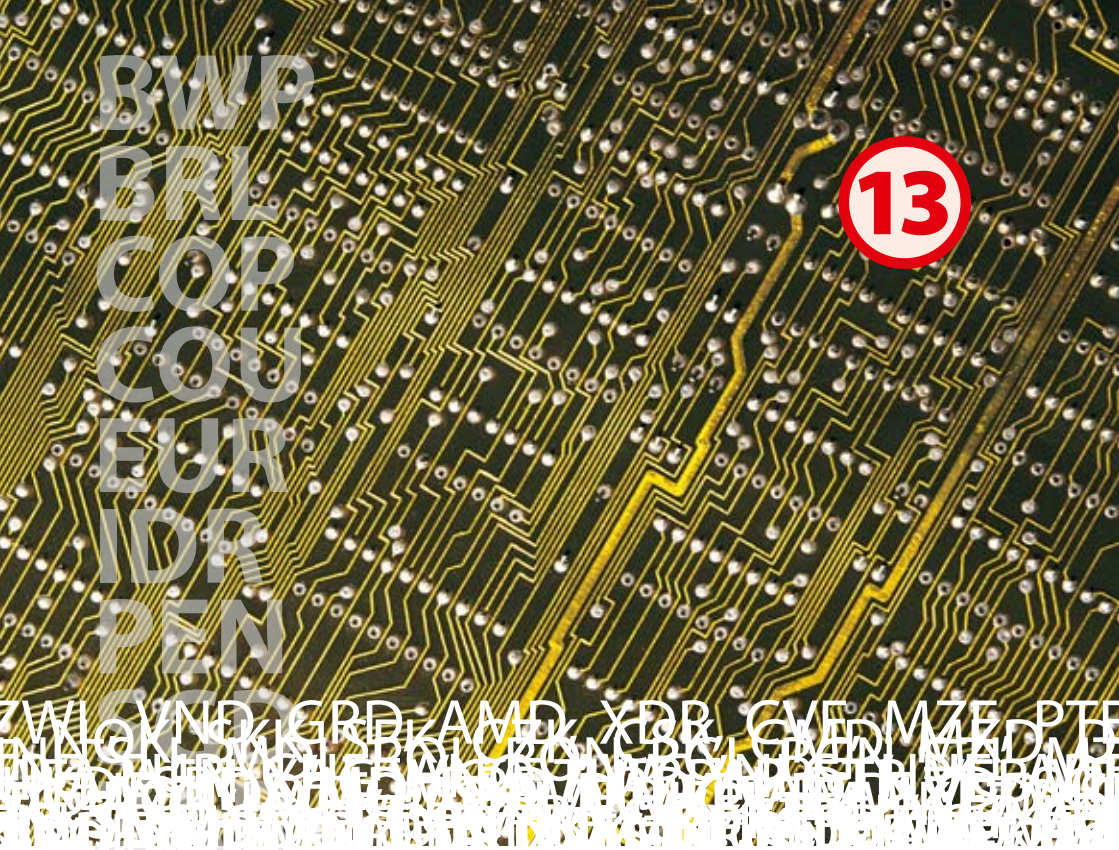

Nanotron Technologies GmbH, Germany

Country : Germany
ISO member body : DIN Deutsches Institut für Normung
(DIN German Institute for Standardization)
Project team :
Author : Mr. Hannes Langer, Student, Technical University Berlin,
Department of Economics and Management
Advisors : Prof. Dr. rer. pol. Knut Blind, Technical University Berlin, Chair of Innovation Economics,
Dipl.-Ing. Heinz Gaub, M. Sc., DIN, Member of the Management Board,
Dr. Jens Albers, CEO of Nanotron Technologies GmH
Duration of the study : October 2010 – June 2011

13.1 Objectives and organization of the pilot project

In this study, we have applied the ISO methodology for the assessment of the economic benefits of standards to the German company Nanotron Technologies GmbH. To do so, we have analyzed the value chains of the industry branch and the company under study and, based on the data, have identified the quantitative and non-quantifiable benefits of standards for Nanotron.

