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- **Award for excellent research with innovative X-ray lasers**
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**Asslar, December 3, 2012.** This year, Dr. Christoph Bostedt was awarded the Röntgen Prize of the Justus-Liebig University of Gießen. For more than fifty years now, Pfeiffer Vacuum, together with the Dr. Erich-Pfeiffer Foundation and the Ludwig-Schunk Foundation, has sponsored the Röntgen Prize for young scientists in the field of radiation physics.

Dr. Bostedt is currently a researcher at Stanford Linear Accelerator Laboratory in the USA, where he is successfully engaged in the Linear Coherent Light Source (LCLS) as a team leader in the field of nuclear and molecular physics.

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#### About Pfeiffer Vacuum

Pfeiffer Vacuum (Stock Exchange Symbol PFV, ISIN DE0006916604) is one of the world's leading providers of vacuum solutions. In addition to a full range of hybrid and magnetically levitated turbopumps, the product portfolio comprises backing pumps, measurement and analysis devices,

Dr. Bostedt was awarded the Röntgen Prize for his scientifically very broad-based and successful experimentation in the field of research into innovative X-ray lasers. His excellent work with the free-electron lasers FLASH and LCLS is especially highlighted. Dr. Bostedt was repeatedly able to also take advantage of vacuum solutions by Pfeiffer Vacuum in his scientific work.

On November 29, 2012, one day before the awards ceremony at the Justus-Liebig University in Gießen, Dr. Bostedt visited the sponsoring company, Pfeiffer Vacuum, and reported on his latest findings and research results.

components as well as vacuum chambers and systems. Ever since the invention of the turbopump by Pfeiffer Vacuum, the company has stood for innovative solutions and high-tech products that are used in the markets Analytics, Industry, Research & Development, Coating and Semiconductor. Founded in 1890, Pfeiffer Vacuum is active throughout the world today. The company employs a workforce of some 2,300 people and has more than 20 subsidiaries.

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## KNOWLEDGE TRENDS IN THE SUBFIELDS OF MANUFACTURING ENGINEERING AT THE PLATFORM OF ISO/IEC STANDARDIZATION

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**Abstract:** *This paper is a part of research and isolated segment of the statistical analysis of the trends of the international ISO/IEC standardization, simultaneously by manufacturing engineering subfields. The focus is on the trends of updating the knowledge at the beginning of the second decade of the 21st century, in order to ensure and enhance the quality of knowledge resources in the field of production engineering. The methodology of statistical surveys is applied, at a separate sample of 3385 units from a population of 44000 ISO/IEC standards in all areas of creativity, with the possibility of comparing trends. As a part of the multi-year research and monitoring of standardization, this paper presents the important details (the results): comparisons of knowledge trends, analyzed by subfields (for the area ICS = 25), directions of further development of new units of knowledge through new projects, as well as the opportunities for comparison with the standardization of local (national) level in the same and also in all the other fields of creativity (for ICS = 01, 03, ... 99).*



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## 1. INTRODUCTION

In recent decades, especially in the 21 century, the pace of knowledge innovation and training in professional work is very intense. This is especially true for new technologies and information technology (IT). Experts in certain areas are facing with major challenges to remain competitive and be "in progress: lifelong learning and maintaining a level of knowledge that is needed to successfully perform their job. Much of this knowledge has been acquired and thoroughly revised through practical work in companies, as informal education. In this paper, a platform of knowledge of ISO/IEC standards is made with the aim of modeling and knowledge management, as in [1].

This paper presents a statistical analysis of the results obtained by our own IT application, developed for the purpose of comparative analysis and evaluation of international (ISO/IEC) knowledge and obligations on the production engineering examples, represented by quantity indexes of ISO/IEC knowledge. The sample included all subfields of production engineering, qualitatively and quantitatively. Appropriate mathematical relations of knowledge trends are established for each subfield by regression analysis method, with the prediction of financial resources for knowledge units.

In recent years, we have all been witnesses of the growing problem of continuous improvement of individual knowledge as compared to the standardized (partly public and collective) knowledge of new technologies for higher quality products. The assimilation of new technologies through knowledge/technology transfer is important, even for small and medium size enterprises, [2]. The problem is not only reflected in the price of knowledge, but also in the continuous improvement of product quality (educational services). Knowledge is primarily based on the innovations of standardized engineering principles and individual knowledge necessary for the target level and quality system, [3].

Standardization and innovation are compatible concepts. They accelerate technological and organizational change while improving innovation performance. Standards also promote innovative products and services by providing stable references for the development of new innovative solutions, [4]. For example, in the UK, around 60% of all enterprises which are innovation active are users of one or more types of standard as a source of information. The share accessing standards based information increase with business size, with over nearly 80% of large business units promoting a standard as sources of innovation, but Only 25% of businesses which are not active in innovation record finding standards a valuable knowledge input, [5].

Standards are reliable and important source of knowledge primarily because they contain elements of problem solving, rather than developing and implementing the same in the innovation process. Standards facilitate and enhance knowledge transfer, disseminate technologies and best practices, the use of research results, networking with other industries and stakeholders in future studies, the inclusion of all stakeholders in setting the rules for future researches, access to new technologies, interoperability with own, compatible technologies, compatibility with other manufacturers, providing a platform for innovation at the same time, [6, 7].

Membership in ISO has 164 national standards bodies from small and large countries, industrialized, developing and countries in transition, from all regions of the world, [8]. Forty hierarchically organized areas of standardization are covered by International Classification for Standards (ICS), divided into 392 groups. Standards are increasingly being used to support technical regulations and increasingly related to the technologies which are developing rapidly, especially in the field of Information Technology (IT), closely related with the Manufacturing Engineering: as an integral part of the product design (IT as a "product enabler"), group intelligence, creating of smart collectives, nanolayers, sheets and films and fibers in construction composite materials store and process probed data from the environment, [9].

## 1.1 Scope and objectives of research

According to the ICS, the area of manufacturing engineering is classified through nine subfields (ICS=25.xy0): 25.040 – Industrial automation systems (IT applications in industry), 25.060 – Machine tool systems, 25.080 – Machine tools, 25.100 – Cutting tools, 25.120 – Chipless working equipment, 25.140 – Hand-held tools, 25.160 – Welding, brazing and soldering, 25.200 – Heat treatment, and 25.220 – Surface treatment and coating, [10].

In the explored "subject" field (ICS = 25), the "problem" is "obvious" just in 2010 and 2011. Only during 2010 the ISO has published 329 new features (the value of 90058 CHF).

The initial hypotheses and research objectives in the field of manufacturing engineering are important possibilities:

1(P-Plan) resource planning: Prediction of future resources, financial needs for evaluating knowledge units and commitments for each of the subfields and in the entire field, by subcommittees and development stages of new projects (from a practical point of view),

2(D-Do): Evaluation of standardized knowledge units with the ability to form explicit mathematical relations, as the regression trend lines,

3(C-Check): Setting clear correlations of obligations and knowledge innovation trends with annual trends of innovation of











