Whitepaper

Evolving Value Chains in the Automotive Industry – Implications for Business Processes and Information Systems

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Management Summary

Recent developments in the automotive industry have shown that the entire industry faces fundamental changes. These changes are not only due to difficult market requirements and increasing environmental consciousness, but also result from the current re-configuration of well-established value chain structures. With OEMs concentrating on downstream activities, suppliers have taken over former OEMs’ development, production and logistics tasks. They are driving innovation and increasingly assume responsibility for coordinating the complex supplier network. Owing to these evolving value chain structures and the new role allocation, networkability has become a key competitive factor for all automotive companies, most importantly for OEMs and their Tier 1 suppliers. Networkability is a precondition to avoid business failure or being acquired by a competitor. It enables companies to quickly adjust to changing customer requirements, sustain business relations with adjacent value chain partners and to be responsive to actual market dynamics.

Recent experiences in redesigning quality management and engineering change management across companies’ boundaries have demonstrated that automotive manufacturers and suppliers are not as yet sufficiently prepared for such changes. Among their weak points are many problems related to the management of external relationships (network management) and the coordination of business processes across company boundaries (public processes). Other major issues are the technical realization of seamless electronic process integration and the shortcomings of the prevailing forms of B2B integration, i.e. supplier portals and EDI.

This Whitepaper outlines the need for automotive companies to take action:

- On the **strategic level**, companies have to define their positioning and role in the evolving automotive value chain. This provides a basis for segmenting their business partners and defining cooperation models be supported.

- On the **organizational level**, companies should pay more attention to “public processes” as a means of increasing networkability. Public processes describe practices for organizing cross-organizational business processes to allow efficient coordination with external partners. To address the many issues at their organizational boundaries, automotive companies need to assign cross-functional responsibilities to manage external relationships.

- On the **information systems level**, traditional B2B integration approaches such as EDI, extranets and supplier portals are unable to cope with the increasing integration requirements. In future, these approaches will be replaced with more efficient process platforms which rely on service-oriented architecture principles. Process platforms link internal and public workflows through

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1 in the context of VDA recommendations QDX and ECM
existing application systems. Accordingly, they will be able to meet the extensive demands of process, information and reporting-related coordination.

**Figure 0-1: Challenges and Recommended Actions**
1 Networkability - Competitive Factor for Automotive OEMs and Suppliers

The automotive industry is often cited as a pioneer of new management concept and process innovation implementation. Through the implementation of production and logistic concepts like Lean Management and Just-in-Time / Just-in-Sequence, manufacturers have massively reduced cycle times and inventories over the past few years. This has not only increased the efficiency of the entire industry, but has also improved service levels and shortened response times to new customer and market requirements. As a mature industry, the automotive value chain is currently characterized by a high division of labour and vertical integration between manufacturers (OEMs) and suppliers. With more than 10 000 single parts, each car is the product of a highly complex value network.

Recent developments are indicative of the massive changes in the automotive industry. The following five trends are decisive factors in this respect:

1. Changes in the established value chain structures
2. Consolidation
3. Globalization
4. Model variety and shorter innovation cycles
5. Environmental consciousness and higher raw material costs

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**Figure 1-1: The Car as a Product of a Highly Complex Business Network**
1.1 Trend 1 – Changes in the Established Value Chain Structures

New value chain structures have clearly emerged in the automotive industry: On the one hand, given that the downstream business clearly promises better returns at lower capital needs, manufacturers concentrate increasingly on marketing and after-sales activities [Oliver Wymann/ Frauenhofer IPA, IML 2004; Kagermann/Österle 2006]. With OEMs increasing their level of external sourcing in areas once considered core – notably development, production and logistics –, their value added has decreased to an average of 2,670 EUR per car. The outsourcing trend may go as far as to sub-contract a product line’s entire development and manufacturing to one of the emerging Tier 0.5 suppliers. This is what has happened in niche segments, as demonstrated by Porsche (outsourced to Valmet), BMW and Daimler (outsourced to Magna Steyr). On the other hand, suppliers have gradually increased their added value and taken an increasingly important role in the design of future cars. Suppliers’ innovative power has become apparent in their increasing share of development costs, which is expected to increase to 63% in 2015 – a 70% increase since 2002 [Accenture 2007]. Intensive innovation activities in the supplier network have resulted in a brain drain of engineers from manufacturers to suppliers. These developments have strengthened the role of Tier 1 suppliers, which not only provide technological leadership and extensive module and system integration skills, but also manage a complex network of sub-suppliers.

![Figure 1-2: Changing Value Chain Structure and Role Models in the Automotive Industry](image-url)
1.2 Trend 2 – Consolidation

As a result of the increasing competitive pressure, the automotive industry has been struck by a wave of consolidation. According to estimates, this concentration of car manufacturers should result in only 19 independent OEMs in 2010 (from 27 in 2006) and an average volume of 6.17 million cars per manufacturer [Accenture 2007]. Even the supplier side has been struck by the wave of consolidation since the 1990s. The number of first and second-tier suppliers is estimated to decline from between 1 500 and 2 000 in 2004 to between 500 and 700 in 2010. Of these, only around 100 system integrators will negotiate with the OEMs directly [BCG 2004].

1.3 Trend 3 – Globalization

Both the sales and production sides have been affected by increasing globalization. On the one hand, production units have been transferred to low-wage countries and emerging markets, so that car production in China and India is growing rapidly [VDA, 2007]. 92% of the production volume growth between 2000 and 2015 will come from emerging markets, which will amount to 25 million units [OESA, 2006]. Keeping cost-saving by means of external sourcing in mind, many OEMs have established production sites and purchase organizations in these new markets. At the same time, suppliers have set up subsidiaries in the emerging markets or have undertaken on-site joint ventures, in order to achieve these potential savings [BCG 2004]. On the other hand, emerging countries have become more important markets for manufacturers. Their people’s growing prosperity has increased the demand for cars and has positively impacted local sales figures. In 2005/2006 China and India’s sales growth was 25.6% and 21.5% [VDA 2007]. Not only have the established European, Japanese and American OEMs benefitted, but the rapidly growing local manufacturers and suppliers like Tata in India (which has produced 580 000 cars, 220 000 of which in 2007) and Chery in China (which produced 489 000 cars in 2007) have benefitted even more [Economist 2008].