13.2 The ISO methodology

The ISO methodology describes company processes, definitions and explanations and provides a toolbox to determine the benefits of standards for a company or an industry sector.

13.2.1 Objectives of the ISO methodology

The key objective of the ISO methodology is to provide a basis for studying the benefits of standards and ensuring that the results of such studies are comparable. The advantage is that it can be adapted to the analysis of individual enterprises, different industry sectors and other types of organizations.

The intention is to quantify the benefits and to relate them, for comparative purposes, to the total sales revenues of the company being studied. Non-quantifiable benefits should also be identified and their impacts described. The key assessment questions are :

1. What impacts do standards have on the value creation of the company ?
2. Are there any factors specific to the industry sector or the company that have a particular impact on value creation ?
3. How can companies maximize the benefits of standards in value creation ?

13.2.2 Approach

The following table summarizes the key steps of the ISO Methodology as applied in this study and is based on the documents *ISO Methodology Guide, ISO Methodology Essentials* and *ISO Methodology Implementation Guide*.

No	Step	Importance to the approach
1	Describe the industry sector value chain	Helps in planning the case study and in relating the company to an industry sector
2	Locating the position of the company in its industry sector	Preparation for describing the company value chain. Assists in identifying value drivers for step 4
3	Description of the company value chain	From step 2 and the organization chart of the company it is possible to establish the company value chain. The chain facilitates in mapping standards to their areas of application. To do this, it is useful to classify standards into their main applications
4	Identify value drivers	Helps to focus the later stages of the study and to determine the most important impacts of standards
5	Identification of standards	Identification of standards used in the last five years in order to determine the benefits derived from their use
6	Identify the impacts of standards	Identify the impacts of each standard
7	Decide on the scope of the study	Focus the study on the most important segments of the company
8	Identify operational indicators to quantify impacts	Serves in quantifying the benefits with the help of indicators
9	Calculation of quantifiable benefits	Determine the benefits of standards
10	Add up the benefits to those company functions within the scope of the assessment	Analysis on the basis of those business functions to which standards are applied
11	Relate the impacts on the company EBIT to total sales revenues	This enables a comparison between companies and industry sectors on the basis of sales revenues
12	Describe the non-quantifiable impacts	Reveals additional areas which benefit from standards

Table 1 Assessment approach in accordance with the ISO Methodology

13.3 Introduction to the selected company

13.3.1 Nanotron Technologies GmbH

Nanotron is a medium-sized engineering company founded in Berlin, Germany, in 1991 and participates in the global information and communication technology (ICT) sector. With the support of venture capital Nanotron started up its own technology development in 2001. The company currently has 25 employees and develops products on the basis of patented Chirp technology. Its first product, nanometer, was introduced in 2004 to enable the implementation of wireless networks.

Nanotron's current product portfolio is focused on physical position localization, the identification of persons and objects, and the installation of intelligent sensor networks. The company uses Chirp technology, radio frequency (RF) modules, development kits and subsystems, as reference for final products. The product strategy is to sell products in four development stages, as illustrated in **Figure 1,** indicating the relationship between the products.

