

NEW DIMENSIONS IN TRAINING

The demands are high on mechanical designers. They must be able to construct well, know about various materials and different production technologies, have knowledge of the Machinery Directive, CE Marking and ISO standards, and so on. And at the customer's table, they have to make the trade-off between their technical potential and their company's commercial interests. Inventas offers a wide range of courses in these competences. A recent addition is the Model-Based Definition course, which helps designers, purchasers and production people to be in agreement about the interpretation of the latest standards for dimensions and tolerances in drawings, or rather 3D models.

Today, by far the majority of countries and companies worldwide adhere to ISO standards that are translated per country and issued in the Netherlands by the Dutch Institute NEN in Delft. These standards ensure that industry can work together worldwide thanks to a clear and unambiguous technical language. Designers in the world-leading Dutch Brainport region and elsewhere who are involved in product creation can interpret a 2D drawing or 3D model in the same way and collaborate across national borders. Market leaders such as ASML are currently looking for ways to make production drawings even more efficiently and to record product information in 3D. Component suppliers, system suppliers and the customer must understand and speak the same technical language.

Challenges in the Brainport region

One of the challenges for the Brainport region, says Jos van Grinsven (Figure 1), founder and trainer at Inventas, is to keep the leading position in technology. "One of the elements to achieve this is creativity, inevitably". New ideas, innovation and cooperation are important to keep our economy strong and competitive. Creative designs, good communication in the supply chain and the right commercial attitude are unavoidable.

"Let's zoom in on these three elements. Creativity, the knowledge and skills in mechanics and mechatronics give the designer the power to innovate. Good communication with specialists in electronics and software are essentials. The communication tool for the designer is the technical drawing. One condition for success is that all people involved in the supply chain understand what a drawing is about and what the symbols and designations in the model or drawing actually mean.

"The pitfall is that there is a proliferation of agreements here, as a result of which constructors, work planners, buyers and production people no longer understand what the designer actually means. As a result of this, it takes too much effort and time for a manufacturer to reach the market. For product designs to become successful, drawings have to be unambiguous and clear, so that all parties involved – from OEMs and suppliers to training institutes – are aligned and speak the same language. We can achieve this by working more efficiently, meaning a good mutual understanding for all of us."

Model-based definition

From the semicon, but also the automotive and other markets, there is a need to make a number of efficiency steps in the process from 3D design to production. For example, by



Jos van Grinsven, founder and trainer at Inventas: "For product designs to become successful, drawings have to be unambiguous and clear, so that all parties involved – from OEMs and suppliers to training institutes – are aligned and speak the same language." (Photos: Rik van den Wildenberg)

Inventas

Fourteen years ago, mechanical engineer Jos van Grinsven founded his own training institute, Inventas, in Nuenen (NL). He had always enjoyed passing on his knowledge and experience, which he wanted to further professionalise with Inventas. As a teacher of design principles, he mainly provided training at Fontys University of Applied Sciences during the first few years. He developed his own teaching materials, drawing heavily on the famous Dutch canon of (precision) mechanical design, with teachers such as Wim van der Hoek, Rien Koster and Herman Soemers.

Nowadays Inventas provides a wide range of mechanical engineering training for companies, large OEMs as well as SMEs. This is done based on in-house trainings and open registration, in Nuenen or, for example, at the Brainport Industries Campus in Eindhoven (NL). Van Grinsven works with a dozen freelance teachers who have earned their spurs in mechanical engineering practice and fully control their didactic skills.

Course participants cover all age groups, from school leavers who are immediately sent on a course by their new employer for brushing up on practical skills to senior engineers who want to improve communication with clients about their designs or learn the latest definitions for dimensions and tolerances. In cooperation with Bos Business Training, Inventas also offers orientation on leadership and management and training in consultative selling.

Design for manufacturing

The target students of Inventas include engineers at higher professional education (HBO) and university (WO) level, and nowadays also at intermediate technical (MBO) level, because due to the acute lack of technically trained employees, more and more knowledge and skills are also expected of an MBO-educated professional. Because MBO students learn in a different, more practical way, current learning materials are also made suitable for them in the training courses. Conversely, some HBO and WO students still have insufficient feeling for the feasibility and manufacturability of their designs, which is why there's paid a lot of attention to this in courses. Manufacturers must also have knowledge of manufacturing and assembly techniques.

