D2.2 Target Market Sector Descriptor Report

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This document points out the characteristics of ADVENTURE'S potential market sector to help maximize the projects exploitation potential. It gives insight into the user partners' market sectors and identifies potential risks and challenges that ADVENTURE might face, coupled with mitigation strategies.

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Table of Abbreviations

A	
ASCC	Advanced Supply Chain Collaboration
B	
B2B	Business to Business
C	
CAD	Computer Aided Design
CCP	Common Configuration Platform
CCRP	Customer Complaint Resolution Protocol
CNC	Computerised Numerical Control
CTP	Capable to Promise
D	
DA	Distribution Automation
Deliver IT	Delivery Information Technology
E	
EMS	Electronic Manufacturing Service
EDI	Electronic Data Interchange
ERP	Enterprise Resource Planning
G	
GUI	Graphical User Interface
I	
ICT	Information and Communication Technology
IED	Intelligent Electronic Device
IT	Information Technology
M	
MES	Manufacturing Execution System
O	
OLE	Object Linking and Embedding
OPC	OLE for Process Control
OTD	On Time Delivery
P	
PCBA	Printed Circuit Board Assembly
PLC	Programmable Logic Controller
S	
SOA	Service-Oriented Architecture
SCM	Supply Chain Management
SME	Small and Medium Sized Enterprise
SMS	Short Message Service

Executive Summary

The purpose of this deliverable is to describe the current market sector for ADVENTURE in order to maximize future exploitation opportunities. The manufacturing sector is the obvious target for the creation of virtual factories as the processes and communication channels in this sector have not changed over many years and the new technologies now available to enhance collaboration and interoperability are under exploited. Many of the findings within this sector are transferable to other domains where there are relationships between customers and suppliers.

The report begins at looking at the typical challenges faced by the manufacturing sector as a whole and sets the scene by highlighting generic issues that most businesses face in this tough business climate. It includes the current thinking within the manufacturing sector including risk analysis to understand the market sector.

The main basis of the target market descriptor is the user partners' descriptions of their operations within the manufacturing sector and getting a clear understanding of their current operations and ultimately the tools they require that ADVENTURE should provide. These tools and methodologies should enhance their operations to deliver increased profitability, reduced costs by creating greater transparency between themselves, their customers and their suppliers. The report seeks to identify potential challenges faced by these case companies and analyse areas that ADVENTURE can be applied to address specific concerns within the sector. This information should shape the expectations of the ADVENTURE project and should allow for the creation and development of tools and methodologies that not only address the current sector, but should make it easier to deploy ADVENTURE in other potential market sectors.

The report concludes by understanding the business orientation that ADVENTURE needs to take to give the best results not only in the manufacturing sector but ways to widen the scope of application of the projects tools, methodologies and services.

1 Background

ADVENTURE – ADaptive Virtual ENTerprise manufacTURing Environment – is a project funded in the Seventh Framework Programme by the European Commission. ADVENTURE creates a framework that enhances the collaboration between suppliers, manufacturers and customers for industrial products and services. Section 1 sets the scene for the report defining aims and objectives

1.1 Overall Document Structure

This deliverable is broken down into the following sections:

- Section 2 – Sets the scene describing the current market analysis carried out and the challenges faced by the manufacturing sector. It also introduces the terminology commonly used in this sector and how users might benefit from the project
- Section 3 – Highlights case studies provided by the user partners of their business environment providing a background and the operational understanding of their case companies. This establishes the impact areas and market needs of the various organisations for ADVENTURE. Much of this is performed by analyzing the challenges faced by the user partners and by looking at the current portfolio of products and services including risks and the limitations for the application of ADVENTURE by these businesses
- Section 4 – Goes deeper into the analysis of the market sector to develop the strategy for ADVENTURE, looking at the influencing factors such as finance, challenges faced by businesses in the EU. This takes account of current and future thinking as to where future manufacturing is going and positioning ADVENTURE accordingly
- Section 5 – Concludes the document by offering a way forward through a prototyping approach and the development of the tools that will be needed

This section gives a short introduction of the aims of ADVENTURE (Section 1.2); subsequently the purpose, scope and context as well as the audience of this deliverable will be explained in Sections 1.3 and 1.4. This Section concludes with a description of the structure of this deliverable in Section 1.5.

1.2 Adventure Project Aims

The framework proposed by ADVENTURE provides mechanisms and tools that facilitate the creation and operation of manufacturing processes in a modular way. ADVENTURE combines the power of individual factories to achieve complex manufacturing processes, providing tools for partner-finding, process creation, process optimization, information exchange, real-time monitoring with the tracking of goods and linking them to Cloud services.

There have already been several research projects that address the combination of different independent manufacturers to so-called virtual factories. However, most of these research projects focus primarily on the business-side in general and on aspects like partner-finding and factory-building processes in special. There exist however no proven tools or technologies in the market that provide the creation of virtual factories

applying end-to-end integrated Information and Communication Technology. This is where ADVENTURE is looking to provide such tools and processes that will help to facilitate information exchange between factories and move beyond the boundaries of the individual enterprises involved. The collaborative manufacturing process will be optimised by enabling the integration of factory selection, forecasting, monitoring and collaboration during runtime.

ADVENTURE builds on concepts and methods of Service-oriented Computing and benefits from the advancements in this field. The monitoring and governance of the collaborative processes will be supported by technologies from the Internet of Things such as wireless sensors. Existing tools and services that can be integrated will be considered during the development of the platform for ADVENTURE.

The increased degree of flexibility provided through ADVENTURE will benefit SMEs especially as it helps them to react quickly to changes and to participate in larger, cross-organizational manufacturing processes. Furthermore, ADVENTURE will help manufacturers in assessing the environmental friendliness of actual manufacturing processes and resulting products and services. Other objectives of ADVENTURE include research in areas such as service-based manufacturing processes, adaptive process management and process compliance or end-to-end-integration of ICT solutions.

1.3 Deliverable Purpose, Scope and Context

This deliverable describes the current market sector for ADVENTURE to address as perceived by the involved user partners. This document explores the market background, challenges and needs as seen by ABB, Azevedos and Control 2K (a member of TANet) in order to verify and shape the project in its marketplace and to ensure exploitation opportunities are understood and maximised.

1.4 Document Audience

This deliverable is to be used by all participating project members. It highlights the needs and characteristics of the target market as seen from the user perspective. It will be the foundation for the subsequent requirements analysis shaped by the user partners. This document will shape the technical requirements and architecture of the project as an essential step towards building the general requirements of ADVENTURE.

1.5 Definition of the Term Target Audience

Within ADVENTURE the term “target audience” applies to the user partners from the manufacturing industry, their customers and suppliers. Based on the cases of ABB, Azevedos and Control 2K, this document will describe the respective market sectors. This target audience is intended to use ADVENTURE for efficient data exchange, production monitoring, as well as simplified setup of new business relationships. The use of smart objects will enhance the supplier / customer connectivity elements.

As every business itself may act as supplier (i.e. to other companies) suppliers can be further differentiated:

- Manufacturers of parts, goods and services that contribute to manufactured products. These Suppliers will participate as partners in virtual factory processes.
- Service Providers who deliver services that contribute to the handling (i.e. planning, execution, monitoring) of the manufacturing process. These suppliers

will contribute plugins (software) to ADVENTURE to facilitate interaction between virtual factory partners.

According to this definition, ABB and Azevedos, which manufacture parts and act both as customers and suppliers belong to the first group, whereas Control 2K focuses on the service supplier model.

From the above discussion it becomes clear that:

- The two target audience differentiations are not segregated as companies typically operate in a network of partners, and have multiple roles in this network
- The purpose of ADVENTURE is to also integrate service providers which provide specialised software that help companies in the handling of manufacturing processes

When looking at the customer side, a clear definition of the target audience enables manufacturing companies to determine where and how the market should be extended for possible growth.

2 Current Market Analysis

2.1 EU manufacturing Context and Challenges

It is estimated that for the EU, 75% of GDP and 70% of employment is related to manufacturing (Zobel and Filos, 2006; Nicolescu et al., 2012). One out of four jobs in the private sector in the European Union is in the manufacturing industry, and at least another one out of four is in associated services that depend on industry as a supplier or as a client. There are about 2.5 million manufacturing SMEs in Europe that represent 99% of European manufacturing businesses. At the same time 80% of all private sector research and development efforts are undertaken in industry (Bititci et al., 2012). It is a driver of innovation and a provider of solutions to the challenges our societies are confronted with. The future of manufacturing is part of the European economic growth and sustainability and EU competitiveness is strongly influenced by the performance of its manufacturing SMEs and large companies. The long-term shift from a cost-based competitive advantage to one based on high added value requires that European manufacturing increases its technological base and develops a number of new enabling production technologies with cross-sectoral benefits [Foresight 2020, (2006)]. There is also an increasing demand for greener, more customised and higher quality products.

During recent years the world economy has changed rapidly and unpredictably. This change, fuelled with the increasing globalisation of markets and emergence of developing economies on the one hand, and climate change, energy, food and health issues on the other hand, is challenging the businesses all around the world. A survey conducted by the Economist Intelligence Unit for European Voice [Foresight 2020 (2006)] shows that aside from the financial crisis, the three biggest challenges facing European manufacturers are, in order of significance, competition from developing economies, climate change regulation is also a concern, In addition to the global challenges, the specific challenges facing a typical EU manufacturing SME include:

- Large customers moving their emphasis and factories to the emerging markets of the East;
- Competitors from countries with extremely low costs of employment
- Changing demographics of European customers and staff

- The internet making customers better informed and more aware of competitor's offering
- Bureaucracy as a barrier to growth
- Problems in finding skilled employees and managers
- Rapid technological change

Further, 66% of firms will move some of their production facilities outside the EU's borders over the next two to three years. However, only 9% will move because of more onerous regulation. The most common reason for moving production abroad is to get closer to key markets (58%), followed by "access to labour" (41%) and then "tax advantages" (27%) (GET, 2011).

The concussion is that if EU small manufacturers are to remain competitive, they must continue to invest heavily in R&D. While production of basic goods will continue to shift eastwards, EU manufacturers have to focus on innovative, high-end products, such as complex composites (Brinkley, 2009).

In this context the current challenges in manufacturing engineering are mostly in the integration of the product/process/factory worlds (data and tools) and the synchronization of their lifecycles. Major ICT players already offer all-comprehensive Product Lifecycle Management (PLM) suites supporting most of the processes (DEAM, 2012). However, they do not offer all the required functionalities and they lack interoperability.

In his paper "Adaptive Capability A must for manufacturing SMEs of the Future", Bititci et al (2012) explained: "It is widely recognised that manufacturing SMEs need to be able to quickly and effectively reconfigure their production and other resources to keep up with the increasing pace of change. In fact, they need to do more than just change – they need to be able to shape the future, so innovation becomes very important.

2.2 Modern Manufacturing Baseline

The state-of-the-art in manufacturing is based on few core concepts that provide the foundations of the modern manufacturing practices we see today and that should be also considered in the context of ADVENTURE requirements. These concepts are:

- **System Thinking and Process Excellence** – a holistic view of the manufacturing enterprise is taken and everything is seen as a system of interconnected processes. The optimization of these processes is performed by eliminating waste and variation in the process. The approach ensures reliability and repeatability of the processes that consistently meet expectations.
- **Customer Focus and Orientation –** based on quality management the long term sustainable performance could only be achieved by consistently meeting and indeed exceeding customers' expectations.
- **Supply Chain Integration** – coming from the thought that "no man is an island", no manufacturing organisation can operate effectively without having a "good" upstream and downstream supply chain. Being consistent with systems thinking, here the processes are extended beyond the boundaries of the single organisations and in to the suppliers and customers.
- **Agility** – in response to increasing levels of complexity and uncertainty in environment in which organisations operate, it is widely recognised that manufacturing organisations need to be able to quickly and with minimum pain

reconfigure their production and other resources to keep up with the increasing pace of change and to be able to deal with unexpected demands and events.

- **Innovation** – based on the understanding that with increasing market and customer sophistication organisations can significantly influence their revenues and margins, whilst meeting and exceeding customer expectations through provision of new innovative products, services, processes and indeed business models.
- **Process Automation** – covering manufacturing, information and communication processes, this is seen as an essential element of any modern manufacturing system ensuring that materials, resources and information keeps on flowing through the processes of the organisation and the supply chain. There is also emphasis on everyone across the organisation and the supply chain using the same information whilst ensuring that repetitive activities are automated enabling people to be used at higher levels as problem solving knowledge workers.

Individual enterprise systems of the future are likely to be leaner, more adaptive, flexible, innovative, and open. They need to enable value innovation at the business level. They also need to deliver value beyond economic value and drive innovation that meets a set of business objectives and sustainability concerns much broader than those of today, including societal and environmental objectives.

2.3 Market Vision

As already stated, a certain degree of productivity and cost efficiency is required in order to sustain in highly competitive, global markets. Compared to SMEs, large companies rather can achieve such a degree as they typically address the whole supply chain of a product and thereby can profit from synergy effects, e.g., realised by merging cross-sectional departments. In addition, they have tools and methods to monitor and control complete manufacturing processes. They have the possibilities to define and model the manufacturing processes and to describe the capabilities required to realize certain parts of a process. In case of changing market circumstances or business requirements, large players rather than SMEs have the possibilities to adapt products and respective business processes to new, upcoming and changed market needs.

In addition, large companies can monitor and adapt business processes according to recognised manufacturing obstacles or delivery issues. As they have tools and methods to control the whole manufacturing process, they can timely react on manufacturing failures and obstacles minimizing risks and satisfying delivery constraints.

In some cases, large companies even have the market power to specify and predefine guidelines and standards which have to be applied and adhered to by their suppliers. SMEs acting as subcontractors and component suppliers, respectively, have to be compliant to these standards. They require to exactly fulfilling the requirements issued by the large player. They have to adapt their processes according to the large player's needs and to (probably) changing requirements as issued by the large player.

A direct interaction between SMEs on the other hand is rather difficult as each SME probably has its own standards, data formats and descriptions, processes, habits, manufacturing focuses, strengths and weaknesses which probably do not match each other, core competencies etc. E.g. regarding Azevedos, documentation and data are spread in different physical locations, in different formats (paper and/or electronic) and also from different software frameworks (CAD, Microsoft Office, ERP, MES), so that it is

impossible for Azevedos to access these documentation and data records in an appropriate way.