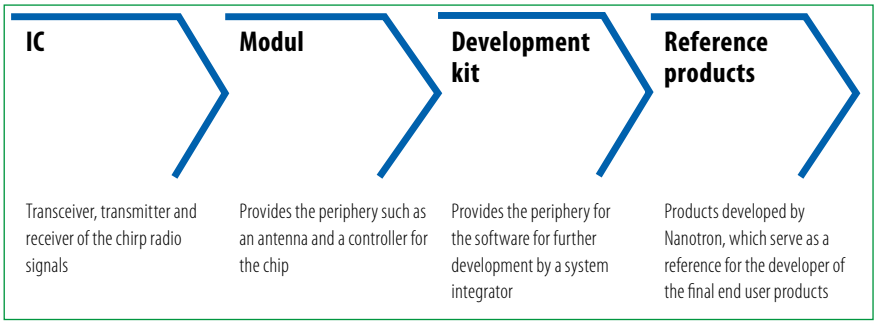

Figure 1 Interrelationship between Nanotron products

Reference products developed by Nanotron include a child loss protection system (CLOPS), a pet fencing system, and real-time locating system (RTLS) tags and anchors. CLOPS supports parents and teachers in monitoring children to ensure they stay within a "safe environment". The pet fencing system makes it possible to encircle gardens with virtual fences to contain domestic animals safely. RTLS anchors are used to set up networks to localize RTLS tags. Production of Nanotron products is outsourced.

Chips and modules to measure distances, location and data transmission are needed in many markets. To date, applications have been developed for the consumer, industrial, health care, energy and logistics sectors.

About 36 % of Nanotraon sales come from the consumer sector, the remaining sales are derived from different industry sectors, including health and senior care. **Figure 2** shows Nanotron's sales per region.

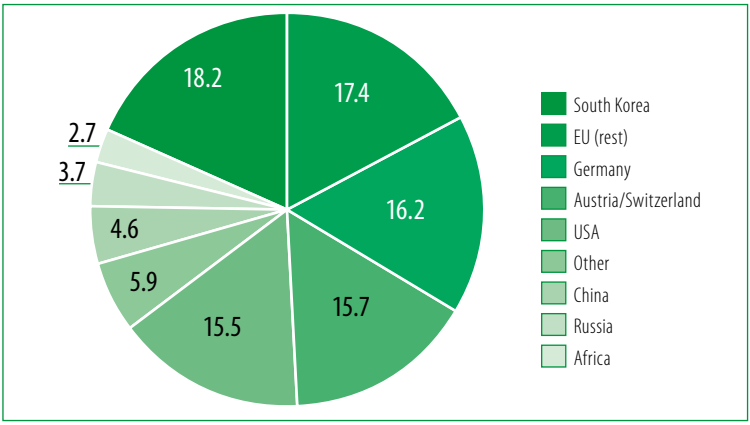

Figure 2 Nanotron sales revenues per region

13.3.2 Attitude of the company towards standardization

Soon after the company's transition to a technology provider, the management decided to implement standards to gain from the advantages of doing so and participate actively in the development of new standards.

The company's internal processes and responsibilities have been oriented towards DIN EN ISO 9001. Standards are mainly used as a strategic marketing tool and to enhance sales. It is most likely that without the use of standards Nanotron could only exist in niche markets. Standardized products and technologies assist in winning high volume chip and module contracts with major companies. Customers are developing products based on new chirp spread spectrum (CSS) technology after having built confidence in this new technology. If this technology is standardized, then such confidence can be much more easily built.

Nanotron has played an influential role in the development of the standard ISO/IEC 24730-5:2010, *Information technology – Real-time locating systems (RTLS)* – Part 5 : *Chirp spread spectrum (CSS) at 2,4 GHz air interface* published in 2010. This standard defines the air interface protocols for real time location systems RLTS using CSS within the 2.4- GHz ISM-frequency band. In 2007, Nanotron participated in the development of the IEEE standard 802.15.4a, which supplements IEEE 802.15.4 by adding the physical layers of an ultra wideband and a CSS-signal. The company plans to engage in future standardization projects in parallel with the development of future products.

13.4 Application of the ISO methodology

13.4.1 Analysis of the value chain

In a value chain all activities which result in the production of a product are implemented in a particular sequence. The product gains in value by passing through each of the stages of the chain. It is possible to develop value chains for whole industries, individual companies as well as for divisions of companies.

13.4.2 Value chain of the ICT industry sector

The ICT sector is involved with a wide range of data communication technologies. **Figure 3** illustrates the value chain of the ICT industry sector.