1.4 Trend 4 – Model Variety and Shorter Innovation Cycles

As a result of customer requirements and technological innovations, the number of different car series has increased massively over the last ten years [BCG 2004]. In the light of the broad configuration possibilities and the constantly growing range of optional equipment, manufacturers currently enable every customer to configure an “individual” car. This “individualization” is reflected in, for example, 6 635 000 000 possible combinations of optional equipment at the Mercedes Car Group [Mercedes Car Group 2006]. Hence, the market has changed from a sellers’ to a buyers’ market with decreasing volume model sales and a smaller production output. Besides model variety, the shorter innovation cycles also appear to be a challenge. In the past ten years, a car model’s average life cycle has declined from eight to just four years. Simultaneously, the development period from the design freeze to the start of production was reduced by one-third [BCG 2004]. The drivers of current and future innovations are electronics and mechatronics, which not only allow better driv-
ing safety, emission and fuel consumption, but also constantly improve comfort and maintenance. Consequently, the portion of electronics will almost double from today’s 2 220 EUR per car to 4 150 EUR in 2015 [Mercer 2004].

1.5 Trend 5 – Environmental Consciousness and Raw Material Costs

Greater environmental consciousness and growing raw material costs drove this industry’s dynamics. Increased gasoline prices strengthened consumers’ ecological arguments and made them aware of fuel consumption. OEMs have consequently developed alternative drive technologies – such as hybrid technology – and invested massively in innovations to protect the environment [Oliver Wyman 2007]. With several competing technologies and no obvious dominant approach, companies face significant risks when deciding on future investments. Uncertainties about market success pose great challenges to capacity planning and require the entire value chain to be more flexible.

1.6 Consequences and Need for Action

The previously mentioned developments have changed the structure and stability of the automotive value chain. It has become critical that OEMs build exclusive F&E partnerships with key suppliers to ensure their future innovation power. Close cooperation with a few highly innovative partners is emphasised. Tier 1 suppliers’ number of direct customers has decreases, even though these suppliers are responsible for handling the rest of the supplier network. The emerging markets’ increasing demand requires the global expansion of production and sales activities. Additionally, short innovation cycles lead to faster changes in business partnerships and a more dynamic reconfiguration of supplier networks, which are usually formed by the OEM for the scope of a new car development project.

Given the present change in the automotive industry, networkability has become a competitive factor. Networkability is high when organizations can efficiently establish and disband relationships with business partners in terms of time and cost. It allows companies to adapt modified structures, strengthen business relations with important cooperation partners and react to the actual market dynamics. Hence, networkability is a precondition for avoiding business failure or acquisition by a competitor and may even be a company’s crucial competitive factor. Magna Steyr’s business model, for example, built strongly on networkability and flexibility when evolving into a Tier 0.5 supplier that offers brand-independent engineering and manufacturing services to different OEMs. This Austrian company has even succeeded against competitors from the client’s group, because it offers faster time-to-market and better quality.

An automotive company needs to address three strategic issues. It has to (1) reshape and clearly define its position in the value chain, (2) classify the existing business partnerships against this background and establish appropriate cooperation models, (3) develop capabilities to not only implement these models in the own organization, but also with varying partners.
Evolving Value Chains in the Automotive Industry - Implications for Business Processes and Information Systems

Mega-trends in the automotive industry

- Specialization
- Consolidation
- Globalization
- Shortened innovation cycles and more model variety
- Environmental consciousness and raw material costs

Implication: Networkability as competitive factor

- Changing value chain structure with new role models
- Need for close collaboration with key partners
- Frequent re-configuration of networks

Strategic need for action

1. Redefine the positioning of the company within the value chain
2. Segmentation of existing business partnerships and definition of cooperation models
3. Develop capabilities for fast implementation of cooperation models

Figure 1-3: Strategic Need for Action
2 Coordination Requirements in Automotive Value Chains

2.1 Why Coordination Matters

Every major change in value chain structures causes coordination problems between business partners. In the automotive industry, there are many symptoms of such coordination problems, among which delays in the start-of-production, product recalls and increasing quality costs. In Germany, car manufacturers and their key suppliers officially acknowledged their mutual responsibility for product quality in 2005 when they signed a joint agreement on sustained improvement and quality assurance. As part of the agreement, the manufacturers have first and foremost committed themselves to defining product specifications, which includes the responsibilities, interfaces, deadlines, costs, quality objectives and design freeze, “clearly and in good time”. Furthermore, the manufacturers and suppliers have agreed that changes to deadlines, processes, materials, sites, technologies, installation points and conditions for use during series production would be “notified, coordinated and released in good time.” If a fault is detected, both sides guarantee to provide information and introduce countermeasures promptly, in order to “remedy” the causes “permanently”. The VDA supplemented the agreement with three further instruments: component specifications (Komponentenlastenheft - KLH), maturity validation (Reifegradabsicherung - RGA) and robust production process (Robuster Produktionsprozess - RPP). While these provisions increase suppliers' accountability regarding product quality, there is still a long way to go before these concepts are fully implemented. Most importantly, they need to be operationalized in day-to-day business by means of detailed instructions and appropriate software solutions; both of which are still lacking.

In addition to these voluntary provisions, escalating national and international environmental and documentation requirements force automotive companies to intensify coordination. The German End-of-life Vehicles Regulation (ELV) and its European equivalent are particularly notable, as well as EU directives on chemical restrictions (REACH) and the Restrictions of Hazardous Substances (RoHS). According to these standards and directives, each car manufacturer and supplier is responsible for all aspects of a product throughout the entire life cycle from sourcing, production and sales to recycling and disposal. Furthermore, manufacturers are obliged to store detailed data about every single car to allow the original material compositions to be traced and reconstructed, and graded into danger levels.

2.2 The Reality – Black Box at Organizational Boundaries

Although automotive companies have comprehensively documented their business processes, most of them only focus on internal activities. Since other organizations are considered “black boxes”, companies lack a more systematic understanding of how their business processes interface with those of their business partners. Concepts like Just-in-Time (JIT) or Vendor Managed Inventory (VMI) have only increased awareness of inefficiencies at organizational boundaries in logistics. These concepts also demonstrate that significant saving are realized if cross-organizational business
processes are effectively designed, notably in terms of inventory reductions and supply chain cycle time. Consequently, industry and de-facto standards for cross-organizational business processes and associated electronic messages are most widely adopted in logistics. In all other areas, such as product development or quality and complaint management, the inter-organizational interdependencies of business processes are not yet well understood.