In addition, in contrast to large companies, monitoring and control structures covering the whole supply chain are actually missing – current business scenarios of ABB for instance do not cover status updates from corresponding partners– which impedes appropriate reactions and adaptations of SMEs to manufacturing obstacles or changing market requirements. In fact, there has to be an "instance" which controls the interaction of SMEs leveraging their collaboration.

2.4 Overall Goals for the Business Environment

Today's globalised business environment puts extra challenges on European SMEs by forcing them to be competitive against low-cost countries. This changing business scenario exerts substantial pressure on the European SMEs and motivates them to be collaborative in terms of sharing costly resources and expertise. This collaboration can be of different formats such as a business cluster, industrial districts, consortiums and so on. In virtual collaborations, the collaborative companies are connected to each other through ICT-based communication infrastructure, whereas, in real life collaboration, partners are physically integrated with others for mutual benefits.

In the ADVENTURE project, the goal is to collaborate virtually among partner organisations, while the integration takes place through the internet. In this collaborative environment, partners are mainly connected with each other by virtually integrating their various business processes. The necessary management of these processes is performed through forecasting, simulation, execution and monitoring. Synchronization of such processes can ensure real-time process adaptation, which also support collaborative partners to excel in the expected business environment. This environment provides the crucial business needs like a faster time-to-market and the developing of innovative and cost effective high-end products.

2.5 Future Internet Research and Development Opportunities

As stated by the European Commission, the exit from the current economic crisis should be the point of entry into a new sustainable social market economy which is moreover a smarter, green economy. In its Research Roadmap FINES (Future Internet Enterprise Systems) cluster points out that the Future Internet is expected to give rise to new opportunities of creativity and innovation, to enable new forms of participation and collaboration, to catalyse further the formation of networked enterprises and business ecosystems that span from the local to the global, thereby ushering in a new generation of enterprise systems. The convergence between Enterprise Interoperability and Enterprise Collaboration is now taking place in the context of service developments within the momentum of the Future Internet movement; specifically, these services are one piece in a much broader and wider global picture and future markets will not sustain these services as isolated offerings. Now modern Enterprises successfully embrace the advanced capabilities of the Internet and reshape their working models towards automating and distributing business processes and streamlining workflows. Virtualization is a key modernization factor.

In the context of Future Internet the vision of ADVENTURE is towards:

- Fostering the growth of virtual factories on the web (like the social web evolved) in highly competitive manner which is especially flourishing environment for small

organisations. Thus they can compete with large organisations and Eastern markets by participating transparently in collaborations and mashups that together provide competitive solutions.

- End-users having transparent and intelligent access to a large variety of competing offerings wrapped as services and directly influencing and shaping the services market driven by the freedom of choice and the active role they will have in defining services context, feasibility, reliability etc., beyond device-constraints and service provider definitions.

From a more specific view the ADVENTURE research will target at:

- New business models, supported by technologies (cloud and service) that allow for dynamic ad-hock virtualization of factories and full automation of distributed communications-enabled business processes.
- Service based, smart applications that are industry-specific and provide line-of-business features. The focus shifts from strictly defined services and data integrations to goal-oriented, dynamically self-tuning ones, providing enough reliability to the consumers (both machines and humans) to safely abstract from core technologies and focus on business goals.
- Finding a non-intrusive way to describe digital assets and evolve the knowledge about them. A number of digital assets will be encompassed - some providing services, some qualified as content. Semantic technologies (more precisely lightweight semantics and micro-formats) have great deal into the seamless convergence between these. That is, the easy, semi-automated provisioning of knowledge about assets is crucial to introducing semantics in the web.
- Creation of new, sometimes unpredictable convergence opportunities between digital assets (content, services, things), to bring instant value to end-users in an open and transparent manner. This includes also on-the-fly convergence of content and services, adaptive tuning of changed environment and non-intrusive inclusion process of new digital assets without compromising the quality of their presence on the web.
- Automated personalization, context-awareness, complex event processing and digital assistance brought to an unprecedented level and made available to the average user, in order to cope with the immense data flows expected, coming from various sources (sensors, ERP systems and events). Harness the value of these immense data flows while investing little to no time to process them and to extract only the valuable knowledge.

Considering the market environment characteristics and the research directions, it can be summarised that modern factories have to be modular, scalable, flexible, open, agile and knowledge-based in order to quickly adapt to the continuously changing market demands, technology options and regulations.

Modern Manufacturing principles and Future Internet technologies convergence will provide compelling business value in terms of integrating the single factory into the value chain globally, driving greater manufacturing productivity, reducing time-to-market and business risk, enabling innovation and creating sustainability.

2.6 Possible Limitations of the ADVENTURE Approach

The uptake of ADVENTURE by big companies may be hindered by:

- In companies where full-fledged all-round-solutions are in place, ADVENTURE might be an overhead and the integration into existing workflows would be too time-consuming.
- Larger companies usually have proven structures, processes and systems in place, and the added value of ADVENTURE might not be perceived.
- ADVENTURE might be seen as risk in terms of data security

The uptake of ADVENTURE by SME's may be hindered by:

- The initial time investment to set up the companies data, describe its services and the integration in the company's workflow might be too time-consuming. Additionally, persons with technical understanding might be needed, and those cannot always be taken for granted in a very small company.
- Keeping the companies data up to date might be a problem because there could be very flexible workflows and processes in place that would have to be remodelled very often.
- If a server needs to be run in the company for the ADVENTURE system (for example if the company wants to use the more integrated functions of ADVENTURE as an Active Member of the system), the hardware or the necessary knowledge involved might be too expensive for a small company

ADVENTURE tries to tackle these problems by creating a system that, is partly hosted in the cloud and can be easily tested to see if it is applicable for the company. This will make it easier for companies to test the systems without integrating them before the possible impact can be evaluated and bigger commitments in terms of time need to be invested. The problem of the security related concerns will be tackled by providing a secure solution, a methodology to implement ADVENTURE in a secure way and by describing the concepts and methods used.

A further limitation on the market is the need of a critical mass of ADVENTURE members in each market sector to give value if ADVENTURE is used to find new partners and to make the adaptive process execution feasible. Again, the cloud-based software will pose a low barrier of entry for companies to take part in ADVENTURE. Even if they only take part as a passive partner, this will help the project results to reach a critical mass of member companies. Additionally, the ADVENTURE project contains a Work Package that markets its value to interested companies.

Another limitation is to be seen in the complexity of companies' products and services. In the stage of partner finding, a broker can specify a certain product or service that he needs for the smart process to work. The better a product or service and be described, the easier is the participation in ADVENTURE. If a product could not be described easily or strongly differs from standards, a broker will need more time and manual effort to find a partner which can provide the needed component, because they might be described differently. Of course it will be possible to contact a supplier and ask for the limitations of a service or the variations of products, but the overall partner matching that is provided by ADVENTURE will be an important part of the acceptance in the market.

2.7 Risk Analysis for the ADVENTURE Approach

The related risks in terms of technical and business perspectives for ADVENTURE approach are summarized in the Table 1. The associated risks are also prioritised according to high (3), medium (2) and low (1) levels.

Table 1 - Various risks related to ADVENTURE approach

Risk	Consequence	Solution	Risk 1=Low
Technical			
SME doesn't have the technical knowledge to implement ADVENTURE tools	SME won't be able to provide connections with production processes and ERP systems.	ADVENTURE should provide a solution where it is still possible for a company to participate in a virtual factory without having connections to internal production systems. ADVENTURE should provide a solution where manually updating of production statuses is possible with minimal effort.	2
ADVENTURE doesn't deliver the performance needed	ADVENTURE will not be accepted by the SMEs.	ADVENTURE should be architected as a scalable solution and should support both simple as complex environments.	1
ADVENTURE doesn't have the correct plug-in to interact with specific ERP system and/or production processes.	Process information and updates from ERP systems cannot be integrated.	ADVENTURE should provide an open framework so new components can be developed with minimal effort to connect to specific ERP or legacy systems.	1
Business			
The price for ADVENTURE tools/ framework is too high	Companies will not want to invest in buying the ADVENTURE tools/ framework.	In the projects dissemination and exploitation efforts, research will need to be conducted to determine a competitive market price for the ADVENTURE framework and tools.	2
Company doesn't want to share internal planning with partners	It will not be possible to integrate detailed processes with a virtual factory.	Company will have to be convinced to share at least a simplified production schedule or business process.	3
Company doesn't want to share company, product and production schedule details with non-existing partners.	It will not be possible to participate in virtual factory where partners are dynamically selected based on product criteria.	ADVENTURE should provide a mechanism to set the visibility of sensitive information so that only approved partners can see and use this information in a virtual factory. This means, however, that virtual factories can only be conducted by existing business partners.	2
Company only wants to do business with partners they have an existing business agreement with.	It will not be possible to participate in virtual factory where partners are dynamically selected based on product criteria.	Virtual factories can only be executed by partners that have an existing business agreement.	1
Partners of an ADVENTURE	It will not be possible to implement a virtual	Companies should be persuaded and convinced to join ADVENTURE by	3

member are not willing to join ADVENTURE and participate in a virtual factory	factory.	explaining the benefits of the framework. Strong marketing material will be required for this.	
Specific market sector is not suited for ADVENTURE approach	ADVENTURE will not have a big impact on the market sector.	A solid business plan will have to specify which market sectors have most impact from the ADVENTURE approach. The exploitation of the ADVENTURE framework will have to focus on these market sectors.	1
ADVENTURE will not reach a critical mass	Not enough virtual factories will be conducted and ADVENTURE will eventually seize to exist.	Good marketing and a convincing framework will be required to reach a critical mass. Also ADVENTURE should initially focus on specific market sectors instead of focusing on all. After a critical mass is reached in these sectors, ADVENTURE can be deployed to more market sectors.	3

3 Case Studies

In this chapter, the three ADVENTURE User partners (ABB Oy Distribution Automation, Azevedos Industria SA and Control 2K) are the case companies focused in the manufacturing sector that will be targeted for the development and implementation of the ADVENTURE software. The details for each company are covered in the following order:

- The first section for each case company provides details about their present situation and describes the scope of the current activities in terms of the nature of their business, their relationship to customers and suppliers. Also considered is the parts, goods or services they provide and how they carry out the planning, execution, monitoring of their manufacturing processes in the case of ABB and Azevedos. From a service provider viewpoint, the delivery of hardware, software solutions and services in the case of Control 2K.
- The next section highlights the market needs for the companies or all case companies' connections and dependencies to partners (i.e. the target audience) are defined.
- Particular area of interest for each case company (i.e. market needs and challenges).

User partners already have working manufacturing processes including full software support through legacy systems. As the case companies are quite diverse, we have to describe exactly which parts and aspects of the manufacturing process or business portfolio they expect ADVENTURE to cover.

3.1 Case Company: ABB Oy Distribution Automation

3.1.1 Present situation

In Medium Voltage Networks, distribution automation solutions improve personnel safety, power network reliability and protection performance of utility substations, marine and industrial power systems. ABB's Distribution Automation (DA) business serves these needs through protection and control IEDs (Intelligent Electronic Devices), software tools and communication devices. Figure 1 describes the function of an IED.

Protection & Safety
Protection and control IED / Relay

- IED recognizes abnormal power system conditions, or abnormally operating system component
  - Based on the information gathered, IED will initiate corrective actions that are supporting the power system to return its normal operating state
  - In the event of a fault IED delivers an open command to a circuit breaker which in turn disconnects the faulted object from the system, thus minimizing the effects of the fault

Figure 1 – Example of a DA product and its function

As a technology leader, ABB has a comprehensive portfolio of solutions for securing power distribution that is spread over different product families, varying in age and technology (Figure 2). The solutions mainly consist of Feeder protection, Motor protection, Transformer protection, Line differential protection for feeders, Arc protection, Feeder automation for recloser protection and control, Generator protection, Voltage protection and automatic voltage regulation and Capacitor bank protection.

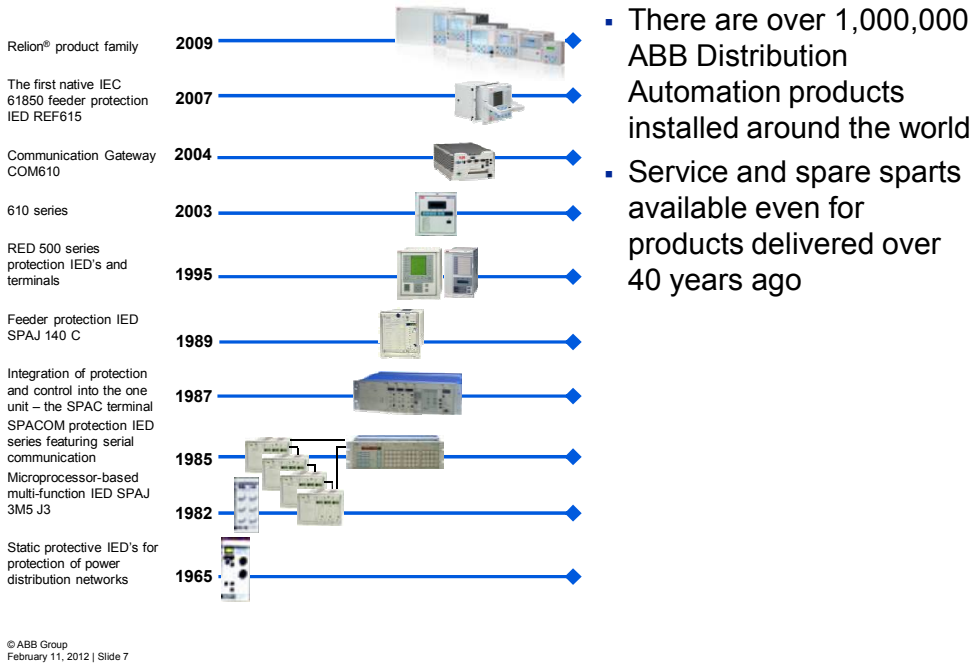

Figure 2 – DA product families

The IEDs are essentially made up of electronic hardware in the form of Printed Circuit Board Assemblies (PCBA's), mechanics and software. These IEDs are applied in Medium Voltage (MV) switchgear or Control and Relay (C&R) panels manufactured by Original Equipment Manufacturers (OEM's) including ABB. The MV switchgear or C&R panels are employed in Power Transmission or Distribution Sub-stations by turnkey project contractors including ABB. Such Sub-stations are an important part of the electrical power infrastructure of Industries or Utilities. Thus, the DA products are a critical element of the value chain (Figure 3) that delivers reliable and smart power systems for the distribution of electricity.

