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(DIN German Institute for Standardization)

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1. Objectives and approach of the study

In this study, the ISO methodology for the assessment of economic benefits of standards is applied to the company Nanotron. To do this, the value chains of the industry branch and the company are being analyzed and, based on an analysis of the data and available information, the quantitative and non-quantifiable benefits of standards on Nanotron are being determined.

2. The ISO Methodology

The ISO methodology is made up of a methodological approach to describe company processes, definitions and explanations and of a toolbox for the determination of benefits of standards for a firm or an industry sector.

2.1 Objectives of the ISO Methodology

The main objective of the ISO methodology is to provide a harmonized basis for studies on the benefits of standards and standards and, thereby, to ensure that the results of such studies are comparable. The advantage of the methodology is that it can be adapted to the analysis of individual enterprises, different industry sectors and governmental institutions.

The intention is to quantify the benefits and to relate them for comparative purposes to the total sales revenues of enterprises. Non-quantifiable benefits should be pointed out and their impacts should also be described. The key questions that are in the core of an assessment are as follows:

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

2.2 Approach

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

Table 1: Assessment approach in accordance with the ISO Methodology

No	Step	Importance for the approach
1	Elaborate the value chain of the industry sector.	Serves the planning of the case study and the categorization of the company into an industry sector
2	Locating the position of the company in its industry sector.	Preparation for the elaboration of the value chain of the company. Assists in the identification of value drivers in step 4
3	Elaboration of the value chain of the company.	On the basis of step 2 and the organization chart of the company it is possible to arrive at the company value chain. The value chain facilitates in the mapping of standards to the areas of their application. To do this, it is useful to classify standards into their main groups of application.
4	Identify value drivers	Helps to focus the study in later stages as well as to determine the most important impacts of standards
5	Identification of standards.	Identification of the standards that have been used in the last 5 years in order to determine the benefits derived from their use
6	Identify the impacts of standards	Identify the impacts of a standard
7	Decide on the scope of the study.	Focus of the study on the most important segments of the company.
8	Identify operational indicators for the quantification of the impacts	Serves the quantification of the benefits with the help of indicators.
9	Calculation of the quantifiable benefits	Determine the benefits of standards.
10	Add up the benefits for the company functions that have been within the scope of the assessment	Analysis on the basis of the business functions to which standards could be mapped.
11	Relate these impacts on the company EBIT to the total sales revenues.	This allows the comparison between companies and industry sector on the basis of the sales revenues
12	Describe the non-quantifiable impacts	Allows to understand additional areas in which standards have benefits.

3. Nanotron Technologies GmbH

3.1 The company

Nanotron is a medium-sized enterprise that operates in the global market. The company was founded in 1991 as an engineering company in Berlin (Germany) with a wide-range service portfolio. In 2001 Nanotron converted with the support of venture capital to start own technology development. It currently has 25 employees and develops products on the basis of the patented chirp-technology. In 2004, the first product, nanoNet, a chip that allows the implementation of wireless networks, was released to the market.

Nanotron's focus belongs to the Information and Communication Technology (ICT) sector.

Nanotron's current product portfolio is used in applications for the localization of the physical position and the identification of persons and objects as well as for the installation of intelligent sensor networks. For these purposes, Nanotron uses Chirp technology, radio frequency (RF)-Modules, development kits and subsystems, which are used as a reference for final products. The product strategy foresees to sell products in four development stages.

Chart 1 describes the development stages and shows the relationship between the products.

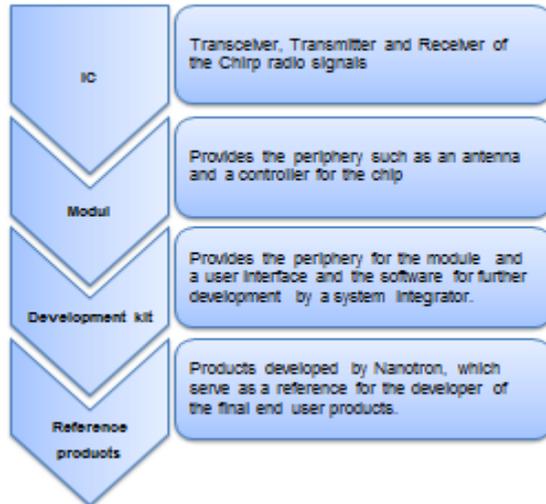


Chart 1: Interrelationship between the Nanotron products

Reference products developed by Nanotron are the Child Loss Protection System (CLOPS), the Pet Fencing System, RTLS-Tags and RTLS-Anchors. The Child Loss Protection System supports parents and teachers in monitoring children to be in a "safe environment". With support of the Pet Fencing System it is possible to encircle gardens with virtual fences, with the effect to contain domestic animals in the safe vicinity of the garden. RTLS-anchors are used to set up networks for the localization of several RTLS-Tags.