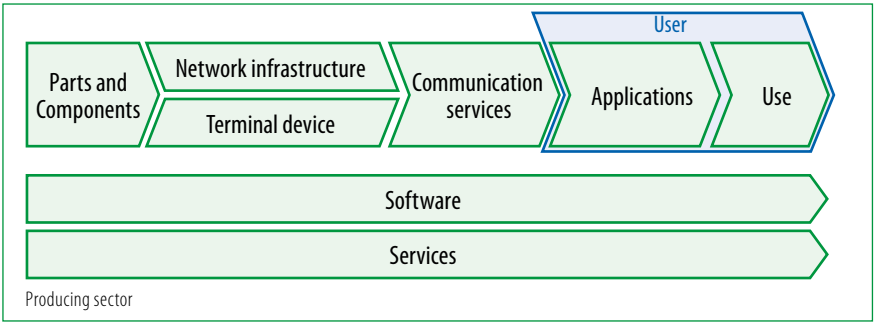

Figure 3 Value chain of the ICT industry

Parts and components include chips, modules and interfaces. The network infrastructure comprises connecting and transmission networks and office networks. Terminal devices can be telephones, computers and localization hardware such as tags and anchors. Communication services transmit the signals. Telecommunication companies are part of communication services, and applications include e-commerce, e-government and localization. The main

communication applications consists of transactions, information collection and the area localization of tags. Software is required at each stage of the value chain to control and handle the hardware. Service providers offer services in the form of consulting, training and other forms of support.

13.4.3 Company value chain

Nanotron produces parts and components in the form of chips, RF modules and the tags and anchors which are also part of the development kits. CLOPS, the pet fencing system, RTLS anchors and tags are offered as reference products for terminal devices. Nanotron also develops the driver and application software for the hardware. The company's production and technology is focused on the areas marked in orange in the industry value chain shown in **Figure 4.**

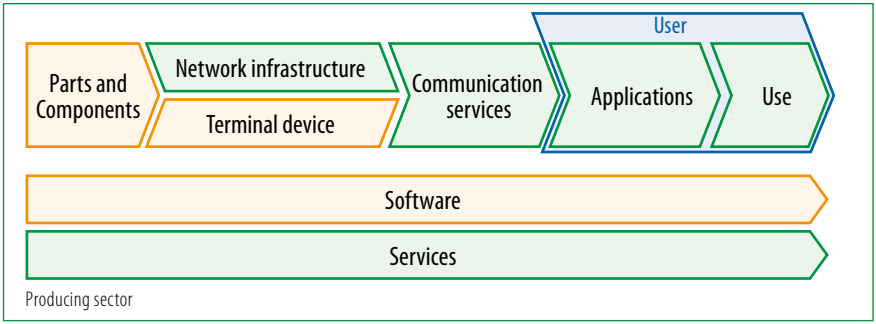

Figure 4 Stages of the ICT value chain covered by Nanotron

Research and development (R&D) is organized in the technology, systems architecture, hardware and software business units (BU). Procurement is undertaken by the operations BU. Production is outsourced to a supplier company. Marketing is carried out by the production management BU, and marketing and sales is supported by customer services. Product management has a guiding function

for R&D in particular. The value chain process is the responsibility of senior management, while administration is in charge for administrative and operational tasks. This results in the following value chain as shown in **Figure 5**:

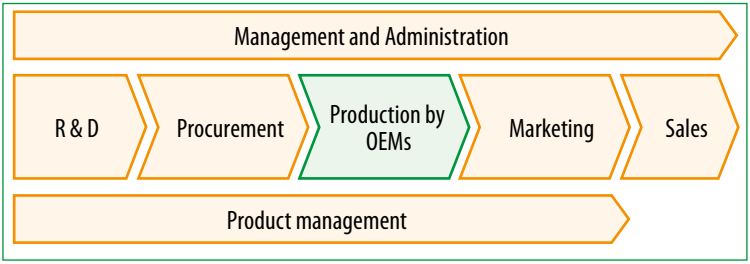

Figure 5 Value chain of Nanotron Technologies

The production value chain stage marked in green is outsourced to original equipment manufacturers (OEMs), that produce products based on design documents developed by another company.

