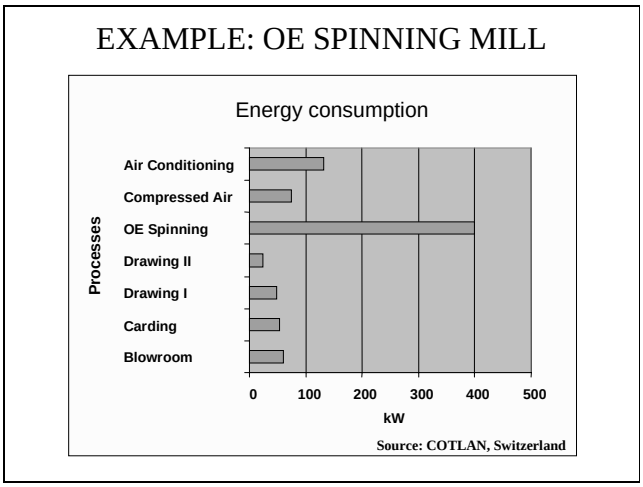

Figure 13. Energy consumption of processes. Air conditioning and air compressing are intermediate processes.

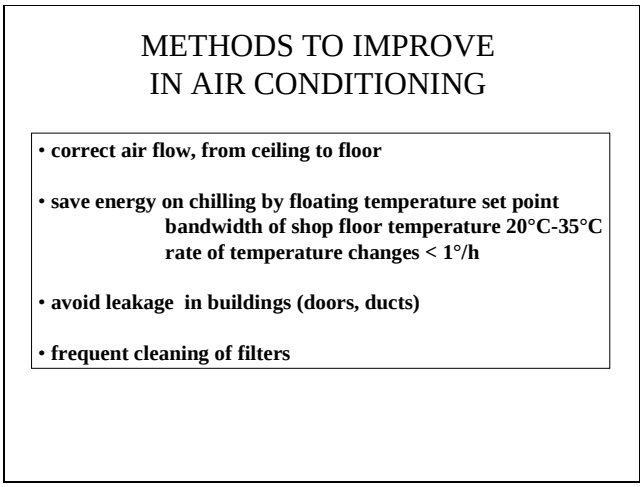

Figure 14. Checklist for improvements in air conditioning.

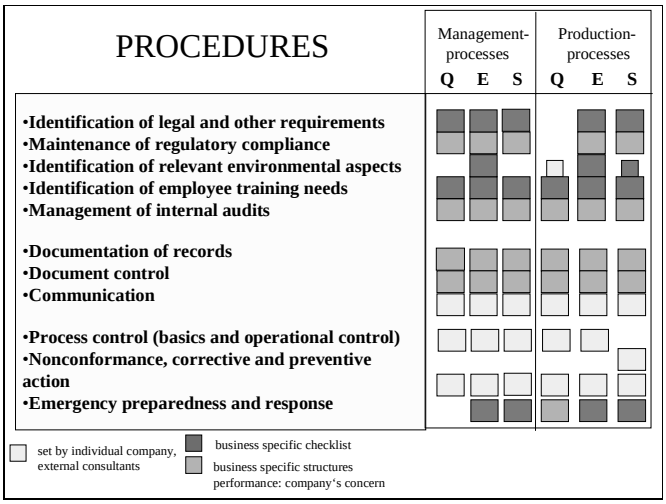

Figure 15. Schedule of the generic solution for an integrated management system (Quality, Environment and Safety). Checklists and business specific structures reduce cost of the system set up.

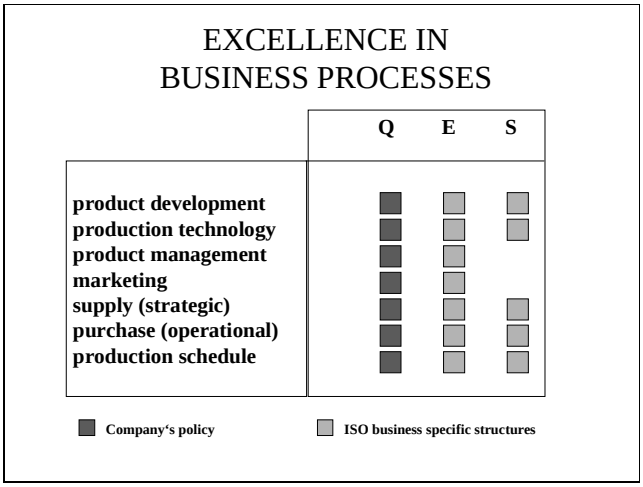

Figure 16. The process oriented ISO system also includes business processes. The generic solution supports the company's effectiveness without interfering into management policy.

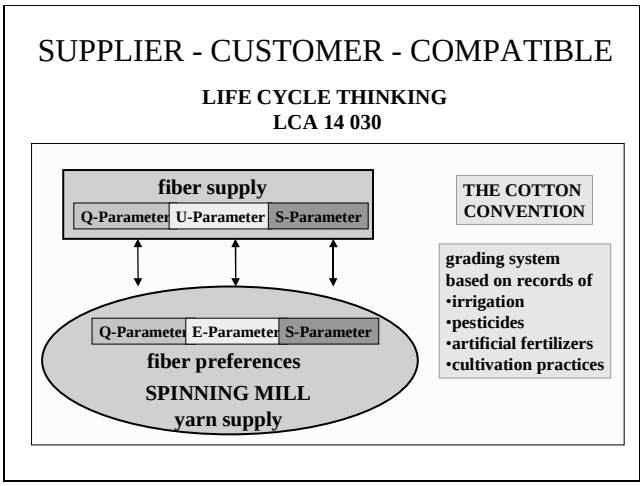

Figure 17. Life cycle thinking in a customer – supplier compatible system is facilitated by means of specific parameters.