Company boundaries, which are regarded a “black box”, are in sharp contrast with the increased cross-organizational need for coordination. As OEMs impose their own rules and practices, first-tier suppliers have to adapt to manifold OEM and plant-specific process variants. The more intensively business processes need to be integrated across organizational boundaries, the more complexity costs will be incurred in future due to the number of different processes and terminologies.

2.3 From Black Box to Cross-Organizational Coordination throughout the Product Life Cycle

As internal optimization potentials in the automotive industry are almost fully exploited, coordination within business networks becomes an important competitive factor. It is a basic requirement for designing and managing organizational interfaces throughout the entire product life cycle – from the first car concept through engineering, start-of-production up to the after-sales phase, followed by disposal and recycling. Based on the product life cycle, it is possible to identify typical collaborative business processes between OEMs and suppliers, as illustrated in Figure 2-1. Coordination requirements develop in line with three aspects:

- **Process-related coordination** is needed to optimize business processes across organizational boundaries. Its purpose is to remove inefficiencies such as the duplication of activities or media breaks at the organizational boundaries. This can be achieved through the design and electronic support of public processes, which improve understanding of the inter-organizational dependencies and are the basis for streamlining business processes beyond a company’s boundaries.

- In order to run any type of business process, organizations rely on information and their employees’ know-how. **Information-related coordination** indicates the exchange of structured information such as product master data, as well as unstructured information, such as documents like purchase instructions, with business partners.

- Finally, external business partners need to be informed about the status of business processes and the relevant key performance indicators in order to monitor their performance. Therefore, **reporting-related coordination** requires the transfer of status and reporting information, for example, the periodic communication of quality or logistics key performance indicators.
From this list, it is evident that coordination requirements are far more comprehensive and complex than those described in many prior publications on B2B integration. The latter typically consider only process-related coordination. This growing need for coordination is also underpinned by the increasing number of regulations and standardization initiatives that emerge outside the logistics sector, such as in the area of engineering change management (VDA 4965) or quality data exchange (VDA – Quality Data Exchange).

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<th>Collaborative Processes</th>
<th>Business Drivers</th>
<th>Coordination requirements</th>
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<td>• Virtual product development / project management</td>
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<td>• Technical change management</td>
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<td>• Maturity validation</td>
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<td>• Internal sourcing of engineering and production</td>
<td>• Product data / bill of material</td>
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<td>• Concept Engineering</td>
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<td>• Design for environment</td>
<td>Documentation of hazardous substances</td>
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<td>• Compliance (ELV, REACH, ...)</td>
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<td>• Global sourcing</td>
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<td>• Robust production processes</td>
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<td>• Global transport optimization (incl. export, import, customs)</td>
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<td>• Container management</td>
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<td>• Quality costs / Warranty costs</td>
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<td>• International Material Data System (IMDS)</td>
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<td>• End of Life Vehicles Regulation (ELV)</td>
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<td>• Logistics guidelines</td>
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<td>• Supplier evaluation - Logistics</td>
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<td>• Supplier evaluation - Quality</td>
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Figure 2-1: Coordination Requirements throughout the Product Life Cycle
2.3.1 Product Development – From Concept to Start-of-Production

The shift of major development tasks to suppliers and engineering service providers has resulted in globally distributed product development processes. Consequently, product information has to be exchanged between the development partners during all the product development phases – from the concept to start-of-production (SOP) – in the form product specifications, engineering drawings or the resulting bill of materials. With “Design for Environment” becoming a priority and recycling rates having to reach 95% before 2015, there is an additional need for documentation. In order to comply with the various national environmental legislations and EU directives, such as the End of Life Vehicles Regulation (ELV), the automotive industry has established the International Material Data System (IMDS) as a car manufacturing archive, exchange and administrative system.

Furthermore, distributed product development requires the involved parties to follow more formalized structures in development processes. To allow for cross-organizational project management, organizational interfaces have to be clearly defined. Distributed product development needs to rely on a set of basic principles, among them component specifications, which document product requirements and should be passed on to the suppliers at an early stage. As soon as a first vehicle specification is available, global development coordination relies on the distributed development project’s management as well as on the change management responsible for the timely coordination and approval of changes. Industry standards, like the VDA 4965 recommendation “Engineering Change Management (ECM)” and the related SASIG Engineering Change Management Internationalization initiative, specify process models for engineering change management, i.e. process phases, activities and a set of standardized messages.

Finally, intense cross-organizational coordination is necessary to ensure a punctual production start-up and smooth ramp-up.

2.3.2 Procurement / Sales

As a result of the increasing vertical disintegration of automotive manufacturers, the level of external procurement has increased. In order to streamline their purchasing operations, OEMs electronically exchange tenders, contracts and orders with their suppliers. Purchasing departments are not only concerned with the efficient processing of inquiry and order processes, but are also responsible for a systematic supplier evaluation based on defined evaluation criteria. For this purpose, key performance indicators from all relevant areas – development / innovation, logistics, quality and procurement – are collected and communicated to the suppliers. The aim is to optimize the supplier relations and make a pre-selection of suppliers for future placing processes. Some argue that the procurement department should also take a more active role in managing the external supplier networks, which would require an early and intense integration into other business processes that are driven by other departments, particularly development and logistics departments.
2.3.3 Production & Logistics

Owing to growing model variety and production volume reduction, OEMs assign many production processes to third parties. The cross-organizational optimization of production and logistics processes has a long tradition in the automotive industry and is based on established approaches like Vendor Managed Inventory (VMI), Just-in-Time (JIT) or Kanban. The relevant processes have been subject to vertical industry standardization through VDA, ODETTE and AIAG for a long time. In practice, the specific way of performing these processes are imposed on suppliers by OEMs, which provide detailed instructions.

With the worldwide distribution of supplier networks, traceability of deliveries and transport optimization have become an issue. This requires the communication of status and shipping information as well as customs regulations between manufacturers, suppliers, logistics service providers and public authorities. Moreover, additional aspects, such as the optimization of the container logistics chain, have become more important. Assuming more of logistics companies’ services in the area of assembling (Value Added Assembler) needs a closer system connection as well.