About 45 % of the employees are involved in R&D activities at Nanotron, and about 30 % in marketing and sales managed as one organizational unit. Marketing can be subdivided into the processes of product management and marketing management, and sales into sales processing and customer support.

13.4.4 Key value drivers

The ISO methodology defines a value driver as a capability which creates a competitive advantage for a company. Impacts of value drivers can be observed as increases in sales revenues and cost reductions. Value drivers can be based on standards, since standards also contribute to increases in sales revenues and cost reductions.

A comparison between the industry sector and the company specific value chain can provide some evidence of the units in which company

value drivers can be found. The cost structure at Nanotron may also provide relevant information. Value drivers were identified in company units following interviews with senior management. The importance of a value driver is expressed in the form of its impact on sales and costs. As expected, the impact of value drivers in terms of cost saving potential is greater in company units with a high level of costs.

The comparison between the industry sector and the company specific value chain demonstrates that Nanotron combines the value chain stages of parts and components, terminal devices and software in the R&D unit. Most of the costs accrue in R&D, followed by marketing and sales, and management and administration.

Company costs	In % (estimated)
Customer support	5 %
Research and Development	55 %
Marketing and Sales	25 %
Management and Administration	15 %

Figure 6 Cost structure for different company units

From the list of expenditures per unit and the comparison with the ICT industry value chain, it can be assumed that value drivers can be found in R&D, marketing and sales and management and administration. This assumption was confirmed in the interviews with senior managers for all units. The following value drivers were identified, as shown in **Figure 7**:

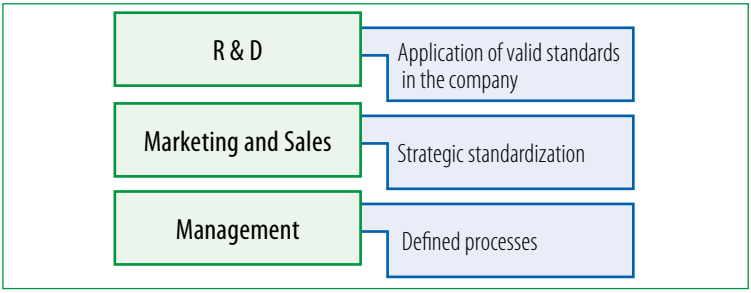

Figure 7 Nanotron's value drivers

The use of standards in R&D not only results in cost savings due to fast access to consensus-based knowledge, but also guarantees that the technical state-of-the-art is met.

In marketing Nanotron uses standards as a strategic tool. Due to its autonomous development of the patented Chirp-chips, Nanotron is not only well known in its industry, but it has also created an international market for its products with the result that standards are of direct benefit to sales. Product development at Nanotron is aware of the content of standards even before their official publication, and is therefore at an advantage in being able to offer innovative products earlier than its competitors. An additional strategic reason to use standards is that customers have confidence in standardized technology and assume that such technologies will remain relevant to the market for longer.

Senior management attaches a high importance to defined process structures since they result in time and resources savings, and contribute to cost reduction in all company units.

13.5 Standards used by Nanotron and their impacts

First, we will subdivide the use of standards into three categories, then analyze in which parts of Nanotron these categories of standards are used, and which individual standards are applied. By mapping the standards to company units, we can describe the impact of the standards as shown in **Figure 8**:

Standard type	Standard reference	Standard description
Product standards	ISO/IEC 24730-5	RTLS – Air interface applying CSS at 2,4 GHz
	IEEE 802.15.4a	Wireless MAC- and PHY-specifications for low rate Wireless Personal Area Networks (LR-WPANs) : Correction 1 : Addition of an alternative PHY-Layer
Process standards	DIN EN ISO 9001	Quality management system standard : Defines minimal requirements for the processes in companies
Conformity standards	ETSI : R&TTE Directive 1999/5/EC	Radio admission for 2,4 GHz CCS Low Power RF transceiver (ETSI)
	FCC : regulations Part 15C	Radio admission for RF transceiver in the range of 2,5 GHz (FCC)
	Japan's ARIB STD-T66	Radio admission for 2,4 GHz CCS Low power radio equipment (ARIB)