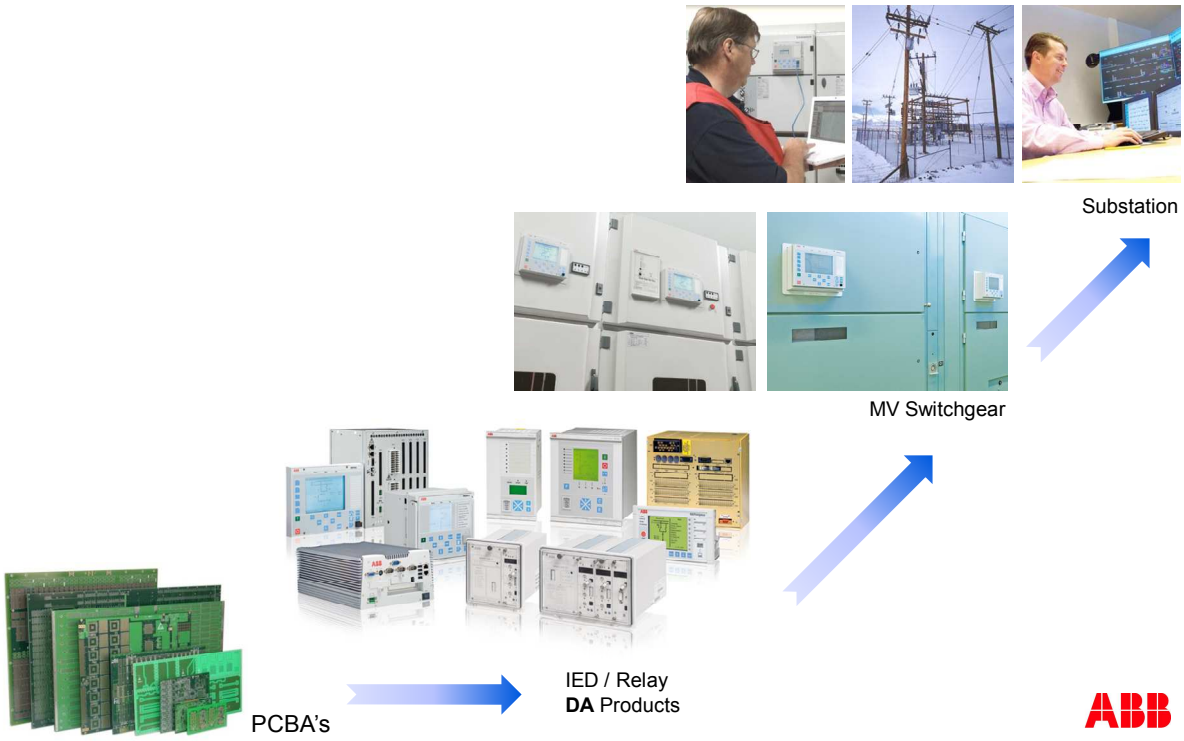

Figure 3 - Value chain of DA products

The principle factory for ABB's Distribution Automation business is located at Vaasa, Finland and is commonly referred to as FI-DA. This factory has global responsibility for development, marketing, sales and production of DA solutions as well as has the responsibility of global operations, supply chain management, customer support and training. The FI-DA factory employs ~240 personnel and has reported ~90 MEuros in revenue for year 2011. Other DA factories are located in India, USA and China, and these factories serve the respective local markets (Figure 4).

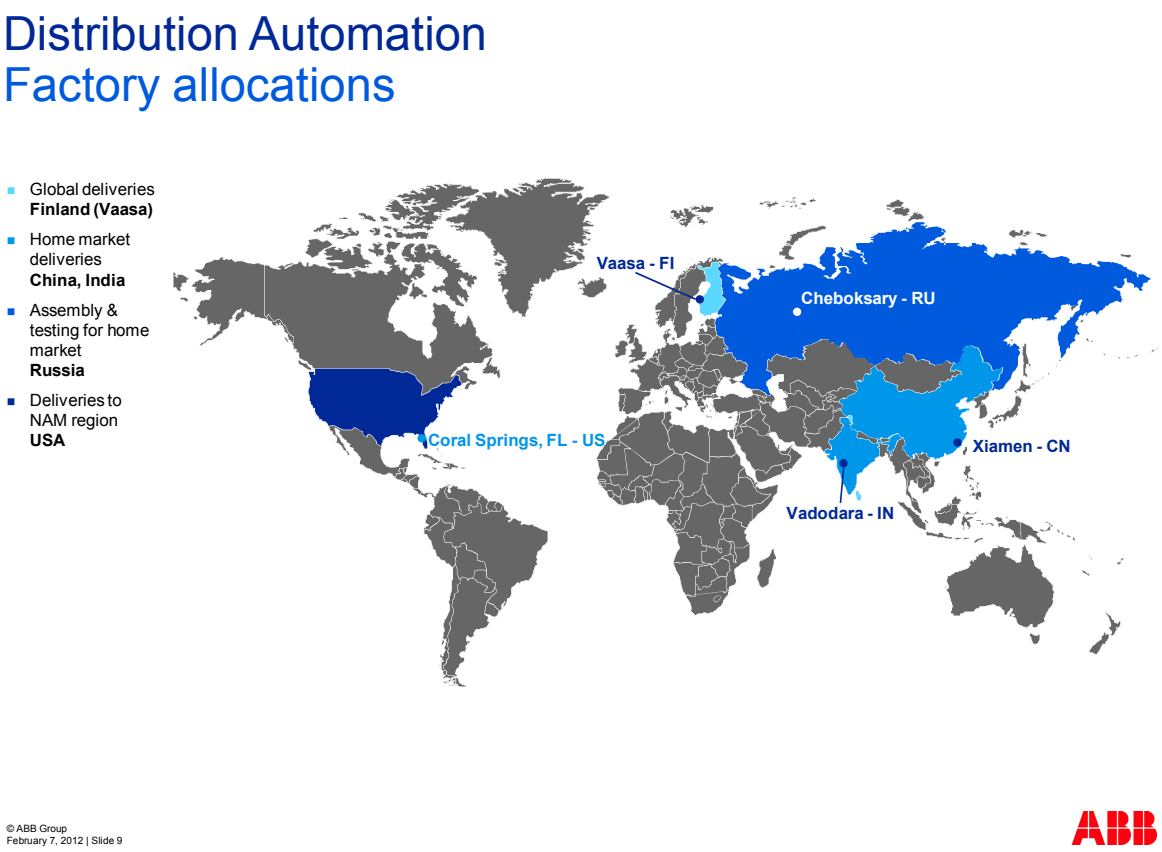

Figure 4 - DA's global presence

The FI-DA factory delivers 1400 IEDs per week that are ordered by customers from amongst thousands of different end product variants. The production process constitutes of final assembly and testing. The devices are calibrated and tested with sophisticated computer-controlled test equipment. The factory has dedicated production lines for each product family or even for different product series in a family, depending on the production volumes (Figure 5).

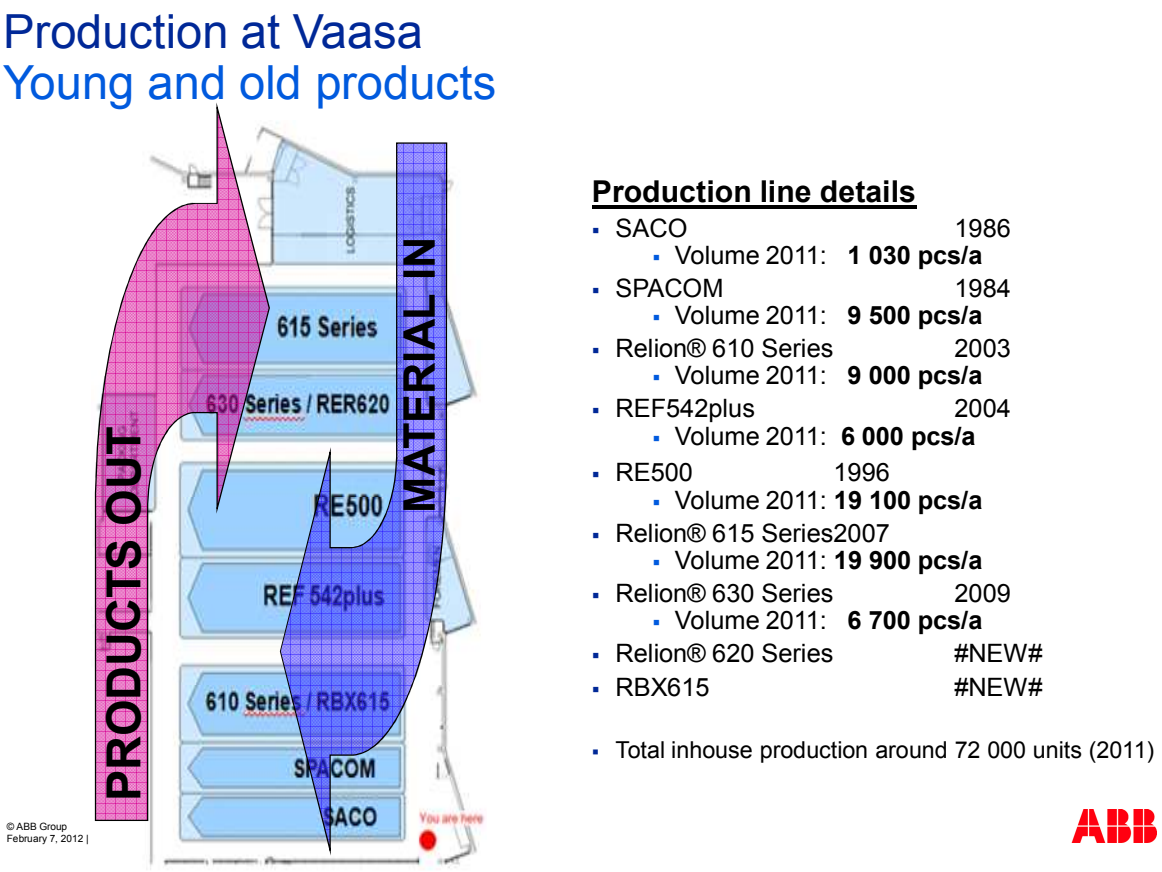

Figure 5 – FI-DA's production lines and volumes for year 2011

The FI-DA factory follows a Make-to-Order (MTO) manufacturing process, where the manufacturing starts after an order is booked. The factory usually promises a delivery time of 2 weeks with express delivery in 2-5 days and has an On-Time-Delivery (OTD) performance of ~91% (2011). FI-DA factory employs 40 multi-skilled blue collar workers and normally runs in two shifts. In the case of an overload, a third shift or week-ends are also used.

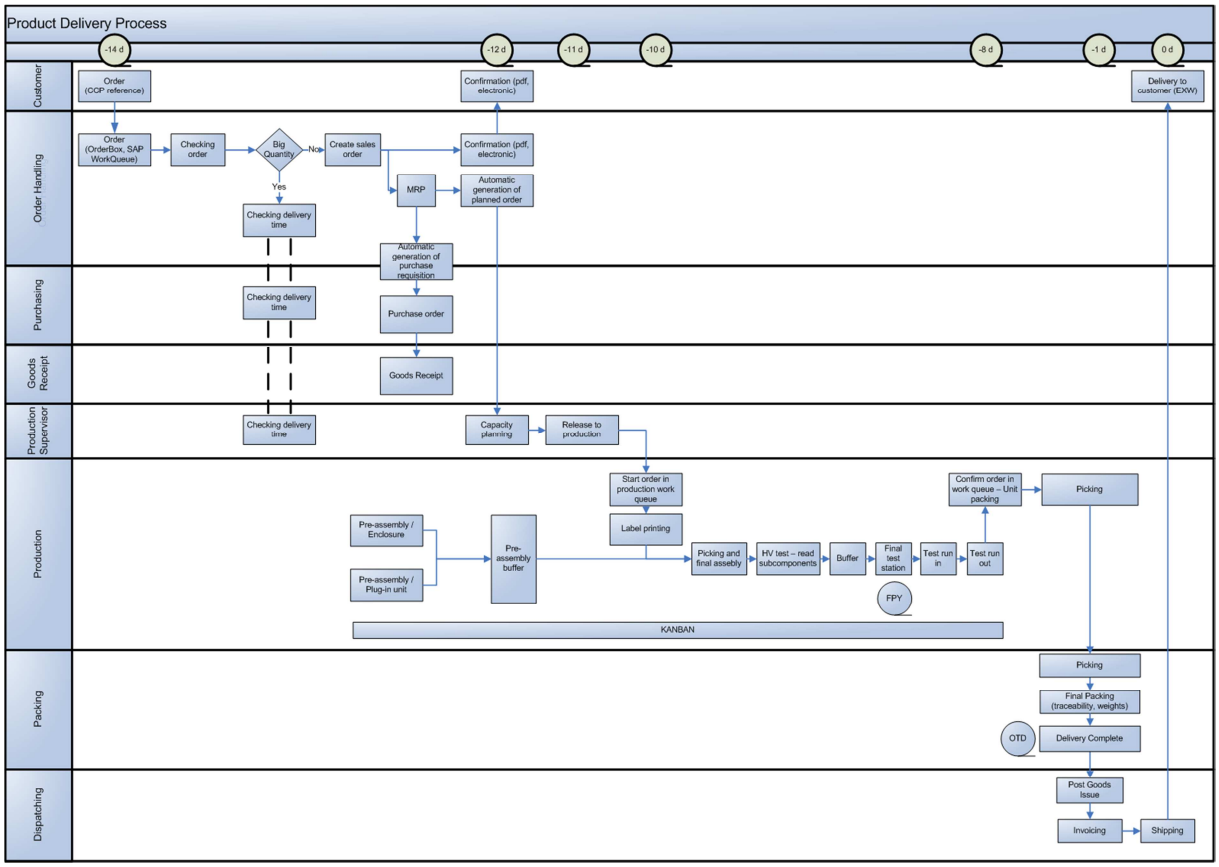

Figure 6 - Product delivery process at FI-DA

A major part of the manufacturing process i.e., manufacturing of PCBA's is outsourced to global Electronic Manufacturing Service (EMS) suppliers. Large mechanics and other electromagnetic parts are outsourced to global suppliers (Figure 6). All DA factories share the same global suppliers. Local suppliers provide non-critical or low value parts like fasteners or packing materials. Most of the suppliers for DA factories follow a Make-to-Stock (MTS) manufacturing process and maintain a buffer of products ready to be shipped on order in one day (Figure 7). The suppliers maintain a buffer of materials required for producing the products required by DA factories. FI-DA consolidates the rolling twelve month forecast from all DA factories and provides it to the global suppliers, on a quarterly basis.