Manufacturing processes are said to be "robust" if they are relatively insensitive to normal changes in processing conditions. To ensure controlled and reliable production processes in an increasingly complex environment, VDA has developed a set of recommendations and techniques for robust production processes. The latter comprise incident management, controlling and steering activities, dedicated supplier management and basic standards for production processes.

Managing global supply networks requires a higher level of transparency, i.e. real-time monitoring of inventories and production capacities, status information and supplier evaluations. Production and logistics requirements already need to be considered throughout the product development process for an understanding of how product design decisions impact complexity and inventories, as well as to synchronize production and logistics during ramp-up.

2.3.4 Quality & Warranty

In 2007, for example, the North American car manufacturers Ford and General Motors spent 8.5 billion dollars of quality costs on customer complaints and field failures. The immense costs reflect the quality problems caused by multiple factors: (1) shorter innovation and product development cycles, (2) increasing product complexity, and (3) the shift of responsibilities in development and production to third-party suppliers. In respect of quality management, the VDA QDX standard provides the most important quality-related documents, such as customer complaints, 8D reports for documentation problem solving, or partial audit reports between business partners.

Warranty processing and complaint management are closely associated with quality management processes. Extended warranty periods, established as a marketing instrument, have lead to an increase in warranty requests and a cost explosion. The
costs have to be fairly allocated to suppliers and appropriate measures have to be initiated to eliminate the root-causes of warranty claims. Warranty costs can be reduced if cross-organizational, integrated warranty processes are implemented that cover all relevant parties from repair shops to importer to OEMs and suppliers. The aim is a more efficient and effective processing of warranty claims, an intelligent warranty control and integrated error avoidance process as well as improvements in data quality and faster warranty processing through master data integration.

2.4 Consequences and Need for Action

To improve their networkability, companies have to consider their external process interfaces and the resulting coordination requirements when designing and implementing their internal business processes. They have to be prepared to comply with an increasing number of specifications and de-facto standards for inter-organizational processes ("public business processes"). Some examples of such specifications and standards that companies have to fulfil in future are given in Figure 2-2. For business policy as well as legal reasons, automotive companies should address these requirements and consider them in their internal process organization. Complexity costs can thus be reduced and savings potentials exploited.

Besides the provision of cross-organizational business processes, it is absolutely necessary to address the various cross-cutting issues caused by increasing consistent and systematic collaboration with external partners. Although purchasing departments often see themselves playing this role, they are not usually involved in designing other divisions' business processes.
## Industry Standardization (e.g., VDA / ODETTE) vs. Legal Requirements

| **Product Development** | **Component specification** (e.g., VDA Gelbheft Komponentenlastenheft)  
Automotive SPICE (Software Process Improvement and Capability Determination)  
Maturity validation (e.g., VDA Gelbheft Reifegradabsicherung)  
CAD / CAM product data and drawings (e.g., VDA 4950ff).  
Engineering Change Management (VDA 4965 ECM and related SASIG activities) | **Global Automotive Declaratable Substance List (GADSL)**  
**EU Directive REACH** (Registration, Evaluation, Authorization and Restriction of Chemicals)  
**EU Directive RoHS** (Restriction of the use of certain hazardous substances in electrical and electronic equipment) |
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<td><strong>Tenders, request for proposals, orders, etc.</strong> (VDA 4923ff.)</td>
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**Production & Logistics** | **Logistics processes and concepts** (several VDA recommendations, ODETTE EDIFACT Subsets, e.g., DELFOR, DELJIT, …)  
**Packaging** (VDA 4941ff.)  
**Container management** (VDA 5007)  
**Robust production processes** (VDA Gelbheft Robuster Produktionsprozess) | |  
| **Quality & Warranty** | **Quality and complaint management** (VDA Quality Data Exchange QDX) | **Product liability and warranty** |
| **Financials** | **Invoicing** (ODETTE EDIFACT Subsets, e.g., INVOIC, …; VDA 4906/07/08) | |  
| **Disposal / Recycling** | **IMDS** (International Material Data System) | **National and EU regulation End of Life Vehicles (ELV)** |

*Figure 2-2: Standards and Legal Requirements for Public Processes*
3 **Electronic Process Integration: From EDI to “Portal Jungle”**

The automotive industry was among the first to tap the potentials of electronic information exchange to streamline the supply chain. Despite the early application of EDI (Electronic Data Interchange), even the big players in the automotive industry are still far from extensive electronic process integration throughout the entire product life cycle. To meet the process, information and reporting-related coordination requirements and cope with the emerging value chain configurations, companies must not only link their operational systems (specifically the ERP, SCM and PLM systems) via electronic workflows in future, but should increasingly focus on electronically processing documents and management information.

3.1 **Dominance of EDI in Structured Data Exchange**

The 1970s saw the start of the first industry-wide Electronic Data Interchange initiatives in the automotive industry. They resulted in various VDA recommendations for EDI as well as in the international EDIFACT standards’ industry-sector-specific subset ODETTE. As a form of machine-machine communication between two business partners, EDI enables seamless electronic processing of business documents. Today, EDI’s penetration in the automotive industry is very high, also due to the restrictions imposed on suppliers by OEMs. Though all major automotive companies have established an EDI infrastructure, the application remains limited to a small number of well-structured logistics documents, like delivery schedules, dispatch notifications and orders [Crossgate 2007]. Furthermore, the transaction volume and number of integrated partners confirm that there is as yet no extensive electronic integration of business processes (“electronification paradox”). The expensive implementation of EDI systems in the 1980s prevented the diffusion of more flexible, Internet-technology-based alternatives, such as XML-based electronic messages. Although Internet technologies have in the interim been widely diffused, automotive companies still maintain their plans to expand the usage of their EDI systems and integrate them even better into their backend systems [IDC 2007]. Besides “switching costs”, which prevent the replacement of the existing EDI infrastructures, reasons for the slight utilization of XML are also employees’ lack of qualifications and immense security worries regarding Internet use. Experiences that the authors gained with the implementation of industry standards like VDA QDX, which rely on XML, also demonstrate that widely-used software packages are not yet fully prepared to handle electronic process integration with external partners.