The production of these products has been outsourced.

Chips and modules which can be used for the measurement of distances, localization and data transmission, are needed in many markets. So far application have been developed for the consumer sector, industrial, health care, energy and logistics sector.

36% of Nanotraon sales come form the consumer sector, the rest relies on sales to different industry sectors, inlcuding health care and senior care. The following chart shows Nanotron's sales on the basis of regions:

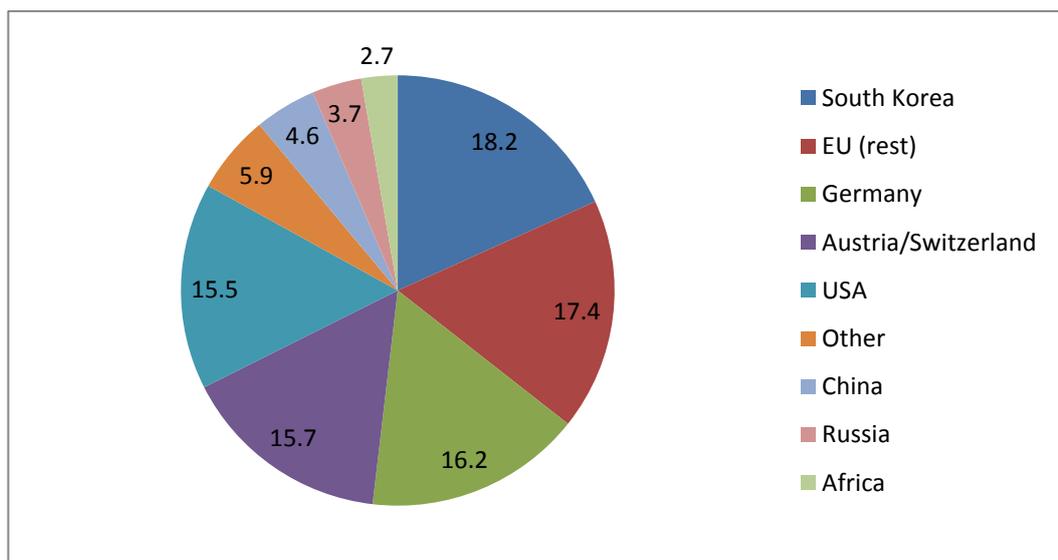


Chart 2: Sales revenues based on regions

3.2 Attitude of the management towards standardization

At an early stage after transition of the company to be a technology provider, the executive management of Nanotron has decided to use the advantages that result from the application of standards and to participate actively in the development of new standards.

Company-internal processes and areas of responsibilities have been oriented towards DIN EN ISO 9001. Standards are mainly used as a strategic marketing instrument and as an argument that assists in sales. It is most likely that without the use of standards Nanotron could only exist in niche markets. Standardized products and technologies assist in achieving the objective to conclude contracts with major companies on the delivery of chips and modules in high volumes. Customers are developing products with a new technology such as the Chirp Spread Spectrum (CSS) after they have built confidence in this new technology. If this technology is standardized, then such confidence can be much easier built. Experience and know-how from the product development are therefore also been made available to the standardization work. Nanotron had an influential role not only in the development of the ISO standard 24730-5, which was published in 2010. This standard defines the air interface protocols for real time location systems (RLTS) using the Chirp Spread System within the 2.4-GHz ISM-frequency band. Already 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. In parallel to the development of future products, Nanotron plans to engage in future standardization projects.

4 Application of the ISO methodology

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.

4.2 Value chain of the ICT industry sector

The ICT-sector deals with a wide range of data communication technologies.

In chart 3, the value chain of the ICT industry sector is displayed.