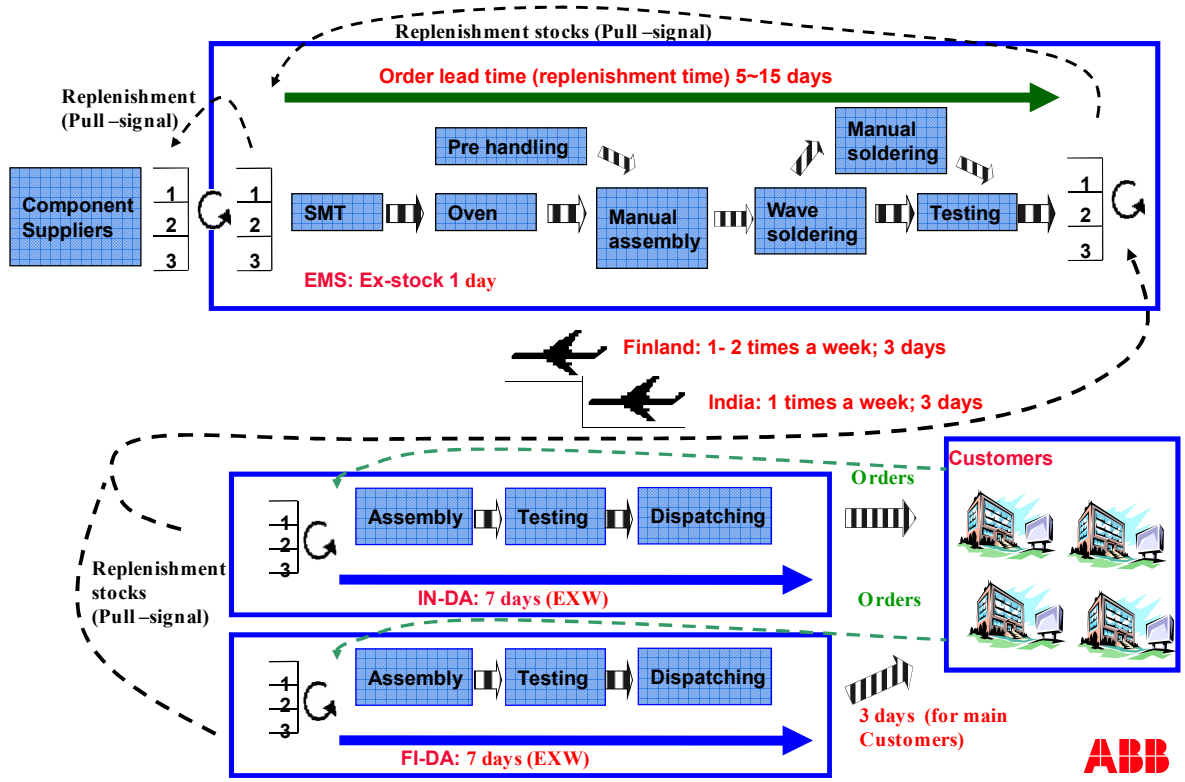

Figure 7 – DA's supply chain

The core of ABB's IT/IS infrastructure is its SAP ERP system, which manages various business processes including the Order-to-Delivery process. Globally connected Test Systems, that are spread over all factories and EMS suppliers are another important element of the IT/IS infrastructure of DA factories. Various EDI tools like ASCC, B2B links, DeliverIT, CCP, CCRP, SharePoint etc, are deployed for handling business relations with customers and suppliers. DA business follows common processes and most of the IT/IS tools are shared across the DA factories (Figure 8).

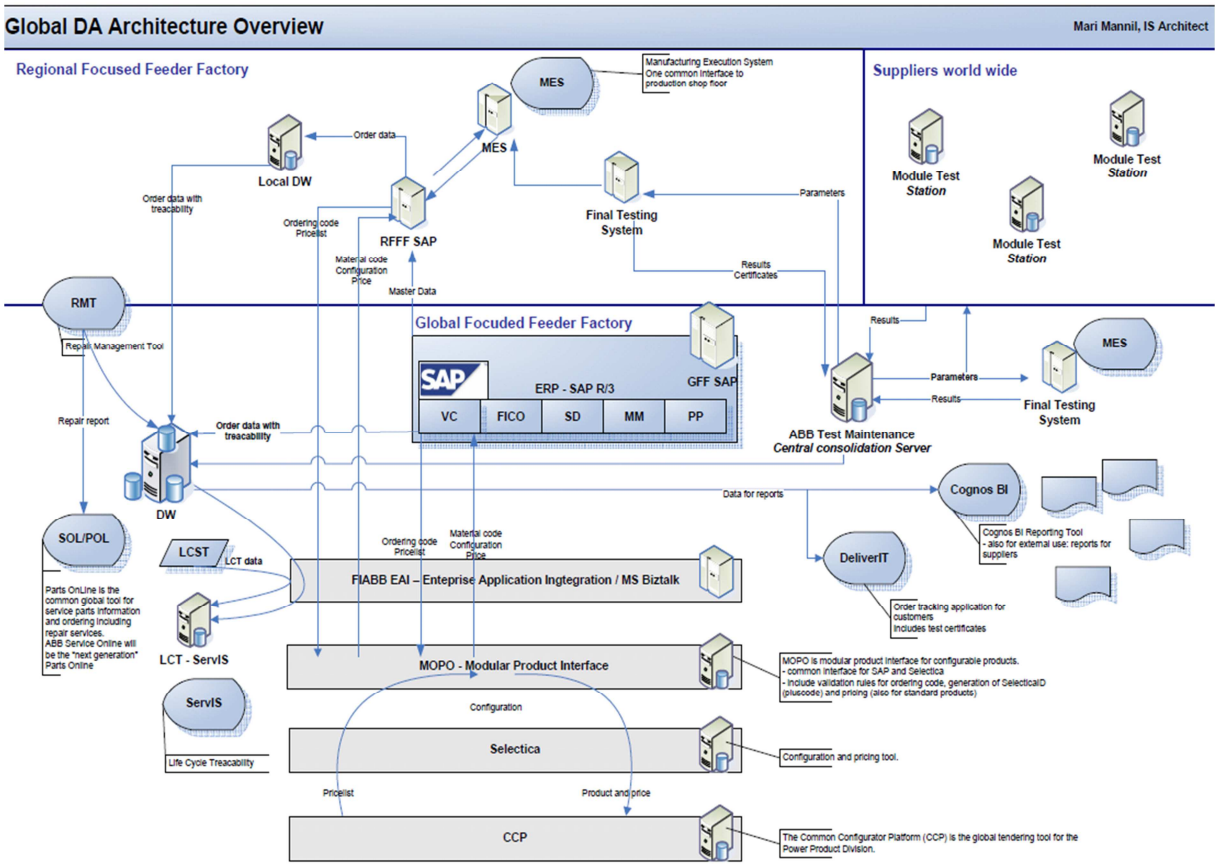

Figure 8 – ABB DA's IT/IS infrastructure overview

3.1.2 Challenges

In the course of its business, a factory establishes relationships with multiple customers on one side and multiple suppliers on the other. These Demand and Delivery relationships, in the context of FI-DA factory, can be named as;

- Customer's demand
- FI-DA's demand
- FI-DA's delivery and
- Supplier's delivery.

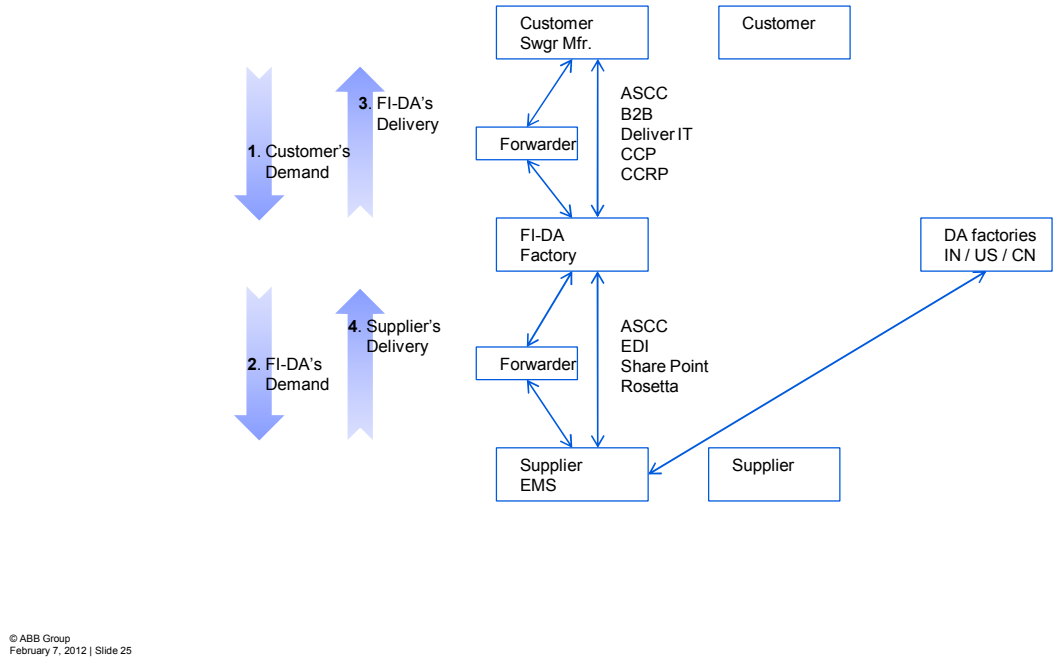

Figure 9 – FI-DA's demand and delivery relationship

Apart from the basic methods of exchanging information for business transactions like phone, fax or email, the IT/IS infrastructure plays a key role in managing these relationships. Although ABB strives continuously to improve the tools that support the management of the Demand and Delivery relationships, there still remain few challenges.

1. Customer's demand - A vast majority of orders, coming to the FI-DA factory come from internal sales channels. FI-DA employs the ASCC (Advanced Supply Chain Collaboration) link or the B2B (Business to Business) link for receiving the orders from certain customers and these tools are used for acknowledging the orders as well. The Common Configuration Platform (CCP) is an offer making tool and used by sales personnel. Although these tools help order handling to a large extent, these don't support the collection or extraction of forecasts. The customer demand forecasts today are based on statistical means or estimations or even informed guess. At present there are no direct means to anticipate large orders or rush orders except by means of personal communication.

2. FI-DA's demand - A short delivery time 1~2 wks to customers with a Make-to-Order manufacturing process means that all materials for production have to be available in the factory before the order is booked. For the materials to be available in stock, buffers need to be maintained through-out the supply chain. These inventories are maintained on the basis of mutual agreements with suppliers and forecasts. The forecasts are arrived at by statistical means i.e., by combining the consumption pattern and a factor for either increase or decrease according to sales budget. The averaging effect, in this

kind of forecast, leaves room for surprise shortages when the ordering goes above the average, especially in case of slow moving variants. If the buffers are depleted, the buffer replenishment time adds to the delay. Apart from the carrying costs, the large inventories reduce the flexibility to react to design changes and impose a significant risk of obsolete stock.

3. FI-DA's delivery - An updated status of shipping is made available to FI-DA's internal customers with the DeliverIT tool. This tool however has limitations in terms of ease-of-use and often the delivery delays get updated at last moment. This leaves little opportunity for customers to adapt to the situation. The products change many hands before reaching the end customer i.e., Utility or Industry. The downstream deliveries of Switchgear-Substation-Project can be affected by the late delivery of FI-DA products. A real-time update of the manufacturing status is not available to the customer. After the products are collected by the forwarder for shipping, and untill they reach FI-DA's customers, there is no visibility of shipment in transit - this adds to the unpredictability of the deliveries and corresponding schedule risks.

4. Supplier's delivery - The global suppliers deliver products in one working day from stock. This works fine as long as the buffer level is maintained while the stocks are being pulled by different DA factories. The suppliers periodically, or on request, provide a off-line update of buffer status. This information is made available through Excel sheets in Share Point. In the event of orders, with large deviation in quantities with respect to forecast, the delay in availability of online buffer status and non-visibility of pending orders from different factories, hinders capacity optimization and vendor selection. After the products are collected by the forwarder for shipping, till they reach FI-DA's factory, there is no visibility of shipment in transit - this adds to the unpredictability of the deliveries and corresponding schedule risks.

These challenges, to some extent, limit the ease of doing business and impede the overall operative excellence in functions and processes. ABB recognizes the need to move beyond existing operational limitations for leveraging the information exchange between factories. This is where a need for runtime integration of factories is felt.

3.1.3 Need for an Integrated Factory

Over the years, the manufacturing processes at ABB have evolved and focus has shifted from integrated factories housing a significant part of value chain to Focused Feeder Factories (FFF) concentrating on core activities like R&D, final assembly and testing, global sales, marketing, supply chain operations management. On the upstream side, PCBA's that were once produced in-house are now outsourced to global EMS suppliers for whom this is a core-competency. On the downstream side, C&R panels which include relays, and which were once engineered and produced in-house, are now being produced by other ABB factories or OEM's.

The notion of focused feeder factories has been successful, but, the present economic situation is pushing industries to look for various options to gain higher cost and operational efficiency. One of the options is to bring about an integration of factories in the value chain as in the old days reap the benefits like - real-time information exchange for quick decision making, enhanced visibility of manufacturing status hence better management control and risk mitigation, to name few. Although the benefits are compelling, it is no longer feasible to bring about physical integrations by mergers or

acquisitions in developed European economies. Hence, the best way forward is to integrate the real factories into a Virtual Factory.

FI-DA's largest European customer is the switchgear factory CZELS located at Brno, Czech Republic. Fideltronik, located at Sucha Beskidzka, Poland is FI-DA's major European EMS supplier. Amongst other customers and suppliers, FI-DA intends to introduce these factories to ADVENTURE to begin with and as test case. ABB visualizes a virtual factory prototype that supports the Demand and Delivery relationship with customer CZELS, or with supplier Fideltronik or over the entire value chain including both CZELS and Fideltronik.