Figure 8 Standards used by Nanotron

In the ISO methodology and this study, "standard" refers to consensus-based standards, which are developed by international, regional or national standardization organizations, as well as consensus-based consortia standards, for which participation in development and access to documents is open. Excluded, however, are regulations and company standards as well as standards which have been used in a company for longer than five years, or have remained unchanged during this period. The conformity standards used by Nanotron are

regulations for radio admission, which is why they are excluded from the analysis. Since ISO/IEC 24730-5 is based on IEEE 802.15.4a, we will also not include this IEEE-standard in our assessment.

Nanotron uses standards at five levels:

- In R&D of new products
- In senior management of the organization for process definition
- In sales as an incentive to sell products
- In the process from marketing to product definition
- In the creation of markets for Nanotron's CSS technologies.

This makes it possible to categorize the benefits derived from standards in a manner consistent with the categories proposed by the ISO methodology:

1. Operational standards adoption
2. Strategic standards shaping
3. Strategic standards adoption

In category 1, the main benefit of standards results from their use in company operations. Standards provide information about technologies, describe methods or define guidelines. This results in shorter development times, expedites work processes and contributes to a unified basis for communication. The key benefit is the streamlining of work.

In category 2, the main benefit results from the company being engaged in standards development. This gives it an information advantage over its competitors, through its involvement in modifying and adding to existing standards, as well as through the opportunity to submit proposals for the development of new standards.

In category 3, the main benefit is derived by applying the standards in the company. The standards are an advantage that supports the sales or purchase proposition. The customer has confidence in the

quality of a standardized product or in its compatibility with standardized interfaces. Indeed, the product is defined on the basis of its conformity with a standard. This standards-based strategy helps Nanotron to create a market for its products or reduce time to market in order to generate higher profits through early market introduction.

The categories applied to the standards in figure 8 are expressed in **Figure 9**:

Category of use	Company units	Standards
Operational standards adoption	R&D	ISO/IEC 24730 IEEE 802.15.4
	Management and administration	DIN EN ISO 9001
Strategic standards shaping	Marketing	ISO/IEC 24730 IEEE 802.15.4
Strategic standards adoption	Sales	ISO/IEC 24730 IEEE 802.15.4

Figure 9 Use of standards by company units

ISO/IEC 24730 is the basis for software and hardware developments in R&D. Due to the application of this standard, there is no need for new developments of air interfaces (AIs) and application programming interfaces (APIs). The specification for such interfaces is part of the standard.

Senior management places a high level of importance on the implementation of the organizational requirements in DIN EN ISO 9001 to ensure the optimal design of processes.

The marketing unit at Nanotron took a strategic decision to become actively involved in standardization. It was the company's intention to offer other service providers an alternative to already standardized technologies such as the direct sequence spread spectrum (DSSS) by standardizing a CSS air interface for RTLS.

It was also a strategic vision to create a worldwide market for the technology as a consequence of the dissemination of, and penetration by, the standard.

In the sales unit, standards are used strategically. The standardization of products serves as a sales argument, since standards are seen as evidence of quality and compatibility. Customers pay attention to market penetration when they buy products and are also influenced by how long a product is likely to be offered on the market. This applies to new technologies in particular. Both aspects are supported by standardized technologies, so that sales can use "standards" as a strategic argument in advertising. The following impacts of standards can be identified:

Company unit	Standard	Impacts
R&D	ISO/IEC 24730 IEEE 802.15.4	- More precise product specifications
Marketing	ISO/IEC 24730 IEEE 802.15.4	- Creation of a global market - Costs for the development of standards
Sales	ISO/IEC 24730 IEEE 802.15.4	- Reduced time-to-market - More efficient product description - Confidence in the product
Management	DIN EN ISO 9001	- Shorter processes and workflows

Figure 10 Impacts of standards

13.6 Scope of the pilot project assessment

On the basis of the available data, it was possible to focus the assessment on the R&D, marketing, sales and management units.

