1 Summary

1.1 Project Context

The information gap between virtual product and manufacturing engineering and the physical start of production is a fundamental problem for European manufacturers. Knowledge about products and processes, which is currently distributed over heterogeneous systems, is rich of information, but a platform for presenting this knowledge according to the different user roles (e.g. manufacturing system engineer or operator) is missing. Enterprise data must be captured, updated, enriched and transferred into an interoperable platform, which enables cross-disciplinary knowledge sharing throughout the product life cycle.

Up to now, the complexity and incompatibility of digital data are the main reasons why planning and training of manual manufacturing processes, e.g. in automotive and aerospace, are still carried out in physical stages. This training method is expensive and often ineffective. In order to reduce the need for physical prototypes and to speed up time-to-market, virtual training must overcome the problems of former approaches, such as inadequate authoring times, cost-prohibitive hardware and insufficient user integration.

1.2 Project Objectives

The overall aim of the VISTRA project is to minimize the number of physical prototypes in manufacturing by developing a user-centred simulation and training platform on the basis of available product and process data. The knowledge and feedback captured by the simulation and training platform should be (re-)used in different phases of the product lifecycle.

The overall aim is divided into the following strategic objectives:

1. **Data Mining and Harmonization from Product and Manufacturing Enterprise Data**
Exploration of effective and efficient mechanisms for the integration of highly complex and partly very extensive product and engineering data from heterogeneous data sources (e.g. PLM, ERP, PPS) into downstream manufacturing processes. Relevant information (e.g. product models, process and workflow information) must be filtered out of huge amounts of data and harmonized for further usage. Respective methods and algorithms have to be identified and adapted.
2. **Acquisition and Representation of Cross-disciplinary Knowledge**
Development of a method for modelling and refinement of an interoperable knowledge representation for manual assembly tasks, using captured product and engineering data. The knowledge model can be used for various purposes (e.g. training). The manual effort in adaption and regeneration of engineering data should be kept to a minimum.
3. **Interactive Environments with High User Acceptance**
Design of intuitive and robust human-machine-interfaces that can be integrated into the domain of virtual training. The user must be able to interact with the virtual environment in real-time and receive an immediate and adequate feedback. Advanced multimedia technologies and game-based learning concepts will also be considered (compare Figure 1).
4. **Physical behaviour and Optimized Real-time Simulation of Deformables in Virtual Training**
The real-time simulation of flexible parts, e.g. cables, hoses and complex wiring harnesses, for interactive virtual training must be investigated and integrated into the virtual environment in order to create a realistic user experience and to reduce the need for physical assembly testing. The evaluation criteria for the treatment of realistic behaviour versus simulation speed have to be identified.
5. **Reuse of Knowledge and Cross-disciplinary Knowledge Sharing**
The potential cross-disciplinary usage of manufacturing knowledge e.g. workflow data, process specifications and training feedback, must be investigated and identified. Interfaces have to be developed to hand back knowledge to upstream engineering processes (e.g. product design, manufacturing planning) in order to support design and planning decisions.

6. Applicability in Real Industrial Environments

The integration of the before mentioned aspects into a complete and sound prototype system. The applicability of the system must be proved and validated in close collaboration between the end-user and the technology providers. The developed system must be easy to integrate into the pre-existing manufacturing infrastructure.

7. Interoperability and Standardization

The exploitation of the developed systems is a key concern of the project. A generic and interoperable solution suitable for all types of enterprises, which can be used in broad application areas, must be developed. This includes also international standardization on how to model assembly processes into an exchangeable and interoperable manner with explicit semantics in order to ease data re-use for other applications.

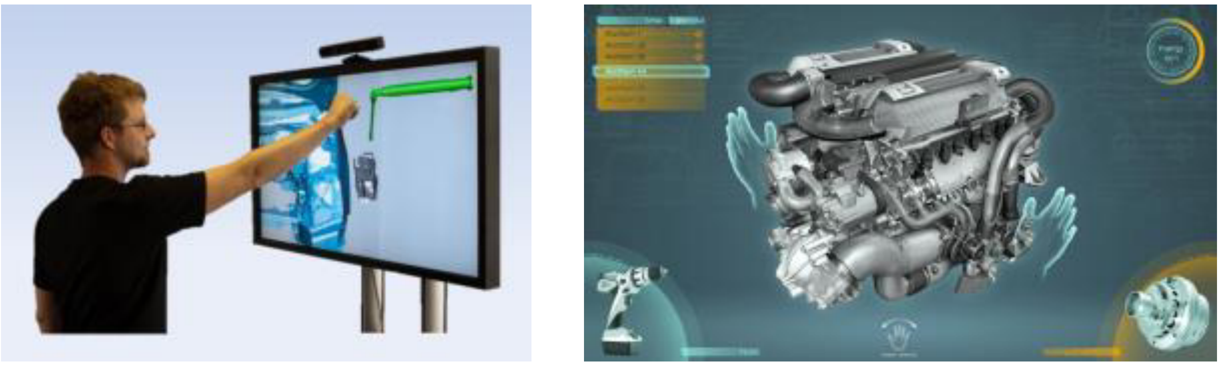

Figure 1: Interaction Concept for Virtual Assembly Training

1.3 Project Progress

The objectives of the second project period (Month 16 – Month 25; Dec 01, 2012 to Sep 30, 2013) can be summarized by the following six activities:

- **Implementation of the first, overall VISTRA prototype** consisting of the individual, system components:
  - VISTRA Knowledge Platform (VKP)
  - VISTRA Training Simulator (VTS)
  - VISTRA Knowledge Sharing Center (VKSC)
  - VISTRA Natural User Interface (NUI)
  - VISTRA Flexible Engine
- **Designing and conducting an extensive evaluation** for the first, overall VISTRA system
  - at OPEL
  - at VOLVO
  - at UNott
  - at SmartFactory
- **Update of the user requirements and system specifications** based on the evaluation results
- **Broadening the dissemination activities by presenting the project results**
  - at trade fairs and scientific events
- **Extending the collaboration with other relevant entities**
  - e.g. through IMS
- **Elaboration of a business plan and intensification of exploitation activities**

All objectives as well as the connected milestones **M7 "First VISTRA Prototype"** and **M8 "Evaluation of the First VISTRA Prototype"** have been achieved successfully. All deliverables of the second project period have been delivered as planned.