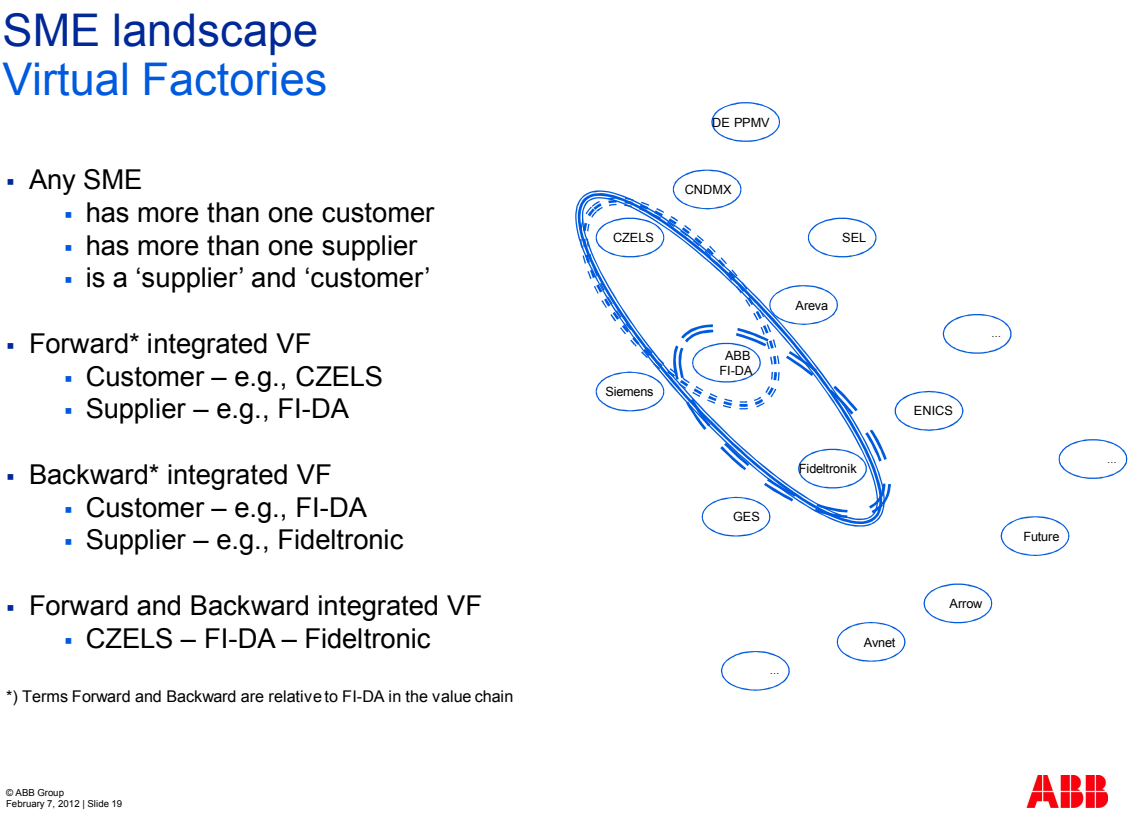

Figure 10 – Virtual factories integrated with FI-DA

3.1.4 Expectations from ADVENTURE

The focus of ABB is to improve the existing manufacturing processes across its value chain with the objectives to quickly respond to changes in customer demands and preferences and to quickly anticipate and mitigate delivery risks. The solving of such issues enables ABB to better participate in its market segments, providing value adding activities such as:

- To meet on time delivery (OTD) requirements
- To avoid material shortage
- To provide forecasts that are as accurate as possible to suppliers
- To improve the ability to fulfil rush orders
- The ability to react quickly to late changes in orders
- To plan capacities (better utilization of capacities in advance)

- To avoid expediting costs (e.g. 'flash' mode of deliveries)
- To avoid emergency situations (early warning forecasts for special variants)
- To enable the ability to quickly adapt and optimize processes by receiving alerts from downstream processes
- To have the ability to quickly adapt and optimize processes by receiving forecasts (decision support) from upstream processes

ABB's current business goals are to improve order status, supplier order forecasts and to know supplier's order status. The order status update might be useful for alerting of late deliveries, reasons for the late delivery, urgent order handling processes that can be managed by automatic notifications from suppliers through SMS. The improvement in supplier order forecast enables ABB to see and reserve free capacity (including material availability) in suppliers' sites that provide visibility of status or locations of shipments. This visibility provides information related to components or modules status in terms of whether they are in stock, in transit, WIP, delayed, lost, damaged, etc.

Updating supplier order status information executes warnings from the respective suppliers in cases of low buffer levels, as is currently the case for ABB's demand forecasts. A high-quality forecast can prevent scheduling risks by avoiding component shortages.

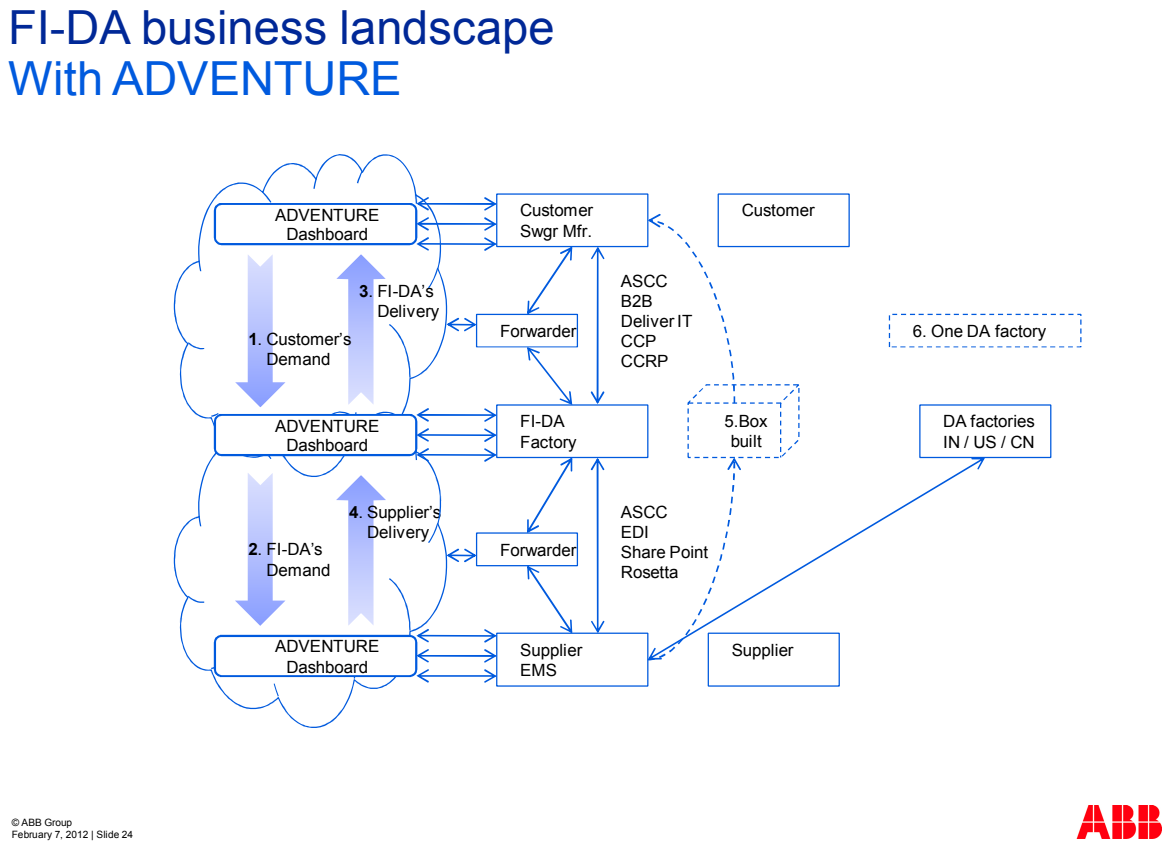

Figure 11 – FI-DA's demand and delivery relationship with ADVENTURE

ABB needs to cover about 100 orders per day. This requires tight monitoring in order to avoid any delivery delays. This monitoring needs to span ABB's production lines as well as suppliers' inventory sites to allow for an average delivery time of two weeks. Thus

ABB expects ADVENTURE to provide support for aggregated real-time monitoring of buffer level throughout all levels of a supply chain.

Additionally ABB expects to use the ADVENTURE dashboard to configure events based on this monitoring. For instance, if the inventory level or stock deviates from a predefined range or whenever a production order is finished, an event should be triggered. These events may then trigger alarms or notifications for responsible staff members. ABB also expects ADVENTURE to support the concept of capable-to-promise (CTP) for its business scenarios. Notifications from suppliers are intended to indicate the availability of components or parts with respect to adequate production capacities.

Finally, a major concern is forecasting the order management process. ABB implements quarterly forecasting. ABB hopes that ADVENTURE will allow for continuous forecasting, to allow for early pre-planning of required engineering and production scheduling. Order forecasting enables ABB to publish a list of components and modules to the respective suppliers, thus in turn allowing suppliers to pre-plan or reschedule their production processes early. Furthermore ABB expects continuous forecasting (and thus earlier and more flexible pre-planning) to improve the overall quality.

The future business scenarios include the box-built approach where the entire manufacturing process could be outsourced to an EMS supplier who may deliver the product to FI-DA's customer. Another business scenario could be of peer-to-peer integration with other DA factories, where assets and resources could be put use optimally, to meet the delivery requirements of any customer, anywhere in the world. ABB expects ADVENTURE would support management of such scenarios as well.

3.2 Case Company: Azevedos Industria SA

3.2.1 Present Situation

Azevedos is a leading manufacturer in the cork transformation industry. Azevedos develops, produces, sells and gives after sales assistance to a wide range of production machinery (see Figure 12) since 1964. Azevedos' products are complex (multi-part and multi-technology) convergent products: they are constituted by hundreds of different components and different technologies. Casting, bending, milling, CNC, image processing, GUI, automation systems, electric and pneumatic components are some examples of technologies and components used. Azevedos only outsources activities which are not covered by in-house competences such as bending, casting, parts' surface treatment and on very few occasions, product engineering. Main reasons for outsourcing are the lack of competences (mainly technological) in some operations and the increase of general plant productivity by reducing delivery time to customers.

Figure 12 – Azevedos's range of cork transformation automation

In fact, some products consist of 500 different components. This fact implies a huge amount of documentation (related with customer interactions, product engineering, process definition, industrialisation, quality, after sales assistance) and data (production, quality records) which must be created and also maintained. Documentation and data are spread in different physical locations at Azevedos, in different formats (paper and/or electronic) and also in different software frameworks (CAD, Microsoft Office, ERP, MES). In spite of the fact that each piece of equipment sold has a serial number, most of the time it takes a substantial amount of time to compile necessary documentation and data for equipment. This documentation can also not be accessed in a web-based manner.

In a one-of-a-kind production environment or in an engineer-to-order business model, a new business opportunity means a new project and to execute such an order involves specific combinations of different activities, like understanding the customer's requirements, conducting a rough product design, feasibility studies, engineering, rough production planning, production, commissioning and after sales support. Azevedos' processes are non-prescriptive; there is a lot of flexibility involved and many decisions are to be made by humans.

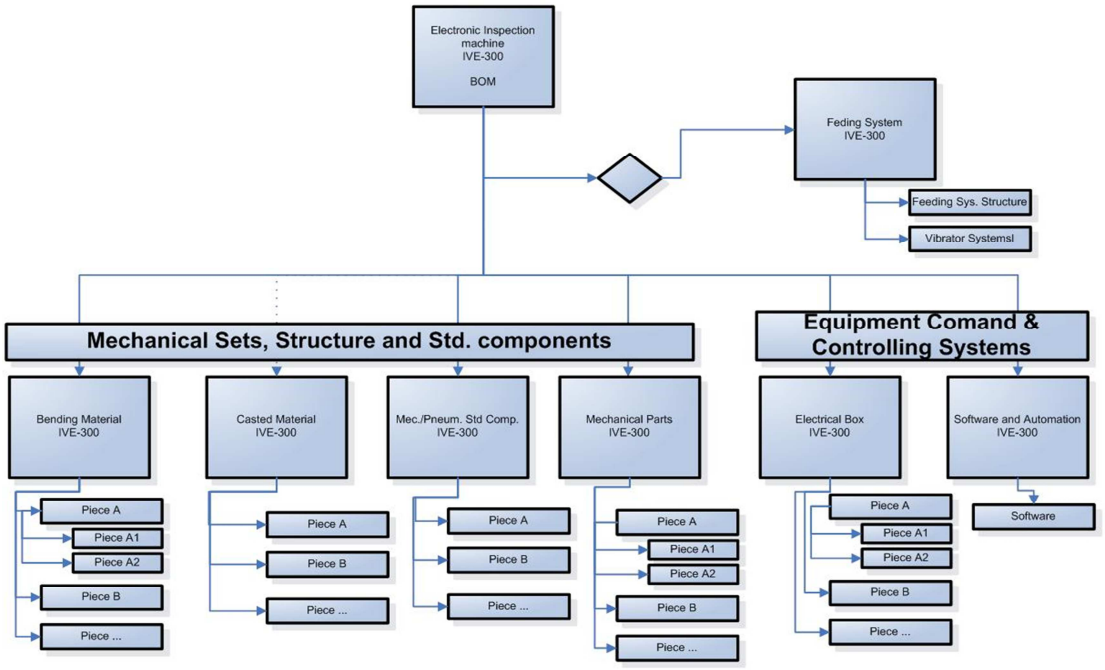

Figure 13 – Infrastructure of bill of materials for internal and external orders

Azevedos in its production process has to place different orders (see Figure 13). Some of them are internal and others are external. Internal orders are executed in-house and are totally managed and controlled by legacy systems, namely by a Manufacturing Execution System. There is however no system that allows Azevedos to manage and control the external orders that are placed with suppliers. Currently, Azevedos can only query the status of external orders manually (by telephone or by email).

3.2.2 Market Needs

Azevedos realizes more than 50% of its annual turnover internationally. Since the beginning of this century Azevedos has been facing great changes in customers' demands. Today's customers demand a much more custom-tailored product and very short delivery periods. The paradigm of producing large series of the same standard equipment seems to be disappearing. This new business environment has brought new challenges, some threats but also opportunities.