13.6.1 Operational indicators used to quantify benefits

After having mapped the standards and their impacts and benefits to the company units, it was necessary to define the operational indicators to be quantified, as expressed in **Figure 11** :

Company units	Value driver	Type of benefit	Standard	Impacts	Operational indicator
R&D	Application of valid standards	Operational standards adoption	ISO/IEC 24730 IEEE 802.15.4	Precise product specifications	Time savings (in %)
Marketing	Strategic standardization	Strategic standards shaping	ISO/IEC 24730 IEEE 802.15.4	Creation of a global market ; Reduced time-to-market	Increase in sales (in %)
Sales	Strategic standardization	Strategic standards adoption	ISO/IEC 24730 IEEE 802.15.4	More efficient product description ; Confidence in the product	Increase in sales (in %)
Management	Lean production	Operational standards adoption	DIN EN ISO 9001 IEEE 802.15.4	Shorter time for processes ad workflows	Time savings (in %)

Figure 11 Operational indicators used to calculate economic benefits

Figure 12 summarizes the quantitative benefits from the impacts of standards on the basis of the company units using these standards :

Company unit	Impacts	Operational indicators	Quantitative benefits
R&D	Price product specifications	Time savings (in %)	5 % of sales revenue
Marketing and sales	Reduced time-to-market	Loss in revenue should standards not be applied (in %)	3 % of sales revenue
	More efficient product descriptions	Time savings (in %)	1 % of sales revenue
	Confidence in the product Creation of a global market	Loss in revenue should standards not be applied (in %)	16 % of sales revenue
	Costs due to participation in the development of the standard	Estimate (of the absolute value)	-4 % of sales revenue
Management	Shorter processes and workflows	Time savings (in %)	12 % of sales revenue
		EBIT Impact (total)	**33 %**

Figure 12 Cumulative economic benefits for each company unit

The total of the quantitative benefits for all Nanotron units, representing the impacts of standards on the company EBIT, can be distinguished into the two categories

- cost savings (14 %) and
- increase in sales revenue (19 %).

The percentage of the impacts of standards of the total sales revenue is almost **33 %**.

13.7 Non-quantifiable benefits

The benefits to Nanotron from standards introduced or modified within the last five years have been demonstrated to a large extent through the quantitative analysis. Participation in standards development, however, provides aspects that are not quantifiable. Nevertheless, standardization meetings and events provide opportunities to

exchange information and views with other companies. It is also possible to discuss future trends, establish business contacts and initiate new projects, including those involving joint development.

In the sales unit benefits result from standardized products. As an example, if there is a need for a water-resistant case for a circuit board, sales can refer to relevant standards for the product, in this case DIN EN 60529, to influence the R&D purchase decision.

The cross-unit benefits of the use of standards have not been analyzed as a consequence of focusing the quantitative analysis on individual units of the company. However, it is possible to benefit, in particular, from the use of standardized electronic components in the cooperation between R&D and outsourced production. Such benefits also result from the consistency in meeting defined dimensions during the planning of circuit board layouts. As a result, products developed by Nanotron can be produced without incurring any additional costs from later adaptations or adjustments.

13.8 Discussion of the results

The results of the assessment demonstrate that standardization makes an important contribution to the EBIT of the company. With a contribution of 33 % of the company sales revenues, the impacts are significantly higher than those found in similar studies in other industry segments and companies. These typically evaluated the impact of standards at about 1-4 % of sales revenue.

Consequently, two questions should be considered:

- Why is the percentage contribution so high in the case of Nanotron?
- Is it possible to base a comparison of the benefits of standards between different companies exclusively on the quantitative benefits?