Despite many years of efforts, the adoption of industry standards in the automotive industry is still relatively low. For instance, at 17%, proprietary data formats are almost as often employed as EDI (17.2%) [E-Business-Watch 2005]. The adoption of Internet-based standards, such as the XML-based QDX standard by VDA, is, as discussed earlier, a slow process and remains far more difficult than foreseen. Only about 6% of the companies interviewed in 2005 employed XML-based standards in comparison to 17% that use EDI-based standards [E-Business-Watch 2005]. In many
cases, national industry consortia agree upon standards, which are later taken to the international level in long procedures driven by industry-sector-specific or cross-sectoral committees. This happened with EDI, whose standards have finally evolved into a subset of the EDIFACT standards for the automotive industry. The high degrees of freedom regarding the interpretation of standards as well as the company-specific customizing by the OEMs, whose market power allows them to impose their interpretation of standards on their business partners, prevent standardization’s desired beneficial effects. Individual interpretations of a standard lead to companies—notably suppliers—having to support various interpretations, which requires a specific effort, to stay in business.

### 3.2 Supplier Portals as Comprehensive B2B Platforms

To use the Internet for electronic coordination with their suppliers, manufacturers and some larger first-tier suppliers implemented extranets, which gradually expanded into comprehensive supplier portals. These supplier portals—such as BMW Group Partner Portal or VWGroupSupply.com—have emerged as very powerful integrating platforms. They started of by offering Web-based access to purchasing-relevant information and gradually broadening their scope. In addition to mere information supply, more and more internal applications have been integrated via portlets in these portals. Through these portlets, external partners can request, for example, actual quality key figures or monitor customer complaints. Consequently, portals do not only support information-related coordination, but also reporting and process-related coordination.

Such portal solutions are undeniably a comfortable solution for the operator side but not necessarily for the user side. A larger first-tier supplier has to use an average of 30-50 portals with engineers or other qualified employees spending significant time on transferring data from or in the portal to the own systems [Vogel et al. 2007]. The company-specific portal layout and the different portal technologies increase the effort that users need to familiarize themselves and for information monitoring and entry. The contractually short reaction times, for example, for commenting on change requests, require frequent, almost daily or hourly monitoring of portal contents. Supplier portals are in fact an easy opportunity to integrate suppliers; their advantages lie in the low costs and little effort required to connect suppliers. However, for users from larger suppliers, which support their internal processes professionally by means of IT solutions, portals are a time and cost-consuming human-machine interfaces requiring much monitoring effort and an error-prone, redundant data entry. Owing to the growing number of portals, which often contain more than hundred applications, suppliers are facing a “portal jungle”.

### 3.3 Digital Agents

Owing to supplier portals’ deficiencies and missing integration possibilities, digital agents that implement data extraction from Web sources have become widespread in the automotive industry. They are used for multiple purposes, from the periodic monitoring of updates to B2B process integration between companies. The essential
benefit of these agents is data transformation and transfer, although they do undertake further duties like the collection and storage of contents or the exchange of data. Digital agents enable a machine-machine interaction in business relationships, where information exchange would otherwise be carried out as human-machine interaction based on a supplier portal. This specifically reduces time-consuming monitoring and manual inspections of supplier portals. Although machine-machine communication cannot be set up everywhere, the agent application does strongly support human-machine interaction. Consequently, digital agents’ application in portal environments offers companies an intelligent, automated approach to data collection from supplier portals and the integration of heterogeneous data sources. Human activity is then decreased in the specific business processes and error rates can be reduced, which results in employee time savings as well as higher data quality. Currently, digital agents have already started to take over complex process coordination tasks and systems’ integration of business partners. They have also taken over former EDI application fields such as requests for proposals and sales departments’ order processing. The preparation of industry-sector-specific process know-how, support of different source and target formats as well as flexible integration opportunities facilitate the implementation of standards such as VDA QDX, thereby establishing m:n relationships. Further agent technology development is expected, which will also assume an important role in the future design of scalable B2B architectures.

3.4 Exchanges

Exchanges – or market places – were developed at the end of the 1990s; the were aimed at streamlining collaborative business processes and offering an exclusive access point for the parties involved in the process. The initial high expectations have in the meantime given way to disillusionment, since power-political reasons specifically affect the platforms’ success. A certain standardization of the electronic process support is necessary to realize potential exchange benefits. Despite the availability of 500 million USD, the OEMs could not really make the Covisint platform succeed, whereas the first-tier suppliers successfully established SupplyOn to coordinate their supplier network. In 2007 SupplyOn represented around 18 000 business relationships with more than 60 000 users and 4.7 million transactions [SupplyOn 2008].

3.5 Web Services and Service-Oriented Architectures

Web services and service-oriented architectures are currently expected to become the dominant future integration technology. They allow traditional message-based integration, as in the case of EDI, as well as a process-oriented integration and document-centric workflows to be realized. A main advantage is that Web services and SOA can not only be applied in high-volume transactions, but also in more complex and less structured collaborative business processes, such as product development or quality management.

Pilot tests – for example the “SOA for Automotive” project by BMW and the suppliers of the engineering change management scenario – have demonstrated the high potential of these approaches [Vogel et al. 2007]. The core Web service standards,
which include SOAP, WSDL and XML, are consistently supported by current middleware or SOA platforms. The WS-I basic profile specification eliminated the interoperability problems between different manufacturers; further WS-I profiles address security and reliability. However, at the same time it has become evident that also SOA and Web services cannot solve all B2B integration problems:

- Web services’ technical interoperability and the technology-focussed understanding of services that software vendors propagate are not sufficient to realize complex B2B scenarios. Cross-organizational business networking only works with SOA, if all the partners use Web services with the same semantics, i.e. that have a similar functional service design. The greatest challenge is the service definition from a business perspective and the use of standardized Web service signatures.

- In addition to the functional service design, non-functional service requirements have to be considered. This implies that, besides security and reliability, aspects like error processing or service levels should be defined.

- Companies have to employ appropriate middleware or SOA platforms to offering their external business partners services. While many companies do so, the existing applications do not as yet have service interfaces and the necessary basic services to realise B2B integration, for example, to manage external identities. Given the general conditions (heterogeneity in existing information system landscapes, available capacities compared to the adjustment effort), a total switch to SOA will take several years.