NEN partner

As partner of NEN, Inventas trains engineers according to the latest international standards on Geometrical Dimensioning and Tolerancing. Since the standards are hard to use as training material, Inventas has translated all designations into easy to understand workbooks, with lots of practical exercises.

New developments

- Design Principles
Jos van Grinsven and Susan van den Berg (lecturer at Fontys) are developing a new method with a workbook and a HBO-level textbook, written by Van den Berg.
- Applied Materials
Work is being carried out with various metallurgists on a new course in applied materials science at HBO-/WO-level. Many different materials and alloys require knowledge from the mechanical designer. Therefore, dedicated training material and coaching is necessary and will be provided next year.

Course portfolio

- Design Principles
- Calculus for Designers
- Geometrical Dimensioning and Tolerancing (2D and 3D)
- Model-Based Definition
- Reading Technical Drawings
- Tolerance Analysis
- CE Marking
- Drive Technology
- Statics and Strength Theory and Practice
- Materials Science (refresher course)
- Applied Materials Science
- Finite Element Method
- Methodical Design
- Design for Manufacturing
- Dynamics and Control Engineering (in preparation)
- Orientation on Leadership and Management
- Consultative Advising for Engineers

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automating or simplifying the dimensioning and tolerancing of drawings, in any case: standardising. Mechanical design has evolved from the former 2D drawing to model-based definition (MBD). In a 3D model, the designer nowadays has to provide all information that is relevant to production; the product manufacturing information (PMI).

The challenge with the transition from 2D drawing to 3D model is that we are free to translate and rotate the model without the fixed views that we are used to on the 2D drawing. The result is that the agreements on dimensions, tolerances and other properties (such as straightness, flatness, parallelism and angular purity)

that were previously associated with the notation in 2D, have become view-dependent. This is the reason why supplementary agreements have been made for, for example, shape and directional tolerances, and in some cases the meaning of existing agreements has even been changed. Most of those agreements and symbols are laid down in NEN-EN-ISO1101 and related GPS standards (Geometrical Product Specifications).

Sustainable design

But there is more in a designer's life than just standards, Van Grinsven concludes with a personal note. "Creativity together with the application of proven design principles may bring us to a higher level. Designs comprising less material and having the same or even higher strength and/or stiffness are contributing to sustainability. All resulting in cheaper constructions, requiring less raw materials and commodities, thus contributing to the sustainability our country needs so badly."

High-tech lab room

The trigger for Van Grinsven to start his own training institute was the observation that after a standard course, what is learned often sinks away quickly. Inspired by the Karin de Galan Training School, every module of a course is therefore structured at Inventas, according to:

- theory: the teacher introduces the theory in a short time;
- feedback: the teacher examines whether the students have understood;
- exercises: the students autonomously make exercises to acquire the knowledge and skills they have learned – in particular the structure of these exercises, that's the pinch of didactics.

Van Grinsven: "It's all about interaction between the trainer and the student". With this method, Inventas is as close as possible to practice. Where necessary and possible, the participants are offered study materials and practicals during a course to try and experience things for themselves. Inventas maintains contacts with numerous companies, which a group of course participants can visit, for example, to become acquainted with the practice of certain production technologies. The high-tech industry is the 'lab room' for Inventas.

Creativity and learning

For Inventas, the 'educational space' is the classroom, not the 'cloud'. Van Grinsven believes that e-learning can work well for certain disciplines, but deliberately sticks to classroom transfer of knowledge and skills for his work area (Figure 2). This is because of the group dynamics, learning from each other and exchanging experiences by interaction.

The field of mechanical design does not only consist of calculation tasks, which can be assessed as 'correct' or 'incorrect'. Creativity is an important part of the work of a mechanical engineer and that is difficult to put in an e-learning module. Feedback on creativity can be given much better in a dynamic, classroom setting, according to Van Grinsven.



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