The first question can be answered as follows:

1. Nanotron has clearly recognized the potential that can result from standardization. As shown, standards are used actively in all three possible areas of application. As a result, the quantitative benefits are especially high.
2. Much of the benefit is generated by the global market for Nanotron's products, which – in the case of the CSS technology – has only evolved as a consequence of the company's participation in standardization. This type of standardization benefit only results for new technologies or products. The benefits of standardization are particularly high for Nanotron, because the impacts from standards apply to almost its entire product range.
3. Since the products are based on new technology, it takes some time until customers are able to develop their own products on the basis of the new chips and RF-modules. Only when this point is reached do the sales volumes of Nanotron's chips and modules increase significantly.

The benefits in points 2 and 3 above can also be argued in conjunction with the product life cycle model (see **Figure 13**). However, since we address the whole company, the model does not, in this case, apply to an individual product, but to the sum of all the company's products. If the product portfolio is composed of a set of products that are still in development, another set just recently introduced and a third smaller set that is fully established in the market, then the product portfolio is still in an introductory phase. This is an appropriate description of Nanotron's current portfolio. However, it is assumed that this phase will be concluded by the end of 2011. On the other hand, it can be assumed that the product portfolio of companies already well established in their markets can be described as being in the maturity and saturation phase.

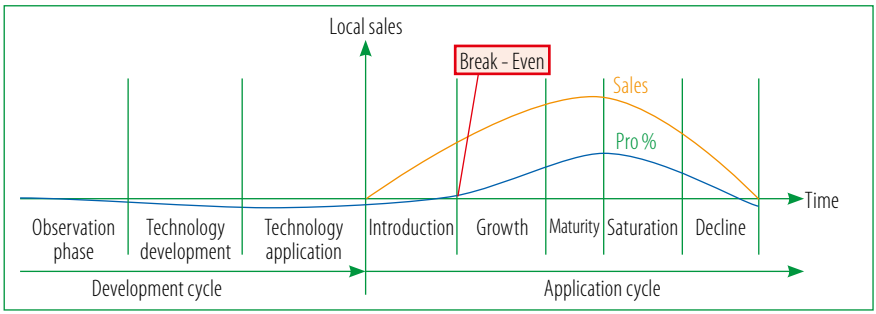

Figure 13 Product life cycle

The comparison between this and other studies demonstrates that companies that have not yet reached their break-even point have an advantage over different companies on the basis of the percentage of the contribution of standards to sales revenues. Sales revenues are still so limited that even a small quantitative benefit results in high percentages. If one attempts to undertake reasonable comparisons it is more appropriate if the product portfolio of the companies is at a similar phase in the life cycle.

13.9 Summary of the study

As the results have shown, standards have a significant impact on Nanotron, amounting to 33 % of current overall annual sales revenues.

It was not possible to identify specifics of the industry sector that have caused this result. However, it could be concluded that, for companies such as Nanotron, with a product portfolio new to the market and partially still under development, the benefits from standardization as a percentage of sales revenues and EBIT are especially high. This phenomenon could be explained with the life cycle theory, which provides an explanation of the sales and cost structure in the introductory phase of products into the market.

Nanotron already exploits all the potential means of using and benefiting from standards as also stated in the ISO methodology. Its implementation of standards, the strategic use of standards, and also its involvement in standardization committees are important elements of Nanotron's business strategy.

List of abbreviations :

AI	Air interface
API	Application programming interface
CEO	Chief executive officer
CFO	Chief financial officer
CLOPS	Child loss protection system
CSS	Chirp spread spectrum
DSSS	Direct sequence spread spectrum
ICT	Information and telecommunication technology
IEC	International Electrotechnical Commission
OEM	Original equipment manufacturer
R&D	Research and development
RFID	Radio frequency identification
RTLS	Real-time location systems
USN	Ubiquitous sensor networks