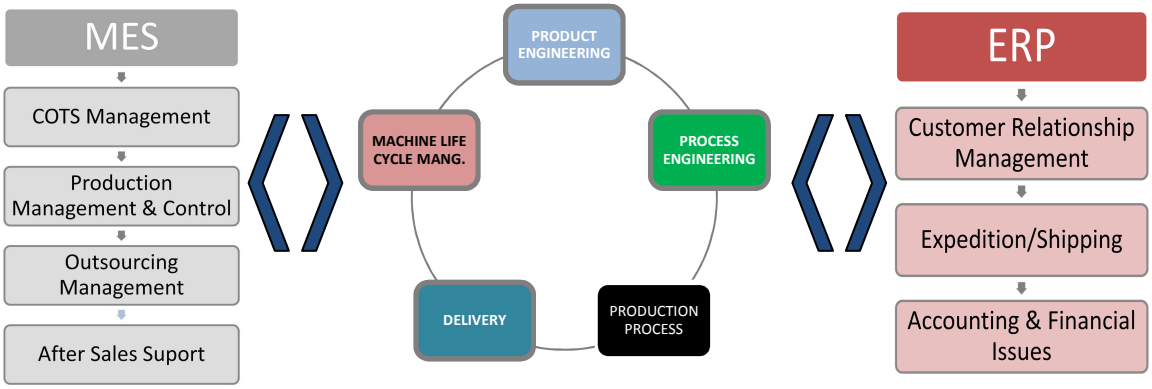

Figure 14 – Understanding the relationships with shop floor processes and systems

In a one-of-a-kind environment, perfect information (documents, production processes and data) is only available after a project has finished and management equals motivating all collaborators to act like a team in order achieve a common goal. This goal is to fulfil the customer's requirements. In order to react effectively to this new environment Azevedos needs a framework which combines workflow management with document management functionalities linking MES and ERP systems to the normal company processes (See Figure 14). In an engineer-to-order environment, everything starts with a rough product design that is being updated and developed while its manufacturing is running. Azevedos calls this 'on-the-fly' production and planning (See Figure 15). Also there are activities that can be driven automatically but others are driven by humans.

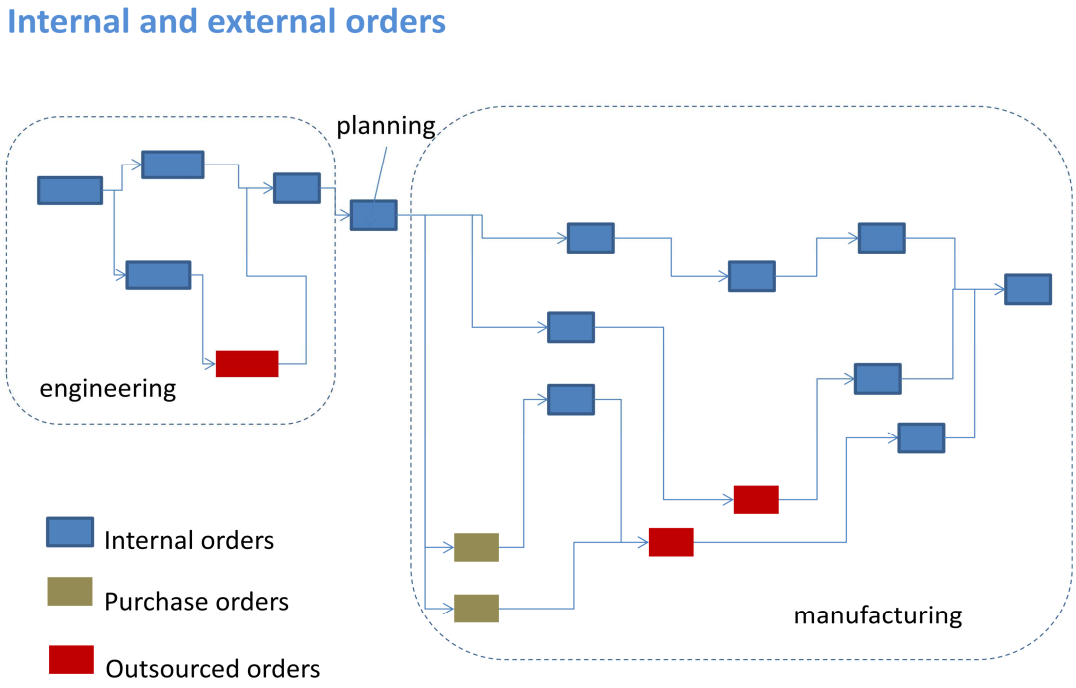

Figure 15 – Process planning with interactions with order processes

Another important need is a web-based consultancy of all documentation and data records related to each machine's serial number. Azevedos gives after-sales assistance all over the world and when a technician needs to analyze or read, for example, a specific bill of materials or an electrical schematic diagram which is related to a specific machine's serial number, they cannot do it. Therefore, a platform with a web-based document management functionality that compiles all documents, all contracts and all emails that are connected to a specific product or even to a serial number would be a great advantage. Figure 16 illustrates Azevedos' business case:

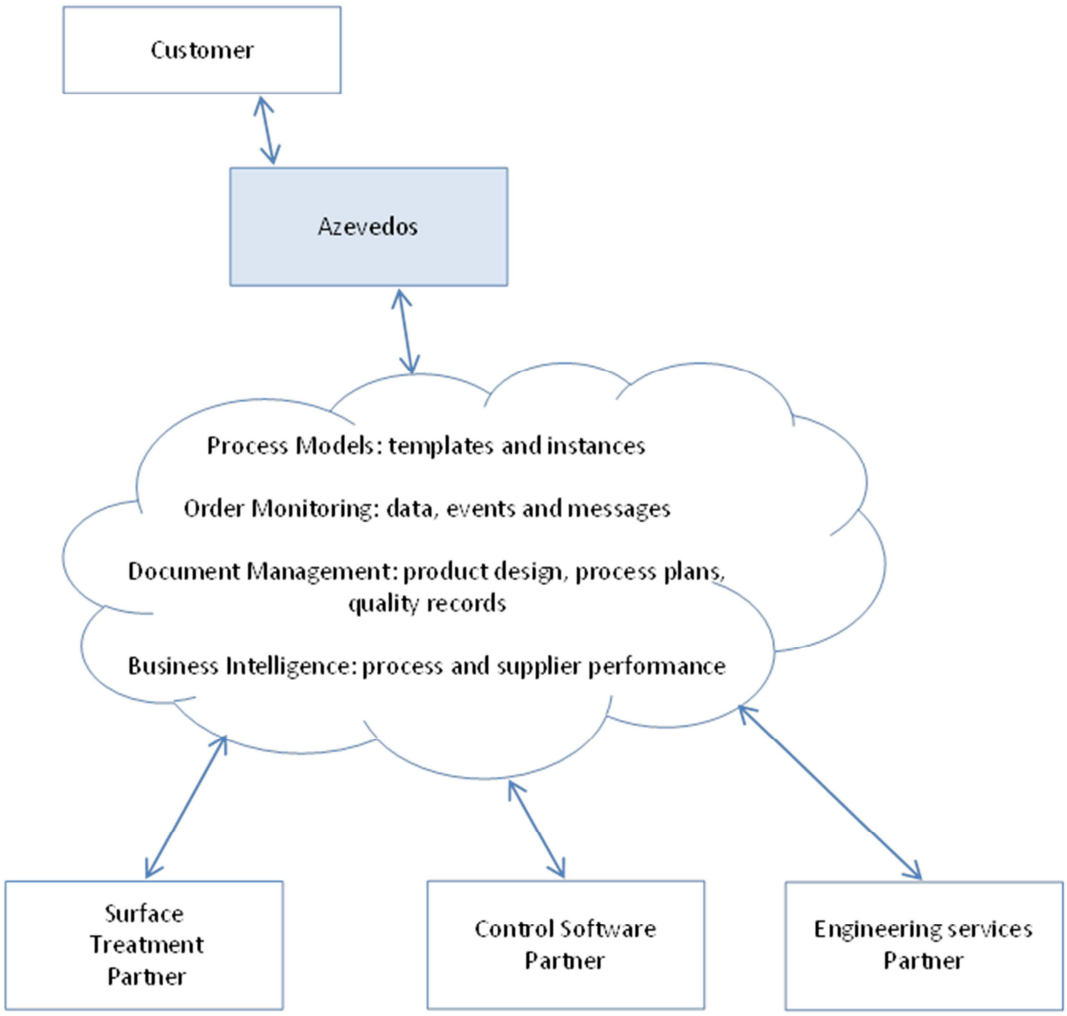

Figure 16 – Azevedos current scenario

3.2.3 Challenges

Azevedos faces significant competition from Spain and Italy but is the market leader with specialised equipment. Therefore, Azevedos constantly improves its manufacturing and management practices in order to reduce lead times of equipment and also to decrease the time-to-market performance indicator. Currently, Azevedos is launching new equipment every six months, which is not often enough. Furthermore, Azevedos performs poorly in terms of the fulfilment of contractual due dates – 40% of the sold equipment is being installed after the delivery date that has been agreed upon (this data is related to the first 6 months of 2011).

3.2.4 Expectations

Azevedos is looking towards Adventure with high expectations concerning the possibility to create and develop new production processes (see Figure 17) easily by using guidelines and templates that are available on the platform.

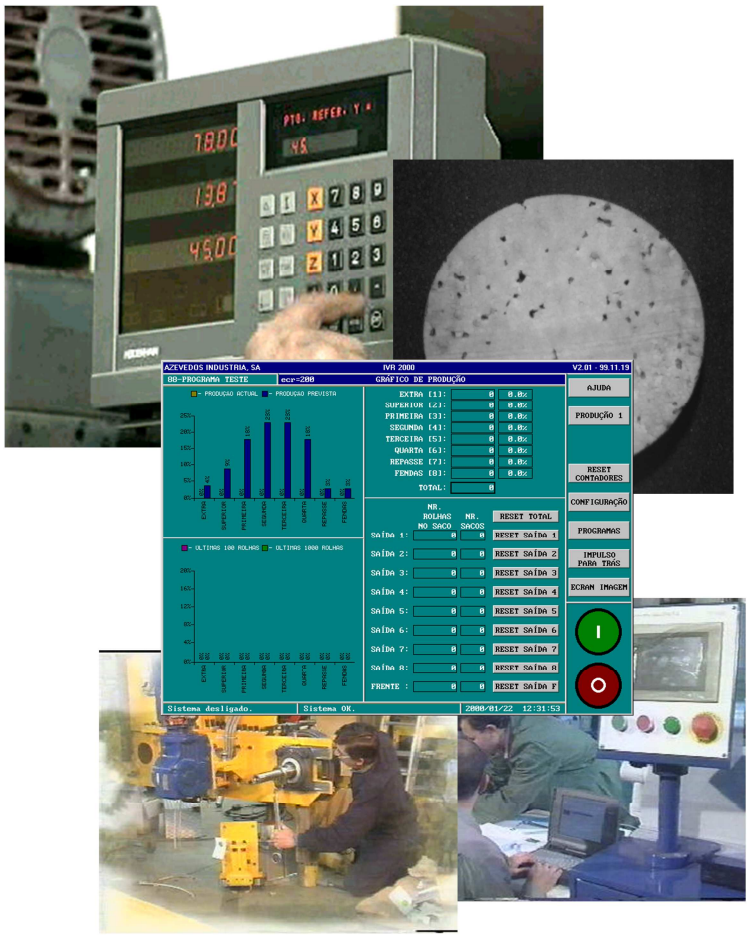

Figure 17 – ADVENTURE connectivity needs to have a factory wide focus

Furthermore, Azevedos expects to be able to find and assign partners to each activity, share information between partners inside the same process task, optimise whole processes, monitor external orders in real time, predict events in order to increase its customer satisfaction and to be more efficient on new products launching to the market.

3.3 Case Company: Control 2K (Member of TANet)

3.3.1 Present situation

Control 2K is a service provider to the manufacturing domain. It provides software solutions that allow manufacturers to monitor their processes and therefore apply process improvement techniques to achieve greater efficiency. In addition, manufacturers utilise this valuable data to help integrate with their suppliers and customers via the exchange of production related data. To achieve this Control 2K uses its own Industreweb software platform which is implemented as either a stand-alone installation or as an integrated part of their customers' existing systems (sees Figure 18).

Larger companies typically link into a singular system such as WebSphere (IBM's Software for SOA environments that enables dynamic, interconnected business processes, and delivers highly effective application infrastructures for all business

situations). These systems are rigidly controlled as with all such proprietary systems but for SME's and indeed other organisations that require cross connectivity and interoperability with other co-ordinated processes it is difficult to see how SME's would be able to use such large scale systems.

These systems are wide spread in all sectors but taking manufacturing as a specific target area, the process of integration is further compounded by the linkage into Enterprise Resource Planning, Materials Resource Planning and Manufacturing Enterprise Systems (MES).

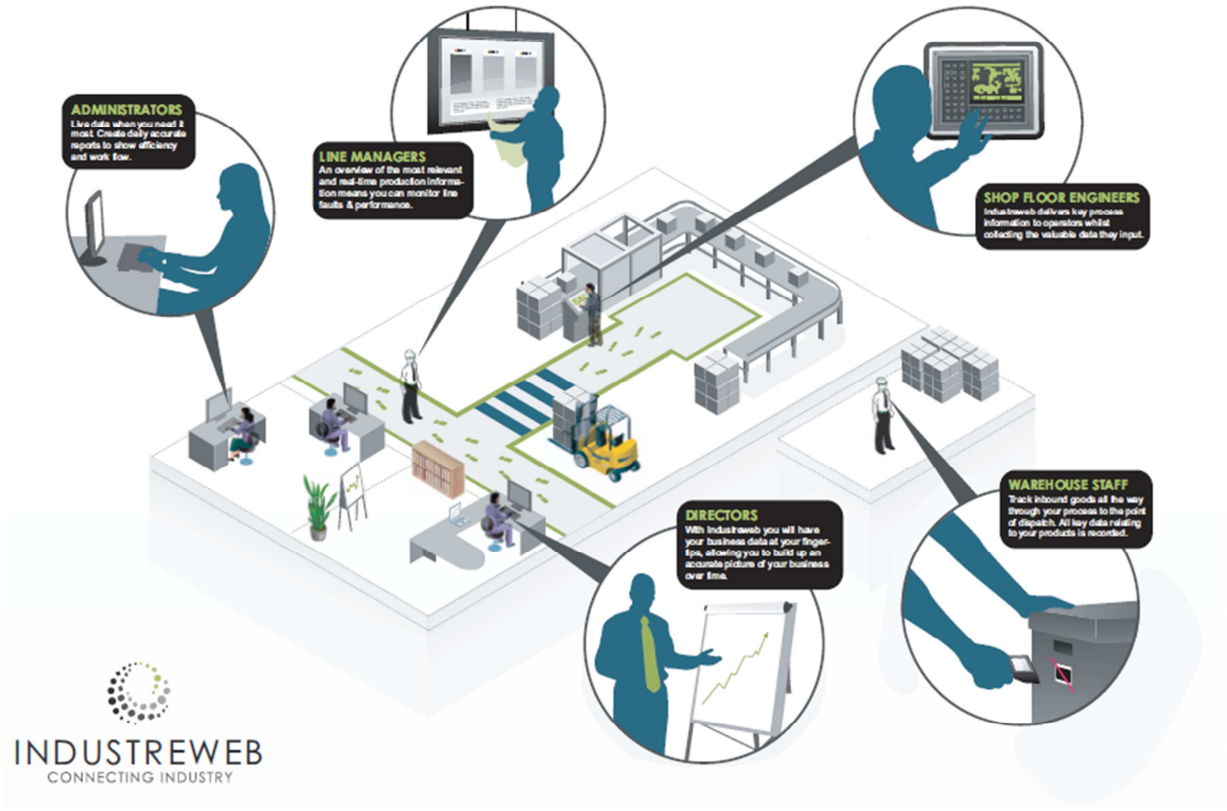

Figure 18 – Data collection, monitoring and presentation at all levels of an SME

If we go back to basics, most businesses will have elements of order processing, financial transactions and dispatching processes. The processing of an order like any business requires an order number and the normal process of financial clearance as highlighted in the other examples within this document.