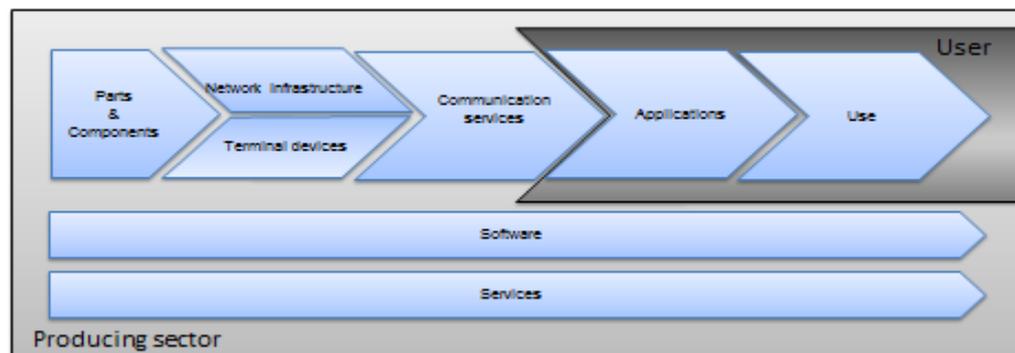


Chart 3: Value chain of the ICT industry

Parts and components are e.g. chips, modules and interface components. The network infrastructure includes connecting and transmission networks as well as 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 the communication services and relevant applications are - amongst others - e-commerce and e-government as well as localization. The main use e.g. in communication consists in transactions, in information collection and the areal localization of the tags. Software is needed in each stage of the value chain for the control and handling of the hardware. Service providers offer services in the form of consulting, training and other forms of support.

4.3 Value chain of Nanotron

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 RTLS-Tags are offered as reference products for terminal devices. Nanotron also develops the driver and application software for the required hardware. With such a focus, Nanotron covers the areas which are marked in red in the industry value chain in chart 4.

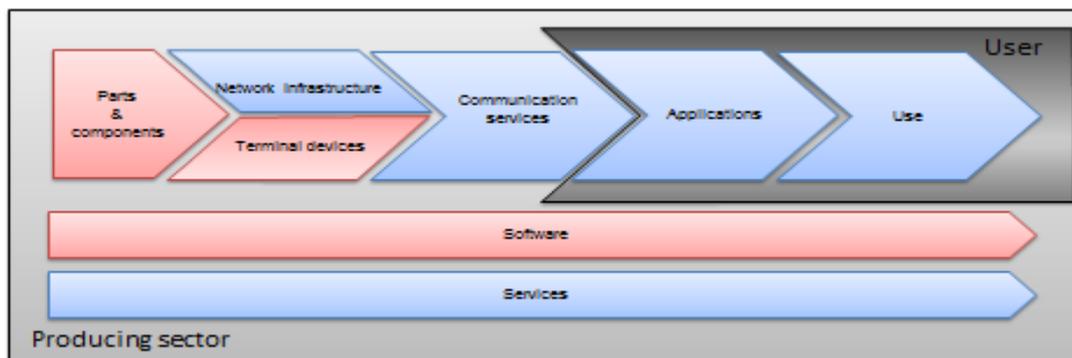


Chart 4: Stages of the ICT-value chain covered by Nanotron

Research & Development (R&D) is organized in the business units (BU) Technology, Systems architecture, Hardware and Software. Procurement is undertaken by the BU Operations. Production is outsourced and is done by a supplier company. Marketing is done by the BU Production Management and Marketing and Sales is supported by customer services. Product management has a guiding function, in particular for R&D. The value chain process is the responsibility of senior management, whereas Administration is in charge for administrative and operational tasks. This results in the following value chain:

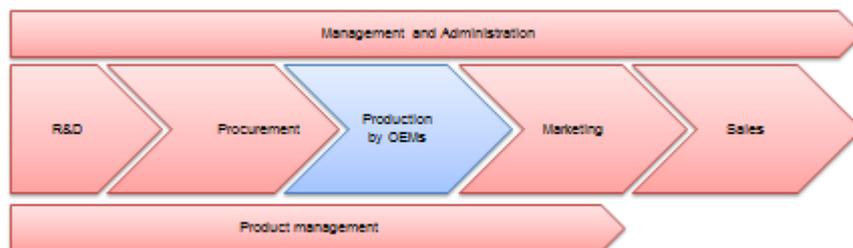


Chart 5: Value chain of Nanotron Technologies

The value chain stage Production which is marked in blue is outsourced to Original Equipment Manufacturers (OEM), which is a manufacturer that produces products on the basis of design documents developed by another company.

About 45% of the employees are involved in the R&D activities in Nanotron, about 30% in Marketing and Sales which are managed as one organizational unit. Marketing can

be subdivided into the processes product management and marketing management and Sales into Sales processing and Customer support.

4.4 Key value drivers in Nanotron

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 in which units of the company value drivers can be found. Additionally, the cost structure at Nanotron may provide relevant information. The value drivers are being identified after the relevant units of the company have been determined through interviews with senior management. The importance of a value driver is expressed in the form of its impacts on sales and costs of the company. It can be expected that the impacts of value drivers in terms of their cost saving potential is higher 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 Parts & Components, Terminal devices and Software in the unit R&D. Most of the costs accrue in the unit R&D, followed by Marketing & Sales and Management and Administration.