During the second project period the focus was set on the **integration, implementation and evaluation of the first VISTRA prototype**. The individual system components have been refined and successfully integrated in the overall VISTRA system. Subsequently, the overall VISTRA system has been deployed at the site of OPEL, VOLVO, UNott and SmartFactory and then has been evaluated in extensive studies by the end-users and the technical partners. The results of the evaluation are very promising and prove the feasibility of the VISTRA concept. With the deliverable D8.3 "Training Process Description", a report on the vocational training process was elaborated to ensure a smooth organizational and technical integration of the VISTRA solution into the manufacturing context.

Anticipating the second development phases, the **user requirements** (D2.8) and the **system specifications** (D2.10, D2.11, D2.12) have been updated based on the finding from the evaluation and the knowledge gained during the first development phase. The updated documentations represent a guideline for the development during the third – and final –project phase.

As the VISTRA prototype represents the first, fully integrated system, it builds the basis for an advanced **dissemination and exploitation** strategy, allowing a more concrete presentation of the project results. Highlights in the dissemination and exploitation activities were the participation of VISTRA at the CeBIT 2013 and at the Frankfurt International Motor Show (IAA) 2013, but also the organization of a session on human-centered production at the IFAC-HMS 2013 in Las Vegas. Further, premium dissemination events are planned for the third – and last – project period (compare D9.14). Taking into consideration, the uniqueness of the VISTRA solution, a huge commercial potential can be stated, which is analysed and described in detail in the VISTRA business plan as part of deliverable D9.15 "Exploitation Plan". The standardisation plan was updated and concrete actions towards the standardization of individual VISTRA components (e.g. ontologies for manufacturing purpose) have been taken (D9.11).

Simultaneously, collaboration activities have been performed on various levels: The **collaboration** with the VISTRA Technical Advisory Board, which consists of several industrial and academic experts, has been further intensified (D9.13). A detailed workplan of the VISTRA-IMS initiative has been elaborated (D8.6) and the first activities of VISTRA-IMS have been already started. Additionally, the VISTRA project is very active in the EC-research community and has contributed e.g. to the *Joint Dissemination Conference FoF-H2020*.

1.4 Project Impact

The VISTRA project is highly industry-driven, addressing specific needs of OEM manufacturers in Europe. The two industry partners, OPEL and VOLVO, are facing the same main issues when it gets to the simulation and training of future assembly processes for a new product. At the moment the training is realized using hardware components in the form of complex physical prototypes. This training method is ineffective due to low availability of the physical training equipment. Ineffective training causes too long and unpredictable ramp-up phases characterized by suboptimal equipment availability, poor quality rates and the need of internal rework. Furthermore, it decreases the effect of operator feedback on the product development as it is generally too late to consider the improving suggestions that come to the operator's mind during training.

VISTRA will enable manufacturers to use already existing product and process data to generate virtual simulation and training setups of manual assembly processes with less or no authoring effort at all. In this way, VISTRA will accelerate product design and manufacturing by enabling new and complex products to be ramped up significantly faster. The early training in an interactive and virtual environment will allow to gain valuable feedback and suggestions for improvements in full complex product design and manufacturing processes. The VISTRA solution will permit to make decisions in the early design phases, leading to faster availability of the assembly lines and better quality rates during the series production.

1.5 Project Consortium

The development of the VISTRA technology requires a unique mix of expertise in very different areas of research and development. The industry-driven project character is furthermore reflected by the well-balanced project consortium (compare Table 1). The integration of the work of the research institutions in a single platform is done by a SME, specialized in the development of games, simulations and virtual worlds. The final implementation of the platform takes place at several sites of two car manufacturers, where the VISTRA Virtual Training Simulator will strongly affect the future assembly and training processes.

Table 1: The Partners of the VISTRA consortium

Participant No.	Participant Organisation Name	Short Name	Country
1 (Coordinator)	DEUTSCHES FORSCHUNGSZENTRUM FUER KUENSTLICHE INTELLIGENZ GMBH	DFKI	Germany (DE)
2	Fraunhofer-GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V	Fraunhofer	Germany (DE)
3	STIFTELSEN Fraunhofer-CHALMERS CENTRUM FOR INDUSTRIMATEMATIK	FCC	Sweden (SE)
4	THE UNIVERSITY OF NOTTINGHAM	UNott	United Kingdom (UK)
5	Serious Games Interactive	SGI	Denmark (DK)
6	VOLVO TECHNOLOGY AB	VOLVO	Sweden (SE)
7	ADAM OPEL AG	OPEL	Germany (DE)

1.6 More Information

The VISTRA project has set up a public website http://www.vistra-project.eu, which provides a short overview of the projects, its status and current achievements.

More information can also be acquired by contacting the project coordinator and technical coordinator.

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