The production process starts from the moment that the order is cleared for production or assembly and at this point all the elements of checking for stock and ensuring all the bill of materials is available for production to commence is gathered from the various systems. Control 2K has developed a product called "INDUSTREWEB – Software Suite for Business Intelligence" to provide a Flexible, Scalable and Low cost solution to systems integration at many levels. It is a MES Based Software (although it potentially offers more functionality than typical MES. It is primarily used to Connect Shopfloor to ERP / MRP type systems providing Error Proofing, monitoring of processes and a customised dashboard to view your data. Figure 19 shows the typical application of the software in an SME environment.

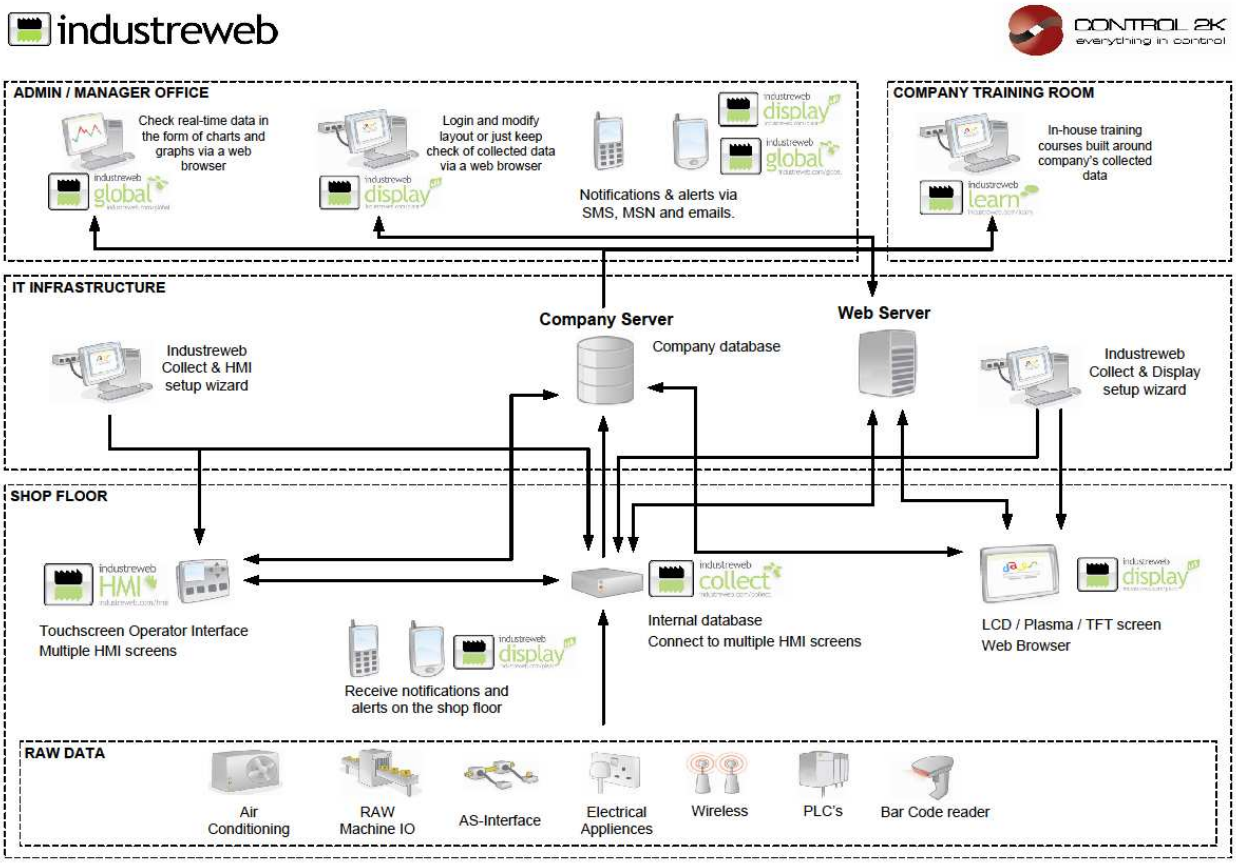

Figure 19 – SME infrastructure for Data collection, monitoring and presentation

Whilst the software works very well as a localised service, it is restricted in the functionality it provides due to poor linkage to Cloud based services. It is limited to point to point connectivity and would benefit by linking the ADVENTURE to expand the portfolio of services that could be provided.

3.3.2 Market Needs

Control 2K currently provides Hardware and software solutions to the client company in order to provide business intelligence for use around the client organisation to provide the client the capability to link to their suppliers and customers. As described in the vision document (D2.1) and Figure 20, Control 2K focuses on integration software and has the option to supply hardware to the customer or the customer may purchase their own hardware from their preferred suppliers. Occasionally the supplier can be the same company that Control 2K sources from and also the customer sources from. These third party hardware suppliers provide sensors and hardware infrastructure to integrate Control 2K's clients with their manufacturing machines using Control 2K's Industreweb software suite.

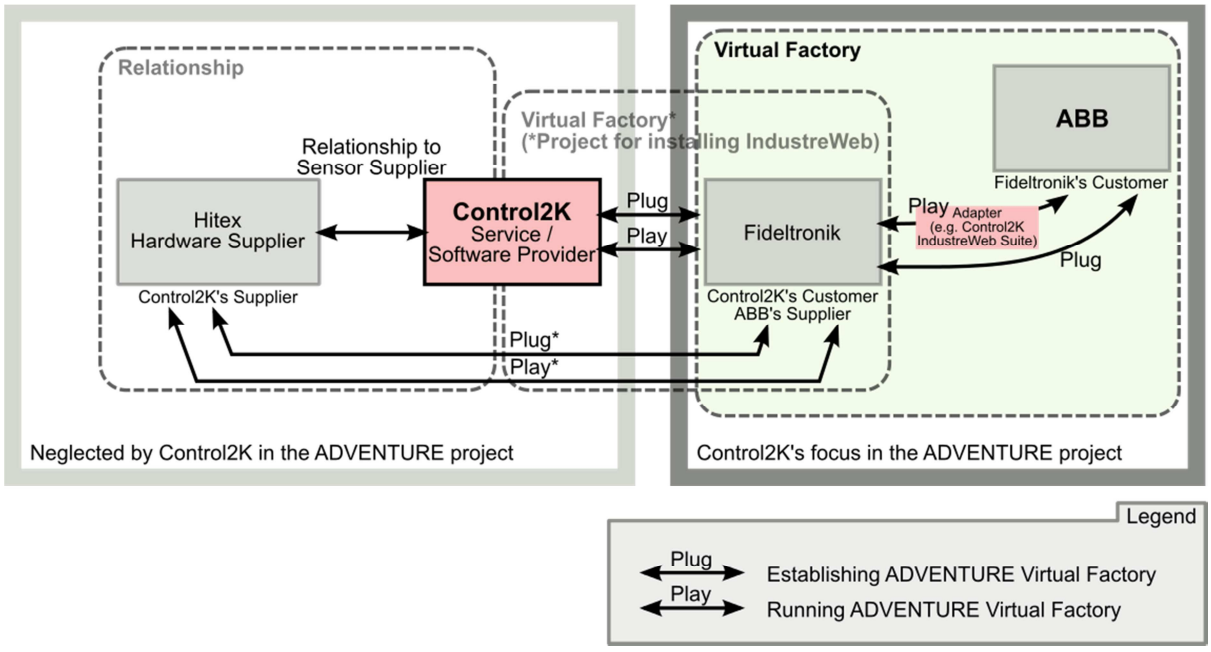

Figure 20 – Control 2K as a service provider

Client companies normally commission Control 2K to provide all the necessary hardware and software to enable communications and monitoring capability to their organisation. Typically the connections are made from the shop floor machines via OPC compatible software to existing legacy MES or ERP systems. The hardware is installed or re-commissioned in order to monitor these machines through the Industreweb software. Control 2K is always looking for partners that can supply hardware at cheaper prices or shorter delivery times to improve its services to their client and increase their own profits at the same time.

The focus of Control 2K within ADVENTURE however is to enhance the connectivity features of Industreweb and ensure that companies using its Industreweb software are "ADVENTURE Ready" without the need for any major additional development work. This includes:

- A web service interface (specification) to allow ADVENTURE to query Industreweb data.
- A methodology and web service interface specification to allow Industreweb to push data to the ADVENTURE cloud (for particular virtual factories).
- A web service interface to allow Industreweb to query or pull data from the ADVENTURE cloud and therefore influence the product process.
- A methodology and web service interface specification to allow Industreweb to provide custom visualization capabilities to the ADVENTURE dashboard.
- A means to describe the evolution and transformation of the structure and semantic meaning of the data, collected from manufacturing machines.
- Allow ADVENTURE users that cooperate with Suppliers with an ADVENTURE ready Industreweb, to feed the Industreweb data into their own ERP/MES systems.

These features will allow Control 2K to offer its customer's additional features for them to become more flexible and enter business relationships faster with fewer costs involved.

3.3.3 Challenges

One of the major areas of concern for any manufacturing company is the constant battle to achieve 100% efficiency. Although this is a dream, most organisations often lose so much on inefficient processes and often overlook areas where major cost impact could be achieved through process optimisation. Whilst lean and agile manufacturing has been around for decades, companies find it hard to get to the root cause of many of the production errors as often the root cause can stem from a variety of processing including human error, machine wear and tear, incorrect or badly designed processes or simply through lack of diagnostic information presented from the process. Labour costs are the most restrictive element in any business but particularly in manufacturing. The increase in the level of automation starts to address the cost issues but in turn introduces a new challenge as often systems need to be interconnected to achieve optimisation.

This optimisation process includes the understanding the complex processes and choreography of the multitude of systems involved within an organisation. To make matters worse, Cloud computing now extends the level of connectivity required when considering smart objects such as tracking devices are used to present supplier delivery times and stock level data. The synchronisation of the overall system becomes unmanageable and the reliance on automated systems to integrate the communications process becomes more critical.

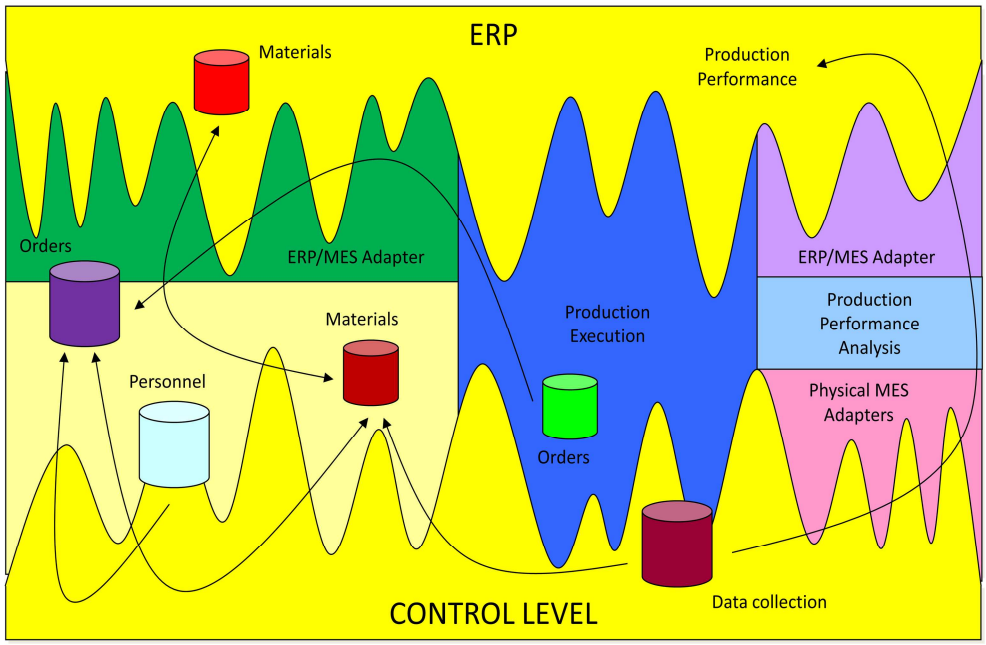

Figure 21 – The demarcation between shop floor and ERP systems is not uniform

When it comes to integrating business processes with existing systems such as PLC and other control systems, MES and then ERP systems, it is assumed that the connectivity is structured and linear with neat self contained silos. In reality though, there are no real clear cut boundaries between services and Figure 21 shows a more realistic relationship between processes and services between the two layers. It is hard to work out the demarcation lines in the multitude of infrastructures and databases in a typical business. Connectivity issues may occur between the ERP and Control Level in manufacturing environments that are very hard to track.

Random errors are the biggest challenge to production and since they cannot be forecast at runtime, they could be predicted if the right level of data is available. The challenge to ADVENTURE will be to consider the response to such errors and the tools that would be needed to monitor such breakdowns of communication. In the real world so much time and effort is spent looking at areas interconnectivity that can potentially go wrong and how the whole process of data capture and correction of errors is presented and monitored across multiple machines.