3.6 Consequences and Recommendations

Like process coordination, seamless electronic integration is mostly only realized in logistics by means of EDI. Despite the popularity of the Internet, those EDI connections have not yet been replaced by XML-based business documents, but are further deployed and expanded [IDC 2007]. The majority of electronic OEM supplier interaction occurs through supplier portals complemented by digital agents on the user side. Industry-wide exchanges are only accepted for use by the tier-one suppliers and their supplier networks with SupplyOn.

Consequently, the information and reporting-related coordination with external partners is still largely performed by human-machine interfaces without any direct integration into the relevant backend systems, i.e. transaction systems, document management systems or data warehouses. Media breaks and an insufficient electronic process integration of network members generate high costs due to duplications and because highly qualified employees often have to take over data transfer jobs. Furthermore, the emerging media breaks bear high risks due to mistakes and delayed processing. These costs and risks are mainly borne by the users’ side. The implementation of digital agents, which allow considerable cost savings and system integrations by taking on automated tasks and freeing employees from simple data entry and monitoring tasks, may offer a solution.
Antiquated technologies are only very slowly being replaced by modern Internet-based architectures, thus inadequacies – such as a lack of expandability due to the fixed EDI syntax – remain and a process-oriented linking of application systems will only become reality in the distant future. Even the emerging industry standards like QDX or ECM are only being slowly adopted, with their scope being focussed on the German community.

In the face of increasing vertical disintegration in the automotive industry, it is expected that the number of electronic integration relationships and their intensity will grow massively. This leads to a considerable need for action to develop scalable B2B architectures that support automotive companies to increase their networkability. Service-oriented architectures provide a basis for the automated data exchange of structured and unstructured contents in m:n business relationships. They specifically allow an improved electronic process handling, routing and monitoring. Also individual customization of partner-specific requirements, for example, business process variants or message structures, becomes easier. EDI will perhaps still be used for electronic data exchange in future, but its application will be limited to the transfer of simple, structured business documents.

<table>
<thead>
<tr>
<th>Description</th>
<th>EDI</th>
<th>XML</th>
<th>Supplier Portal</th>
<th>Digital Agents</th>
<th>Exchanges</th>
<th>SOA / Web Services</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data</strong></td>
<td>EDIFACT standards (VDA, ODETTE, ...); proprietary extensions</td>
<td>XML standards (VDA, ODETTE); proprietary data formats or extensions</td>
<td>None</td>
<td>depends on sender / receiver (EDIFACT, XML, proprietary, ...)</td>
<td>several (EDIFACT, XML, proprietary, ...)</td>
<td>mainly XML-based</td>
</tr>
<tr>
<td><strong>Communication and transport protocol</strong></td>
<td>FTP / OFTP / OFTP2; mostly via VAN</td>
<td>Internet (http); FTP / OFTP / OFTP2</td>
<td>Internet (http)</td>
<td>several</td>
<td>several</td>
<td>Internet and Web service protocols (e.g., http / SOAP)</td>
</tr>
<tr>
<td><strong>Network topology / business partner</strong></td>
<td>1:1 (if proprietary data formats are used), m:n (in the case of standards)</td>
<td>1:1 (if proprietary formats are used), m:n (in the case of standards)</td>
<td>1:n (in the case of supplier portals operated by OEMs)</td>
<td>n:m (via intermediary)</td>
<td>n:m (via intermediary)</td>
<td>1:1 (if proprietary service definitions are used), m:n (in the case of standards)</td>
</tr>
</tbody>
</table>
### Adoption in the Automotive Industry

<table>
<thead>
<tr>
<th>Total</th>
<th>Medium</th>
<th>Low</th>
<th>High</th>
<th>Increasing</th>
<th>Medium</th>
<th>Low / increasing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas of adoption</td>
<td>mostly logistics, partly invoicing</td>
<td>quality management (VDA QDX)</td>
<td>in all collaborative business processes</td>
<td>mostly quality management, warranty and compliance</td>
<td>mostly logistics, production and quality</td>
<td>open</td>
</tr>
</tbody>
</table>

### Suitability to address the emerging requirements in the automotive industry (see Chapter 2)

<table>
<thead>
<tr>
<th>Process-related coordination</th>
<th>(business processes with high transaction volumes and structured information exchange)</th>
<th>(only applicable to simple single-step-processes)</th>
<th>(mostly for portal provider; media break)</th>
<th>(only simple single-step-processes)</th>
<th>(only simple single-step-processes)</th>
<th>(applicable also to complex multi-step-processes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information-related coordination</td>
<td>○</td>
<td>●</td>
<td>(mostly for portal provider; media break)</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Reporting-related coordination</td>
<td>○</td>
<td>●</td>
<td>(mostly for portal provider; media break)</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Partner-specific extensions</td>
<td>○</td>
<td>(only for documents)</td>
<td>(only for portal provider)</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Integration with internal systems</td>
<td>(separate infrastructure for B2B and internal integration)</td>
<td>(mostly for portal provider; media break)</td>
<td>(partly)</td>
<td>(partly)</td>
<td>(partly)</td>
<td>(common infrastructure for B2B and internal integration)</td>
</tr>
</tbody>
</table>

Figure 0-1: Variants of Electronic Integration
4 Outlook and Recommendations

4.1 Networkability as a Management Task

Automotive companies increase their networkability — and thereby stay competitive — only if they do not just optimize their internal processes, but at the same time actively design their external business relationships. Mere reactive behaviour will lead to external business relationships’ diversity and heterogeneity impacting internal processes and systems in the medium term. This would ultimately generate increasing (internal) complexity costs and restrict the internal scope for action decisively, for instance with process changes.

By applying the established Business Engineering approach to the business network, companies have to make important strategic, organizational and information-system-oriented design decisions:

- On the **strategic level**, the individual company has to redefine its positioning in the business network. This positioning is a basis for segmenting existing business partners (e.g., by identifying A-customers or A-suppliers with high cooperation intensity) and for defining the cooperation models that need to be supported.

- On the **organizational level**, companies should orient themselves towards “public processes” to become networkable. The latter describe public processes which are in fact a sector-wide “common practice” and enable a comprehensive optimization of cross-organizational business processes. To handle manifold cross-cutting issues at the organizational interfaces with external partners, companies have to clearly define responsibilities for managing their partner network, too.

