Managing the Exchange of Data in the Extended Enterprise

G. Nikoleris
Lund University, Dept. of Mechanical Engineering

N. Johansson
Volvo Cars IT, Olofström and Odette Sweden

ABSTRACT: The quality in the exchange of technical data in the extended enterprise is mainly defined by the geometrical consistence of the transferred information. Methods and definitions that cover the remaining aspects of data exchange have to be developed. This article discusses a new standardization effort for the exchange management of technical data (ENGDAT version 3) and provides a methodology as well a set of tools to assess the status of communication effectiveness of data exchange in the extended enterprise.

1 INTRODUCTION

At the beginning of the automotive industrial era all necessary production facilities were acquired by the car manufacturer to guarantee the availability of the required resources. An excellent example of this was Ford Motor Company, which bought the entire production chain, from mines, forests and lumbering work all the way along the chain to the moment that the end product, the Ford automobile, rolled off the assembly line. Note that cars at this time contained many wooden parts.

Today, there is no automobile manufacturer that owns the entire chain. Manufacturers depend on close co-operation with their partners to assemble a high quality end product that the target consumer will choose and enjoy and, even more importantly, choose again. This close co-operation depends in turn on increasingly sophisticated communication networks where not only communication but *effective communication* is an absolute necessity to rolling the *right product* off the assembly line and into the showroom at the *right time* and at the *right cost*.

1.1 *Extended and Virtual Enterprise*

The need of close and effective co-operation across the value chain as well as globalization and increased competition require new forms of networked organizations. Independent enterprises, customers, suppliers, service providers as well as academic organizations and government agencies can form partnerships to enhance their ability to adopt and practice state-of-the-art manufacturing strategies and technologies. Virtual and extended enterprises are two emerging forms of such dynamic networked organizations. Virtual enterprises can be described as temporary consortiums of independent member companies and individuals, who come together to exploit a particular market opportunity while the extended enterprise focuses on long-term collaborative alliances (Browne 1999). The success of both the extended and the virtual enterprise relies heavily on the seamless and effectively facilitated information flow between the participating enterprises and the ability to analyze, measure, and improve communication.

1.2 *Product Data Quality*

Product data quality is fundamental in the intense exchange of information in the extended enterprise. Transfer problems between systems with different functionality or between partner companies disable the effective information flow necessary for the success of a networked organization. A simple definition proposed among others by SASIG (Strategic Automotive product data Standards Industry Group) is: "Product data quality is a measure of the accuracy and appropriateness of product data combined with the timeliness with which those data are provided to all the people who need it."

(Contero et al 2002) discuss several product quality definitions and standards and propose three levels of product data quality resembling the different levels and approaches that natural-language analysis uses, namely:

- *Morphological* – relates to the geometrical and topological correctness of the CAD model.
- *Syntactic* – evaluates the use of the proper modelling conventions.

– *Semantic/pragmatic* – considers the CAD model capability for reusing and modification.

In the extended enterprise these quality levels have to be complemented with additional criteria that evaluate the timeliness of the information flow. In order to be delivered product data have to be encapsulated, compressed, processed and conveyed to the right target through automated processes.

2 PRODUCT DATA EXCHANGE

2.1 *Information and data*

Successful product data exchange relies on the structure of the conveyed message and the proper messaging information. A minimal requirement is that organizational information about the recipient, the sender, the data format and the data context has to accompany the product data message as a standardised electronic delivery form.

During the last years several protocols and components have emerged prohibiting the global validity of exchanged product data.

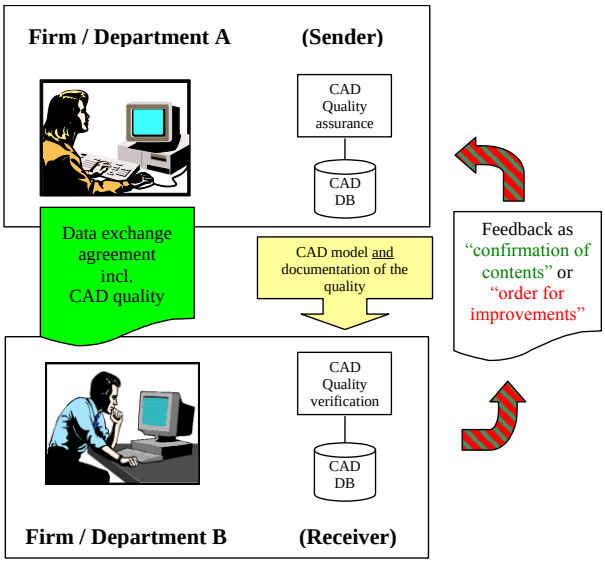

Figure 1. Product data exchange

In Europe, the ODETTE File Transfer Protocol (OFTP) and the ENGDAT message are widely used to transmit CAD/CAM data.