Company costs	In % *
Customer support	5 %
Research & Development	55 %
Marketing & Sales	25 %
Management & Administration	15 %

* Estimated on the basis of the operational results of 2009, the preliminary results for 2010 and a prognosis for 2011

Chart 6: Costs structure for different company units

On the basis of the list of expenditures per unit and the comparison with the value chain of the ICT-industry, it can be assumed that value drivers can be found in R&D, Marketing and Sales as well as in Management and Administration. This assumption was confirmed in the interviews with senior management for all units. The following value drivers were identified, which are shown in chart 7:



Chart 7: Nanotron's value drivers

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

In Marketing Nanotron uses standards as a strategic tool. Due to the autonomous development of the Chirp-chips, Nanotron is not only well-known in its industry, but has also created an international market for its products so that standards are of a direct benefit for Sales. Product development in Nanotron is in a position to take into account the content of standards even before their official publication and has therefore an advantageous position 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 for longer periods in the market.

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.

5. Standards used in Nanotron and their impacts

First, we will subdivide the use of standards in three categories. Then we will 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 will describe the impacts of the standards and capture this in the table below:

Table 2: Standards used by Nanotron

Standard - Typ	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	Radio admission for 2,4 GHz CCS Low

	1999/5/EC	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)

In the ISO Methodology and therefore also in this study, "standard" refers to consensus-based standards, which are developed within international, regional or national standardization organizations as well as consensus-based consortia standards, for which the participation in the development and the access to the 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 four levels:

- in R&D of new products
- in senior management for the organization of processes
- in Sales as an argument 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 which is 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 from 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 works processes and contributes to a unified basis for communication. The key benefit is the streamlining of work.

In category 2 the main benefit results for the company which is engaged in standards development from the information advantage as compared to its competitors, through the cooperation in modifications and additions to existing standards as well as through the possibility to submit proposals for the development of new standards.

In category 3 the main benefit follows on the application of a standard by a company. The standard is now an argument supporting sales or purchase. The customer has confidence e.g. in the quality of a standardized product or in its compatibility which are ensured through standardized interfaces. The product has been defined on the basis of a standard. It is the strategy to create a market for its products or to reduce the time to market in order to generate higher profits through an early market introduction.

The categories applied on the standards in Table 3 are expressed in the following table:

Table 3: Use of standards by respective company units

Category of Use	Company units	Standards
Operational Standards	R&D	ISO/IEC 24730

Adoption		IEEE 802.15.4
	Management & 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

In R&D ISO/IEC 24730 is the basis for the developments in soft- and hardware. 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 for the optimal design of processes.

In Nanotron it had been a strategic decision of the Marketing unit to become actively involved in standardization. By standardizing a CSS air interface for RTLS it had been Nanotron's intention to offer other service providers an alternative to already standardized technologies such as the Direct Sequence Spread Spectrum (DSSS).

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

In Sales 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 the market penetration when they buy products and the time frame within which a product will most likely be offered on the market. This applies in particular for new technologies. 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:

Table 4: Impacts of standards

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

6. Scope of the analysis

On the basis of the available data, it was possible to focus the analysis on the units R&D, Marketing, Sales and Management.

6.1 Operational indicators for the quantification of the benefits

After having mapped the standards with their impacts and benefits to the units in the company, it is necessary to define operational indicators to undertake the quantification. This is expressed in the following table:

Table 5: Operational indicators for the calculation of economic benefits

Company units	Value driver	Type of benefits	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 %)

The following table summarizes the quantitative benefits from the impacts of standards on the basis of the company units in which these standards are used:

Table 6: Cumulative economic benefits for the company units

Company unit	Impacts	operational indicators	quantitative benefits
R&D	price product specifications	time savings (in %)	5% of sales revenue
Marketing & Sales	reduced time-to-market	loss in revenue in case standards would 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 in case standards would not be applied (in %)	16% of sales revenue
	Costs due to participation in the development of the	estimation (of the absolute value)	-4% of sales revenue

	standard		
Management	shorter processes and workflows	time savings (in %)	12%of sales revenue
		EBIT Impact (total)	33%

The total of the quantitative benefits for all the company units, which represents the impacts of standards on the EBIT of Nanotron, can be distinguished into significant cost savings (14%) and increase in sales revenues (19%).