- On the level of **information systems**, the growing need for integration is not adequately covered by the dominant B2B integration approaches EDI and portals. In the future, they will be replaced by efficient process platforms, which build on the principles of a service-oriented architecture. They link internal und public workflows by means of the existing application systems. Thus, they are in the position to meet the extensive demands for process, information and reporting-related coordination.

The conceptualization of a private, internal view and a public one helps focus attention on cross-organizational process and system integration’s essential design elements and eliminates internal processes and IS architectures’ complexity and heterogeneity.
4.2 Organizational Need for Action: Network Management and “Public Processes”

Although an increase in networkability is the decisive factor for future competitiveness, the responsibilities for external business relationships are not sufficiently defined in the automotive industry. Questions referring to integrative aspects and organizational interfaces are often clarified on the departmental level, particularly in development, purchase as well as production & logistics. This means that cross-cutting issues remain often unconsidered and different procedures, concepts and infrastructures for partner integration develop companywide. Even if purchasing departments are often defined as the main contact for suppliers, the current situation makes it impossible for them to thoroughly fulfil their responsibility for the network management. Ideally, the network manager takes on the job of contact person for business partners’ integrative requests. Based on the segmentation of business partners and defined cooperation models, he is in charge of implementing the overall strategy, which results from the positioning of the company within the business network. In close cooperation with the departments, he provides a continuous optimization of the organizational interfaces and cross-organizational processes along the product life cycle. The identification of “public processes”, which should henceforth be used as de-facto standards in the sector, plays a central role in the network management. An important precondition is that partner-specific process variants should be introduced flexibly and at lower costs, and that dependencies between public and internal processes are reduced to a minimum. The implementation of the network management’s dedicated responsibilities will ensure that important strategic options for the business network’s further development are addressed and implemented.
4.3 Technical Need for Action: Process Platforms

Whereas B2B integration is now often realized as an individual project, the growing variety and heterogeneity of electronic integration relations can in future only be managed by a thoroughly planned B2B architecture. Figure 4-2 shows the target architecture for a service-based integration of companies, with public business processes electronically integrated by means of a service-oriented process platform. The target architecture separates the private, internal view from the public view, which is revealed to external business partners. The “public process” and its mapping to the related service interface, the “public business service”, are the two main constituents of cross-organizational process integration. The latter is available in the form of a WSDL description and the respective XML messages. Companies find the relevant services in a service directory’s partner-specific view. Seamless external process integration is possible by invoking service operations via the process platform and responding to external service requests.

The growing maturity of service-oriented architectures enables the realization of comprehensive process platforms with the following capabilities:

- Process platforms separating process and application logic. They simply connect application functions by means of the orchestration (internal) and choreography (public) of web services, thus accelerating the implementation of new process variants.

- With converging platforms for B2B integration (B2Bi) and Enterprise Application Integration (EAI), it will be easier to closely connect public service requests with internal workflows. This supports the seamless processing and integration into the respective internal backend systems, specifically transaction systems (ERP, SCM, PLM ...) as well as document or content management systems and management information systems (Data Warehouses).

- By using XML and Web services, process platforms can cover a broad spectrum of B2B scenarios and their requirements in terms of process, information and reporting-related coordination. Compared to message-based approaches, they can also support more complex (multi-step) processes.

- Process platforms support the different electronic B2B channels (machine-machine and human-machine), given that services can be accessed via a portal as well as via a cross-platform and cross-organizational Web service call.

- A process repository contains templates for “public processes” which can be customized to partner specificities.

- Basic services for public process integration such as the authentication of business partners, logging, etc. can be centrally provided and reused in various cooperation relationships. These services can also be easily purchased from external experts.
4.4 Industry-wide Need for Action: Standardization of “Public Processes” and “Business Services”

In external business relationships, m:n capability can only be achieved if standards and platforms are available for coordination within a business network. Based on previous experiences in the automotive industry, future standardization initiatives should primarily consider the following points to avoid mistakes like high start-up costs for the use of standards or for their implementation.

- **80:20 rule**: Standardization should focus on the few, most relevant aspects for a cross-organizational process, instead of accommodating the requirements of every single organization and defining numerous optional fields into message formats and process variants. However, reasonable concepts for partner specific extensions should be predefined.

- **Implementation guidelines**: To achieve a uniform implementation of industry standards, very detailed specifications have to be given for their implementation beforehand (profiling of standards). In doing so, the standardizations should start from de-facto standards with low start-up barriers like Web service and Internet technologies.

**Process models as integral part of industry standards**: To fully describe process aspects and organizational interfaces, process models have to become an integral part of the standardization.
## 5 List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECM</td>
<td>Engineering Change Management</td>
</tr>
<tr>
<td>EDI</td>
<td>Electronic Data Interchange</td>
</tr>
<tr>
<td>EDIFACT</td>
<td>Electronic Data Interchange For Administration Commerce and Transport</td>
</tr>
<tr>
<td>ELV</td>
<td>End of Life Vehicles Regulation</td>
</tr>
<tr>
<td>e.g.</td>
<td>For example</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
</tr>
<tr>
<td>JIT</td>
<td>Just in time</td>
</tr>
<tr>
<td>KLH</td>
<td>Komponentenlastenheft – Component Specifications</td>
</tr>
<tr>
<td>ODETTE</td>
<td>Organization for Data Exchange by Tele Transmission in Europe</td>
</tr>
<tr>
<td>OEM</td>
<td>Original Equipment Manufacturer</td>
</tr>
<tr>
<td>QDX</td>
<td>Quality Data eXchange</td>
</tr>
<tr>
<td>REACH</td>
<td>Registration, Evaluation, Authorization and Restriction of Chemicals</td>
</tr>
<tr>
<td>RGA</td>
<td>Produktreifegradabsicherung – Product Maturity Validation</td>
</tr>
<tr>
<td>RoHS</td>
<td>Restriction of the use of certain hazardous substances in electrical and electronic equipment</td>
</tr>
<tr>
<td>RPP</td>
<td>Robust Production Process</td>
</tr>
<tr>
<td>UN/CEFACT</td>
<td>United Nations Centre for Trade Facilitation and Electronic Business</td>
</tr>
<tr>
<td>VDA</td>
<td>Deutscher Verband der Automobilindustrie – German Association of Automotive Industry</td>
</tr>
<tr>
<td>VMI</td>
<td>Vendor Managed Inventory</td>
</tr>
<tr>
<td>XML</td>
<td>Extensible Markup Language</td>
</tr>
</tbody>
</table>
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[Oliver Wyman/Fraunhofer IPA, IML 2004]


iSIFrame -
the iPoint
BPM platform
Whitepaper-FollowOn: iSIFrame – the iPoint BPM platform