2.2 *ENGDAT (Engineering Data)*

There are several message sets provided by ODETTE and classified by business cycle. ENGDAT, a part of the design development cycle, is a syntaxed computer interpretable message that refers to one or more files with technical content, normally a CAD part or assembly. ENGDAT provides the means for automation of archiving, converting, guiding, routing and further process product data.

Odette has just released a recommendation for the use of ENGDAT when transferring PDM and CAD data together.

Now that powerful CAD systems have been established for developing products and means of production, it is becoming increasingly common for PDM data management systems to be integrated into the processes. The systems used to do this vary in their performance and functionality.

In order to exchange data between these systems, not only does pure CAD geometry data have to be transferred, but also additional information (e.g. part number, version, assembly structure, etc.).

Originally the developers of the ENGDAT format envisaged that transfer of such information would occur in the ENGDAT abstract. However, the scope is now far too small for today's needs.

This new recommendation is a supplement to the Engineering Data Message (ENGDAT) for a special case of use that will be very important in the near future.

The objective of this recommendation is to define rules for drawing up an ENGDAT message that allows the exchange of combined CAD and PDM information within an ENGDAT package, whilst avoiding redundant or contradictory information.

2.3 *Definitions*

The following terms are often used in the product data exchange process.

2.3.1 *Delivery Note*

"Delivery Note" is a generic reference to any file used to convey information about a series of other files comprising a technical data package. In this context, a delivery note is an ENGDAT message or file.

2.3.2 *Container File*

The form of data created or exported by some CAD systems may be in the form of a set of files – even for the design of a single item. One of these files is said to "contain" the other files, which it does by containing references to them. This file is the "container file". (The files within the container files are called "Contained Files")

2.3.3 *ENGDAT Message*

The ENGDAT message, in EDIFACT terminology, consists of the ENGDAT message, expanded by the information header segment and the information end segment of the EDIFACT engineering data frame.

2.3.4 *ENGDAT Package*

The ENGDAT package is the set of technical data files to be sent using an ENGDAT message, i.e. the delivery note and all files linked to the message by the name convention.

2.3.5 *Technical Data Package*

A Technical Data package is the generic phrase used to describe the set of technical data files to be sent using any delivery note, i.e. the delivery note and all technical data files linked to the message by the name convention. In this context an ENGDAT package is the specific kind of technical data package.