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

7 Non-quantifiable benefits

The benefits for Nanotron from standards that have been introduced or modified within the last five years could be demonstrated already to a large degree through the quantitative analysis. The participation in standards development, however, provides aspects that are not covered by quantification. Standardization meetings and events provide the occasion to exchange information and views with representatives from other companies. It is possible to discuss future trends, to establish business contacts and to initiate new projects, including those which involve joint development.

In the unit Sales 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 for the purchase decision of the R&D unit.

As a consequence of focusing the quantitative analysis on individual units of the company, the cross-unit benefits of the use of standards have not been analyzed. 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 consistence with defined dimensions during the planning of layouts of circuit boards. As a consequence of that, the products developed by Nanotron can be produced without incurring additional costs for later adaptations or adjustments.

8. Discussion of the results

The results of the analysis 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 impacts that have determined as an outcome of similar studies in other industry segments and company sizes, which frequently evaluated the impact of standards to amount to 1-2% of the revenue.

As a consequence, two questions need to be posed:

- 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 described above, standards are used actively in all the three possible areas of application. As a result, the quantitative benefits are especially high.
2. A large part of the benefits is generated by the global market for Nanotron's products, which - for the CSS technology - has only evolved as a consequence

of Nanotron's participation in standardization. This type of benefit from standardization only results for new technologies or products. The impacts from standardization are particularly high for Nanotron, because the impacts from standards apply to nearly its entire product spectrum.

3. Since the products are based on a new technology, it takes some time until customers are able to develop their own products on the basis of the chips and RF-modules of Nanotron. Only if this point is reached, the sales volumes of Nanotron's chips and modules increase significantly.

The benefits as stated in 2. and 3. above, can also be argued for using the product life cycle model (see chart 8). However, since we address the whole company the model does, in this case, not apply to an individual product, but to the sum of all products, i.e. the product portfolio of the company. If the product portfolio is composed of a set of products which are still in the development phase, another set which has just recently been introduced and of a third smaller set of products which are fully established in the market, then the product portfolio is still in an introductory phase. This is an adequate characterization for the current product portfolio of Nanotron. However, it is assumed that this phase will be over by the end of 2011. On the other hand, it can be assumed that the product portfolio of companies which are already established in their markets for quite some time resides in the maturity and saturation phase.

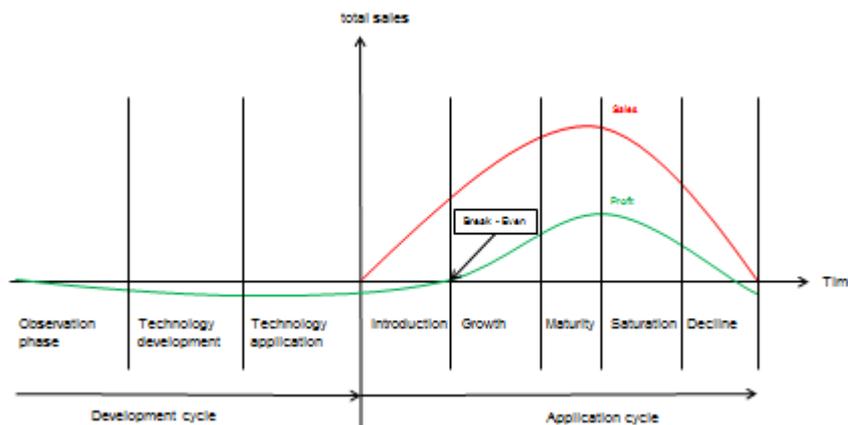


Chart 8: Life cycle of a product

The comparison between this study of Nanotron and other studies demonstrates that companies which have not yet reached their break-even point have an advantage if one compares different companies on the basis of the percentage of the contribution of standards to the sales revenues. The 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 resides in similar phases of the life cycle.

9. Summary of the study

As the results of the calculations of the economic benefits of standards and the description of the non-quantifiable benefits have shown, standards have a significant impact on Nanotron which amounts to 33% of the today's overall annual sales revenues.

It was not possible to identify specifics of the industry sector that have caused this result. However, it could be observed that, for companies such as Nanotron with a product portfolio that is new to the market and partially still under development, the benefits from standardization as a percentage of the sales revenues respectively the

EBIT are especially high. This phenomenon could be explained with the life cycle theory, which provides an explanation for the sales and cost structure in the introduction phase of products into the market.

Nanotron already exploits all the potential means of using and benefitting from standards as they are also stated in the ISO Methodology. The use of standards in the company, the strategic use of standards and also the cooperation in standardization committees are firm elements of the business strategy of this company.

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