Contents:

1 Consequences of the whitepaper’s policy recommendations ................................................................. 3
2 iSIFrame – the iPoint process platform ....................................................................................................... 4
3 iSIFrame solution examples ........................................................................................................................................ 5
   3.1 QDX – data integration with the iPoint Value Chain Agent ................................................................. 5
   3.2 PPM monitoring with the iPoint Value Chain Agent and the iPoint Enterprise Portal ........................................ 6
   3.3 Inter-company compliance processes with the iPoint Compliance Agent .................................................... 7
4 Conclusion ........................................................................................................................................................................... 8
Consequences of the whitepaper's policy recommendations

The white paper clearly identifies the way out of the currently prevailing IT dilemma: many inter-company processes end on the IT side due to corporate boundaries. Integration of data, applications and processes are really the exception – time consuming ‘human interfaces’ and media breaches predominate where machines should be communicating with each other.

The short-term solution: software agents put things straight in the portal jungle. Here we recommend the iPoint product portfolio for fast and reasonable efficient improvement in the areas of value chains (Value Chain Agent), and legal compliance (Compliance Agent).

The strategic solution: A universal integration platform enables data exchange between companies in terms of enhanced network capability. This is exactly the scope of iSIFrame.
2  **iSIFrame – the iPoint process platform**

iSIFrame is a fully process-oriented IT architecture. It follows the SOA (Service Oriented Architecture) dogma to enable the communication between companies:

- Separation of process logic and application code all the way to flexible sub-processes
- Single process layers are individually configurable and highly flexible
- A process management system manages explicitly defined processes
- A user-specific, individual data view is possible
- Different workflows support the particular process
- Improvement of the process quality by reducing mistakes and idle times
- Increased flexibility in terms of fast changing process requirements

The main objective of iSIFrame is to support inter-company processes through an efficient data exchange between external and internal systems. In combination with the well-established and proven agent technology plus the iPoint product portfolio built on top, it is possible to fully integrate these processes.
3 iSIFrame solution examples

3.1 QDX – data integration with the iPoint Value Chain Agent

QDX is the VDA standard for cross-company exchange of quality data along the supply chain in the automotive industry.

The challenge:
Semantic fuzziness and OEM-specific extensions as well as different file formats complicate data exchange.

The solution:
The iPoint extension QDXplus integrates OEM-specific QDX formats, thus enabling the desired generic, process-oriented data exchange. Optionally, the extension to an 8D and / or complaint tool is possible.

The iPoint Value Chain Agent is THE integration solution for quality data in the automotive industry.

The advantages at a glance:

- Minimized manual effort through data and process integration
- Higher process security
- Shorter run-times
- Data integration between internal and external systems
- High conformity demand regarding OEM-specifications
- Complete coverage of the 8D and complaint processes
3.2 PPM monitoring with the iPoint Value Chain Agent and the iPoint Enterprise Portal

Using the iSIFrame component ‘Enterprise Portal’, different web elements and applications can be integrated under a common look-and-feel as well as with a single-sign-on approach. The current Portlet 2.0 standard is utilized, so that these elements can easily be integrated into existing portal environments as well.

An interesting example for such a portlets is the PPM monitor, an optional component of the iPoint Value Chain Agent. It provides a comprehensive graphical visualization of your PPM values including multiple ‘drill-downs’ down to the part number level. The relevant data is automatically loaded from the OEM web portals and stored in a local database, enabling statistic reports over longer periods of time.

The advantages of the iPoint Enterprise Portals:

- Single Sign-On
- Common Look-an-Feel
- Multiple integration options for web based applications
- Suitable for Intranet, Extranet and Internet Solutions
3.3 Inter-company compliance processes with the iPoint Compliance Agent

Using intelligent integration technology, the iPoint Compliance Agent assists in following product specific, legal and individual requirements to product substances. Legal requirements include ELV (End-of-Life Vehicle), the different incarnations of RoHS (Restriction of certain Hazardous Substances) and REACh (Registration, Evaluation, Authorisation of Chemicals). The Compliance Agent also manages environmental requirements like RRR (Recycling, Reuse, Recovery), DfE (Design for Environment) and LCA (Life Cycle Assessment).

Your benefits from using the iPoint Compliance Agent:

- One central communication and process tool for all product and compliance requirements like IMDS, REACh, RoHS, RRR and other job and environmental related requirements.
- One central solution for compliance analysis, substance and usage management, quantity analysis, declarations and sign-offs.
- One central solution to efficiently collect and process all product related compliance information.
- One central solution for compliance, design, engineering, logistics and supply chain processes.
- One central solution for more product safety and a solid relationship between customers and suppliers.
4 Conclusion

The iPoint iSIFrame architecture provides the unique combination of 'instant help' (intelligent software agents) and strategic integration solutions (process platform). You can immediately start improving your networkability and processes and at the same time strategically begin implementing software controlled business processes.

iPoint-systems offers a complete software portfolio:

- Standard software like the iPoint agents with their Live-Up-date feature help you save resources and enable a faster and more cost effective change management.
- Integration of individual components through our powerful Developer Suite.
- Integration know-how, especially in the SAP area – including the full SAP certification.
- Competitive advantage through active collaboration in the most important standards committees (VDA QMC, AK7) as well as current OEM eBusiness projects (i.e. Daimler DocMaster, PSA Amadeus, AUDI QTX, ...).
- Comprehensive know how through a dense automotive business network, especially to suppliers.
- International experience and competency through many customers and projects.
- High degree of innovation through a large number of globally acting customers.
- Market driven development – our software typically is incubated through customer projects.
More than 160 customers worldwide already chose iPoint-systems for their integration solutions!