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## Case Study: Mass Customisation of individualized orthotics – the FASHION-ABLE Virtual Development and Production Framework

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### Abstract

Until now, mass-customisation of (wearable) products has been seen as higher added value which had (and will have) to compete with ready to wear offers. However, there are fields of application for which customer specific product design, including benefits as optimized fit, is not just an added value but a fundamental need. This is due to the fact that off-the shelf products do not meet the morphological or problem specific diversity needed to assure the functionality of the products. Thus, individualized products are in a lot of cases not just an additional feature but a prerequisite for successful curing. The FASHION-ABLE virtual development and production framework is set up on digital development data of the future products as well as workflow specific data and information objects that are processed in dedicated process steps. Thus first of all the relevant information and data objects will be highlighted and described and in a second step aligned with the underlying workflow. The basic information for individualized production of orthotics is composed out of a customer specific 3D scan that is used to extract the relevant measures and the configuration of the orthotic. To enable automated adaption of pattern to customer measures, 2D CAD models that are enhanced with MtM rules are coexisting with 3D simulation ready CAD data, also enhanced with the same MtM rules to enable virtual proof of fit. These CAD data are provided in a modular way to ensure a lean variant-capable setup. Bringing these CAD data together with the customer specific configuration and the 3D scan then enables to simulate a virtual prototype as well as to generate an optimized customer specific marker.

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### Nomenclature

ICT	Information and Communication Technology
CAD/E	Computer Aided Design/Engineering
PDM	Product Data Management
BOM/BOL	Bill Of Material/Bill Of Labour
MtM	Made to Measure

### 1. Current situation and challenge

Until now, mass- customisation of (wearable) products has been seen as higher added value in public perception which had (and will have) to compete with ready to wear offers. However, there are fields of application and groups of the population for which customer specific product design including benefits such as optimized fit are not just an added value but a fundamental need. This is due to the fact that off-

the shelf products do not meet the morphological or problem specific diversity challenge needed to assure the functionality of the products. This holds especially for health related and caring products, for example medical products, as well as high performance supplementing products, as they are used in high performance sports. Thus, individualised products are in a lot of cases not just an additional feature but a prerequisite for successful curing, or function.

This holds for example for people with postural defects, back pain or joint injuries that are dependent on orthotic goods. At present, available knowledge about variant-based product configuration as well as available knowledge about flexibility of production equipment, machinery and the underlying managing and supporting concepts cannot cope with the heterogeneous and individual needs of the customers in an economically sustainable way.

Challenges as country specific reimbursements, health insurance certification, heterogeneous and country specific distributed topologies of legislature, actors and deciders (doctors and orthopedic shops) for medical products accrue to further aggravating aspects [1].

BSN medical as one of the world's leading suppliers in the product segments casting, bandaging, traditional wound care and compression stockings daily faces these problems in product development, certification and introduction into new markets. Textile based medical garments are one of the largest share of products in the company business. Currently BSN medical operates in 28 countries, with a network where production is not managed in a centralized way but it is closed to the user market. Solutions are designed centrally but produced and customized in the country where they will be sold.

For what concerns the downstream network, being a provider of medical devices, the typical sales of a product involves not only the "end-consumer" and the seller, but also the doctor (or hospital) or any other medical expert, and furthermore the seller/ retailer has to provide dedicated and comprehensive technical know-how about how to configure and how to properly use the item. Furthermore also product (medical) certifications and reimbursement aspects, defined by national legislation and social insurance systems have to be considered.

Considering these facts, the business development for BSN is a complex question which periodically needs to be taken into consideration in order to define where to produce which customized wearable product for whom and how with which service taking all legislative, medical, environmental and social-insurance oriented constraints into account.

## 2. The FASHION-ABLE Project

FASHION-ABLE is a research project funded by the European commission. It aims at providing innovative European SMEs with technologies enabling co-design, development and sustainable manufacturing of personalised wearable products, for people with special needs.

The concepts and solutions developed in FASHION-ABLE are validated for footwear for diabetic feet, clothing for wheelchair users and textile compression orthotics.

The expected results are:

- IT solutions for people to customise wearable goods (co-design via internet) to be produced on-demand
- Development of new IT tools for SMEs to produce on-demand and for special-needs
- Exploitation and adaption of new processes and materials such as stretch-leathers, 3D-spacer fabrics, new textile finishing and flexible manufacturing processes and machinery

The combination of these technologies has the potential to impact directly on health, comfort, safety and quality of life of the addressed end-users, such as:

- diabetics developing diabetic feet, estimated 30 million [2]
- physically disabled people requiring a wheelchair, estimated 5 million [3]
- people affected by acute musculoskeletal disorders, estimated 40 million [4], [5]

The selected end-users, whose demand for customised fashionable health related, or medical products are currently not addressed by the market, represent a niche-market to be addressed by sophisticated and customised products. The cross-sectorial approach of project comprising ICT, biomechanics, manufacturing technology, the textile and the medical sector allows the transfer of the developed solutions and the extension to other products and new high-demanding markets of functionality customisation with little effort.

## 3. The FASHION-ABLE Virtual Development and Production Framework

As partner in the Fashionable project, BSN successfully implements new structured approaches for the pre-development of variant-based products, for the definition of multi-dimensional configuration spaces and virtually supported development, flexible functionalization of products and intelligent automated order processing allowing efficient lot size one production. This is done in close cooperation with DITF-MR (Centre for Management Research DITF Denckendorf) and the Human Solutions Group (Provider of body scanning systems, CAD, PDM and ERP systems).

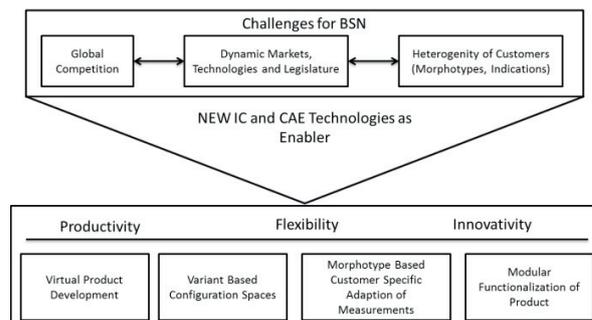


Figure 1: Challenges for BSN, adapted from [5], page 15

The challenges that are to be solved in this context are reflected against the Mass Customisation and Open Innovation Framework of Reichwald, Piller and Ihl [6] summarised in Fig. 1. Global Competition, dynamic markets

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