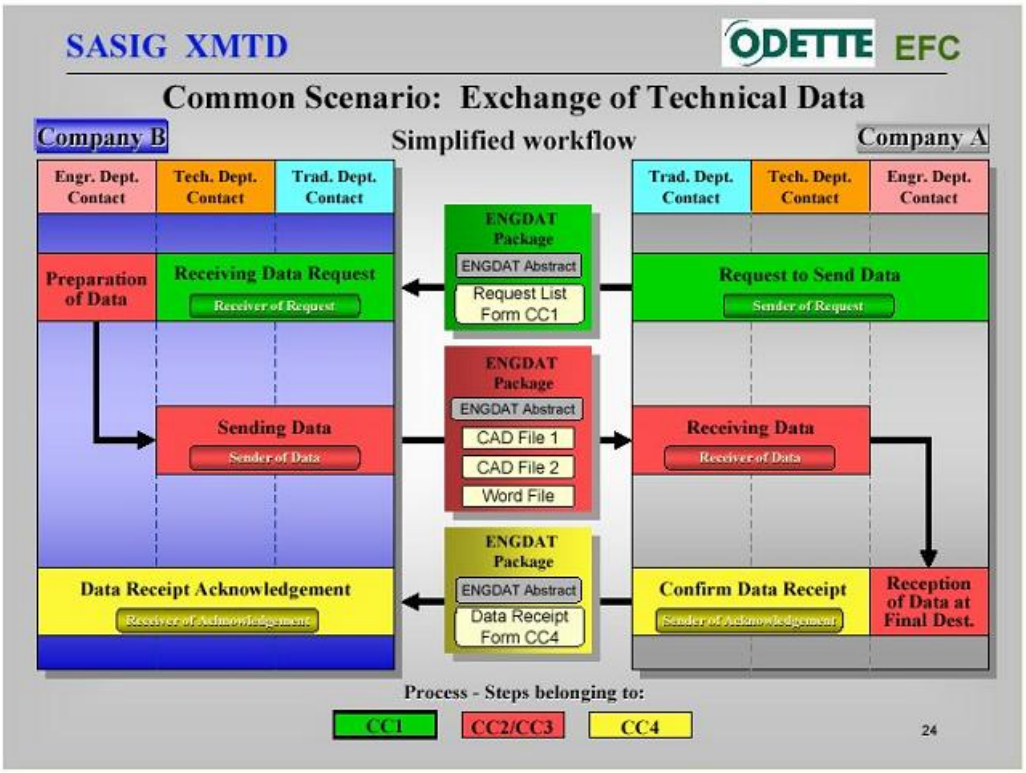

Figure 1. The exchange of technical data in ENGDAT version 3.

2.4 *ENGDAT version 3*

The development and acceptance of a global standard for the specification of product data exchange facilitates the smooth, effective and automated flow of information in the extended enterprises of the car-manufacturing sector. Standards widely used are ISO 10303-214 for the data content and ENGDAT for data delivery and routing.

A work group has been established with members from international standardisation bodies within the Automotive Industry. The initiative comes from SASIG (Strategic Automotive product data Standards Industry Group) whose members are standard organisations in U.S., Europe and Japan. The task of the workgroup is to define the demands for exchange of technical data starting from existing standardised processes, compare them and deliver a solution for the global process chain in the form of a revised ENGDAT specification. To achieve this goal a SASIG – XMTD (eXchange Management of Technical Data) WorkGroup was established.

Table 1. ENGDAT v.3 Enabling standards

	Enabling / Defining standard
ENGDAT version 3	Word
User interface	Browser, XMTD system
Business content	ENGDAT package
Syntax	XML
File transfer protocol	OFTP
Network protocol	ISDN, TCP/IP
Network service	VPN like ANX/ENX/JNX/XNX

The objectives of the new standard are:

- Expansion of the capacity of the exchange of technical data.
- Exchange of partner data.
- Creation of a symmetric solution so that automation will be possible by both the car manufacturer and the suppliers.

- Minimization of manually performed operations and the development towards further automation of the exchange of technical data.
- Increased security by several means as the exchange of identity and password.
- Technical confirmation of receipt on file transfer level. The sending and the receiving system should be able to confirm or to handle information on transparency of file transfer or not, irrespective of file transfer protocol, network protocol and network service.
- Validation of sender and receiver. The sending and the receiving system should be able to negotiate on authorisation to exchange files. OFTP satisfies these requirements.
- Identification of sender and receiver in such a way that the exchange reference together with a receiver is a unique entity. The file transfer protocol should support point-to-point connections where senders and receivers are verified. OFTP satisfies these requirements.
- Describe, trace and document data exchange activities using four conformance classes arranged in different levels CC1 – CC4
  - CC1: Data request
  - CC2: Basic functionality for sending data
  - CC3: Extended functionality for sending data
  - CC4: Acknowledgement for received data

Table 2. ENGDAT v.3 Description

Exchange	Reference explanation
Originator	Initial originator
Destination	Ultimate destination
Filename	ENG{Exchange ref}{No. files}{File No.}
Message identifier	ENG (ENGINEERING)
{Exchange ref}	EXCHANGE REFERENCE, {an17}
{No. files}	NUMBER OF FILES, {n5}
{File No.}	FILE NUMBER, {n5}

Word will be used for the basic definition of ENGDAT Version 3. This means there will probably not be any EDIFACT application for this version.

2.5 *ENGDAT ver 3 and beyond*

ENGDAT version 3 will make the global exchange of product data in the automotive industry easier and faster. Enhanced with STEP AP214 CC6 it will enable the automatic transfer of complete assemblies between EDM/PDM-systems. Large assemblies like an engine containing 300 parts sent automatically as an assembly between EDM/PDM-system will save substantial lead-time and manual work at the receiver of the data.

UML (Unified Modelling Language) will be used for the basic definition of ENGDAT Version 4. Thus applications based on XML and EDIFACT can be automatically produced from the same source, accelerating the development of communication products based on the new standards.

The global adoption of these standards contributes to the globalisation and the agility of the future networked organisations.

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