This is made more complex with flexible processes and the presentation of diagnostic data to operators and managers involved in the delivery of goods. Deficient operation due to missing interoperability between IT systems of manufacturing partners causes high integration issues when it comes to monitoring production machinery. Accessibility to otherwise non compatible software systems means that data could be lost or be none existent when it comes to open infrastructures supporting partner interoperation and the ability to constrain data access and handle data respecting specific restrictions where there are privacy concerns. Dynamic data information is data that is only available at a give instance of the process. Whist it is typically used to give a snapshot of the current state of the process, it is derived from several sources of data and is not captured as the amount of data storage and time taken.

3.3.4 Expectations

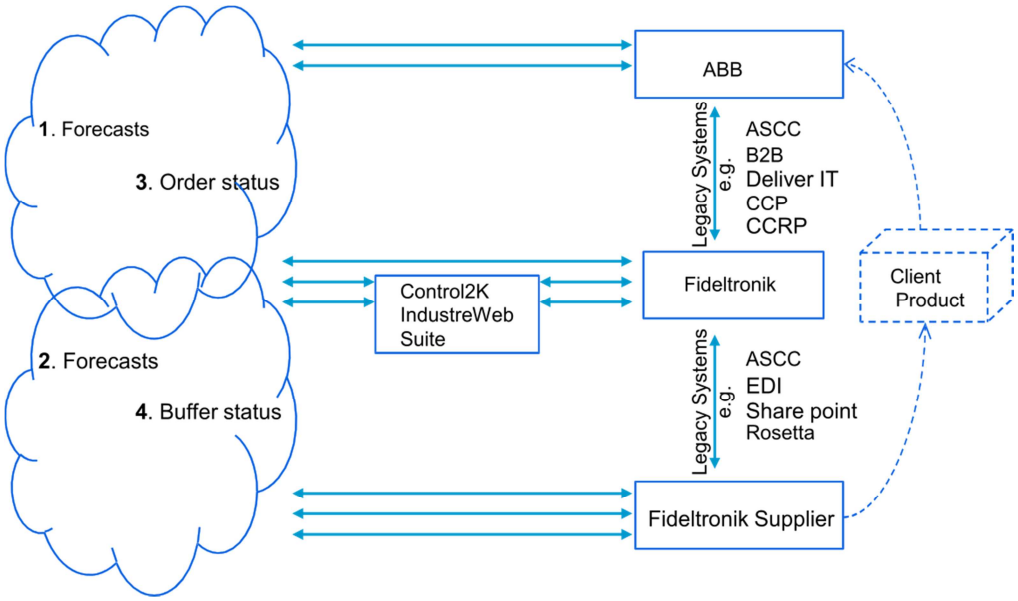

Figure 22 – Industreweb suite via ADVENTURE linking ABB with a supplier

Control 2K can benefit from ADVENTURE in several ways. Foremost, by connecting to ADVENTURE Control 2K can offer their clients the ability to cooperate with their supply chain through ADVENTURE (see Figure 22). This offers the benefits of:

- Faster setup of business intelligence systems
- Integration with ERP/MES systems
- Wider monitoring capabilities including client-supplier tracking of all production related data (not just manufacturing machine related data)

Industreweb acts as an adapter to monitor manufacturing machines, and is itself complemented through the modular structure of ADVENTURE which allows connecting Industreweb to other products without the need to continuously adapt Industreweb to these products.

In relation to aspects of ADVENTURE the expected benefits should include:

- Provide custom monitoring and visualisation of complex data structure to the dashboard, thus allowing Control 2K clients and their customers a holistic view on their cooperative manufacturing venture
- Allow Control 2K customers to adapt their manufacturing process and machines without breaking into currently existing virtual factories
- Allow Control 2K to advertise its compatibility with a wide range of ERP/MES systems through ADVENTURE, through the support of third party vendors (e.g. TIE ERP/MES bridge).
- Pushing real time monitoring data through ADVENTURE to the aforementioned ERP/MES systems.
- Pull real time data from Adventure to enable manufacturing process co-ordination to satisfy ERP/MES planning.

Control 2K is expecting to increase the visibility of the supply chain for its client companies such as ABB in this user case in order to present expected shipping dates, buffer stock levels and allow suppliers such as Fideltronik to see forecast schedules from ABB. As each project Control 2K conducts in relation to its clients is essentially unique, it needs to remain flexible in terms of the automatic interactions through ADVENTURE so that changes to the process can be done with little effort. Control 2K currently relies strongly on personal relations and word of mouth for project acquisitions. As the Control 2K portfolio of services grows, it also becomes visible as a potential supplier of ADVENTURE compatible software and services through the ADVENTURE Dashboard's search functionality in order to win new business. As stated in the Vision document (D2.1) additional future prospects may include automatic or cloud based deployment of Industreweb compatible software through ADVENTURE.

4 The ADVENTURE Strategy

4.1 Business Orientation

Whilst the focus of ADVENTURE is aimed at the SME market place, the resulting tools and methodologies should be applicable for larger organisations since the processes of a virtual factory requires connectivity at a higher level of operations. The case companies are all based in the manufacturing area but the issues faced in this sector are comparable with other sectors too. ADVENTURE aims are to enhance and facilitate the collaboration of organisations by improving interoperability between their processes and IT systems.

ADVENTURE aims to apply concepts of Service-oriented Architectures (SOA) to enhance and achieve interoperability and data integration at a deep technical level. The architecture opens the communication channels especially for SMEs to communicate with each other and collaborate, share, exchange manufacturing related data and messages. ABB has long established business relations with its customers and suppliers and like any organisation is looking to improve and enhance these channels. ting business partners. The other case companies although looking at other areas of the business also expect to reduce their operation costs, increase supplier transparency and widen their services to their customers.

The virtual factory concept allows SMEs to be closely coupled to act as a larger organisation. The core competences of these organisations can be interconnected leading to higher production and cost efficiency. ADVENTURE is looking to address the European SME issues operating in global markets, suffering from higher production and labour costs compared to their non-European competitors. Cloud computing solutions should help to reduce the cost of implementing the tools proposed by ADVENTURE as these tools should offer greater connectivity and interoperability.

4.2 What can ADVENTURE do for the Market Sector?

ADVENTURE users have the possibility to enhance their collaboration so that each collaborating partner can focus on core competencies. For this, it provides tools to facilitate the finding and identification of appropriate (potential) partner factories, with which they could initialize or contribute to a beneficial partnership, based on semantically enriched descriptions of offered and required manufacturing capabilities.

For instance, in order to produce custom tailored products as required by Azevedos (customers demand tailored products with very short due dates), ADVENTURE assists and facilitates Azevedos' partner finding activities. This is realized by enabling an automated search for appropriate partners based on Azevedos' described manufacturing requirements. Having specified a Smart Process and respective required manufacturing capabilities utilizing ADVENTURE's Smart Process Definition component, Azevedos may query ADVENTURE's Knowledge and Information Repository to automatically find matching candidate factories instead of having to manually compare offered with required capabilities for all candidate factories. This presumably saves Azevedos a large amount of time in case of a high number of eligible candidate factories and thus increases Azevedos' efficiency regarding the production of new custom tailored goods.

In addition to enhancing partner connecting activities, ADVENTURE provides tools for monitoring the whole (distributed) manufacturing process – the Smart Process. It provides this information to all partners participating in the respective Smart Process. Usually, SMEs only have insights about the production status and delivery risks for only a rather small piece of the supply chain. They only have information about the parts of the chain they are actively involved in and that are monitored by them. Information about delays or further risks is usually not forwarded by the entity that caused or at least identified the mentioned obstacles along the whole supply chain. Thus, respective information potentially arrives too late at affected SMEs, so that no adaptation to such obstacles is possible.

In contrast to this, ADVENTURE enables transparent business processes. It provides SMEs with tools and methods to monitor the entire manufacturing process. Thus, users can timely recognize delays and obstacles and react upon them. By giving SMEs the full control over the whole supply chain, ADVENTURE accounts for reducing and minimizing, respectively, risks. A current solution by ABB in this context is to maintain a large and expensive inventory keeping high buffer levels in order to reduce delivery risks. As potential obstacles timely are made explicit and visible to the collaborating SMEs by ADVENTURE, lower risk buffers are necessary. Thus, ADVENTURE additionally saves money due to reduced inventory cost. ABB, for instance, would like to have proper monitoring and control facilities covering the complete supply chain and thus improving ABB's supply chain management.

Furthermore, due to enhanced risk detection and management, which is enabled by ADVENTURE as stated previously, it facilitates and improves decision making regarding new, upcoming business opportunities. In this context, ADVENTURE moreover provides improved decision support by means of simulation, i.e., by providing an integrated process forecasting and simulation component. Prior to that, only isolated forecasts and simulations (of own process) are possible. Especially for ABB, the missing forecasting directing from the customers is a serious problem.

ADVENTURE directly allows modelling a potential Smart Process and integrating appropriate partner factories according to a new opportunity – as required, e.g., by Azevedos. The specified Smart Process can then be simulated utilizing ADVENTURE's Process Forecasting and Simulation component in order to forecast whether the new opportunity at all can be satisfied successfully and to assess the effort that has to be put into it. ADVENTURE even enables assessing the impact of a new opportunity on the business processes which already exist at a certain SME. And all this is possible prior to approval of a new opportunity. Thus, ADVENTURE reduces risks as it provides decision preparation and support facilities helping in making potential risks explicit and visible which enables adaptations according to identified obstacles.

Regarding the market sector of ADVENTURE, existing tools applied by ABB fail to forecast and update order status at the customer side and fail in checking buffer levels in the supplier side. In terms of the market sector of ADVENTURE for future exploitation, the most direct potential competitors are SCM (Supply Chain Management) solutions. These systems typically have similar features and cover some of the aspects of the ADVENTURE project while others are not implemented. Most of these solutions have in common that they do not provide functionalities that guide the partner-finding phase, while at the same time the creation of the cross-organizational manufacturing processes is not as modular and flexible as envisioned by ADVENTURE.

Most SCM solutions offer real-time monitoring across the supply chain to manufacturers enabling them to access data on inventories and production statuses of their suppliers and perform forecasts accordingly require the different production partners to implement the same SCM system across the whole supply chain, or to customize these systems in order to integrate their own legacy ERP or MES systems. ADVENTURE on the other hand not only offers seamless integration of legacy systems and sensor data across the supply chain, but also supports companies in finding potential production partners and setting up the respective production processes.

Concluding, while traditional SCM solutions only support inter-organizational production planning and monitoring which turns them to potential competitors of ADVENTURE, they do not cover the creation of modular virtual factories that are integrated end-to-end as envisioned by ADVENTURE.

4.3 Future Business by Adapting ADVENTURE

ADVENTURE affects future businesses in multiple positive ways; as already mentioned, SMEs are provided with tools and methods to monitor the whole supply chain of manufacturing process they are involved in. This enables them to react and adapt in a timely way to recognised delivery issues and other risks. Further, by facilitating and enhancing collaboration between users, they can focus on their core competences leading to a higher degree in production and cost efficiency.

When ADVENTURE is established and comes into play, the future business might look as follows:

- There will be a pool of ADVENTURE enabled partners having specified their manufacturing capabilities, offered quality levels and need. These will all be stored in the ADVENTURE Knowledge and Information Repository. This comprises and describes the total (market) potential of the collection of these ADVENTURE partners. Thus the partners form a virtual factory. Via bundling of capabilities and competencies, the competitiveness and the market power of the collaborating connectivity of partners will be higher compared to the sum of individually acting ADVENTURE partners.
- In the case of a new upcoming business opportunity arising, the respective ADVENTURE partner may plan and transparently allocate offered manufacturing capabilities of ADVENTURE Members in order to verify, whether this business opportunity could be realized successfully and profitably.
- ADVENTURE allows for modelling and simulating of the whole manufacturing process utilizing its Smart Process Definition component as well as the Process Forecasting and Simulation component.
- If all ADVENTURE Members which have been selected for the respective Virtual Factory agree on a business opportunity, the opportunity can be realized (i.e. the factory enters the PLAY phase as described in D2.1).
- While the virtual factory is running, i.e., while the different manufacturing steps are performed and pre-products and semi-finished goods are shipped and transported from one participating partner to the next one in the supply chain, the current production (and delivery) status is constantly monitored and this monitoring information is provided to all involved ADVENTURE Members via the ADVENTURE Dashboard.

- All involved partners are constantly informed about the current factory status and may in real-time recognize potentially occurring obstacles (i.e. factors influencing successful product delivery), so that they can timely perform appropriate adaptations.
- Factory adaptations may comprise of identifying alternative partners and rerouting semi-finished goods to their factories. This way, the order can potentially always be successfully.

5 Conclusion

Businesses need an environment that can ensure the higher productivity and profitability of the manufacturing enterprise as a whole. To be competitive and to lead the market domain, manufacturing enterprises, especially SMEs, need to understand, identify and prioritise their target market sector. ADVENTURE tools and methodologies should help market sector participants to address their business goals, as well as solve pressing business needs and challenges stemming from competitive global markets.

Based on the cases of ABB, Azevedos and Control 2K, this document exemplarily describes respective market sectors. Thus these case companies' existing business strategies / models are highlighted and focused along with their future business needs. Current market limitations and future expectations of the case companies are identified for the purpose of positioning the specific target market audience. This identification process expedites the case companies' business channels to open up and to sustain confidently within future business scenarios. The potentials of the future target market sectors of the case companies are influenced to highlight their corresponding business motivations.

This deliverable concludes that regarding ABB, ADVENTURE has to satisfy their demand for having a tool that monitors buffer level all the way from its internal inventory level to the suppliers' inventory dynamically. ADVENTURE further has to meet ABB's expectation to provide real-time monitoring and control on events like "*Inventory level or stock goes beyond the predefined level*", which happen during ABB's daily operational activities. With its monitoring capabilities, ADVENTURE has to satisfy Control 2K's requirement to provide a holistic view on the cooperative manufacturing venture. Also ABB's expectation regarding the provisioning of a tool to support ABB's order forecasting process by automating it and improving the forecast quality has to be addressed by ADVENTURE. Regarding Azevedos' need to produce custom tailored machines on short notice with a wide array of available partners, ADVENTURE will assist and facilitate respective partner finding activities.

Thus, all things considered, by adapting ADVENTURE the businesses of market participants will be affected by an increased level of transparency, production and cost efficiency, a high level of collaboration, manageable and timely foreseeable risks, and the possibility to quickly and flexibly react to recognised obstacles. ADVENTURE will set up the required preconditions to plan, design, and develop innovative products much faster. Thus, it drives innovation and reduces time-to-market.

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