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**Deliverable D.A7.3**

**Business Content for Selected Industry Best Practice**

**Work package – A7.5**

Leading Partner: SAP

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1 Executive Summary

This Deliverable summarizes experiences from applying methods and tools developed in A7 on selected industry standards, best practices and ATHENA scenarios. A7 has developed methods and tools to support the efficient handling of business documents exchanged in cross-organisational business processes. Furthermore, it provided results on modelling and enacting business protocols as an extension of cross-organisational business processes (CBPs) describing the interaction between business partners. As a further result A7 conducted an analysis of several industry standards and industry best practices in the area of business documents and protocols. A7 also did a survey among the ATHENA user partners providing piloting scenarios to gather the specific requirements for an efficient handling of business documents and protocols. The survey and analysis results provided the basis for selecting ATHENA scenarios and industry standards for the creation of business content.

The results for an efficient management of business documents and protocols have been applied in the following scenarios:

- eProcurement scenario from the furniture pilot
- car configuration scenario from the outbound logistics pilot
- strategic sourcing scenario from the automotive pilot
- process for ordering a new vehicle from the manufacturer based on the STAR standard

The overall experience made was that the results achieved in A7 are well suited to handle industry scenarios and standards. They were able to address the requirements specified by the ATHENA user partners in the interviews executed earlier. A7 results also made a significant contribution to the outbound logistics pilot.

From an overall ATHENA point of view, A7 has provided results that complement the results provided by A2 on modelling and enacting CBPs. In particular, A7 results contribute to closing gaps in the area of modelling the information exchanged between business partners. A7 results provide means to also involve business users in the modelling effort thus abstracting from the purely technical representation provided e.g. by XML messages exchanged via Web services. To also support business users in creating mappings between external and internal data formats, semi-automatic mapping approaches have been developed.

The protocol related results allow specifying the interaction between partners modelled in a cross-organisational business process at a more fine-grained level. They also target different execution platforms for protocols such as agent platforms or BPEL protocols thus considering different infrastructures already existing at partners.

All scenarios showed that the Peer-to-Peer based repository for business documents and protocols facilitates an easy exchange of document and protocol models among partners. The Peer-to-peer infrastructure provides a robust and decentrally organized platform for this distributed repository.
2 Introduction

This document summarizes experiences from applying the methods and tools developed in A7 on selected industry standards, best practices and ATHENA scenarios. A7 has developed methods and tools to support the efficient handling of business documents exchanged in cross-organisational business processes. Furthermore, it provided results on modelling and enacting business protocols as an extension of cross-organisational business processes describing the interaction between business partners. From an overall ATHENA point of view, A7 has provided results that complement the results provided by A2 on modelling and enacting cross-organisational business processes (CBPs). A detailed technical description of the results is provided in Deliverable D.A7.2 ([2]). As a further result A7 conducted an analysis of several industry standards and industry best practices in the area of business documents and protocols. A7 also did a survey among the ATHENA user partners providing piloting scenarios to gather the specific requirements for an efficient handling of business documents and protocols. The results of this work are documented in Deliverable D.A7.1 ([3]).

The content of the two Deliverables named above provide the starting point for the work documented in this final Deliverable of project A7. The survey and analysis results from D.A7.1 provide the basis for selecting ATHENA scenarios and industry standards for the creation of business content. D.A7.2 provides the technical results that have been used and evaluated.

In particular we have applied A7 results in the following ATHENA scenarios:
- eProcurement scenario from AIDIMA (ATHENA pilot B5.6)
- car configuration scenario from CAS (ATHENA pilot B5.9)
- strategic sourcing scenario provided by CRF (ATHENA pilot B5.5).

Applying the results in ATHENA piloting scenarios allowed us to assess the usability and benefits of the results for industrial settings. For each of these scenarios you will find a brief description of the scenario, the A7 results applied and a summary of the outcomes in the remainder of this document.

In addition to that we have also applied A7 results to the STAR (Standards for Technology in Automotive Retail) standard from the automotive industry. This allowed us to assess the potential of the developed methods and tools to facilitate the implementation of concrete industry standards for users. For this case you will find a brief description of the scenario considered, the A7 results applied and the experiences made.

The business content created for the eProcurement scenario will be shown in the A7 demonstrator at the final review. The business content created for the car configuration scenario will be demonstrated as part of the B.5.9 pilot at the final review.

The Deliverable is structured as follows. In Section 3 we describe the application of A7 results to the selected ATHENA scenarios and summarize the outcomes. Section 4 focuses on the application to the STAR industry standard before we summarize the main findings in Section 5.
3 ATHENA Scenarios

In this section we present three ATHENA scenarios in which we have applied A7 results to test their usability and relevance for industrial settings. We start with the eProcurement scenario from AIDIMA (pilot B5.6, [4]) focusing on eProcurement in the furniture industry. The second scenario is the car configuration scenario provided by CAS (pilot B5.9, [5]). The last scenario is the strategic sourcing scenario which is extending the CRF pilot (pilot B5.5, [5]). We briefly sketch each scenario and describe which particular A7 results have been used in the scenario. We close with summarizing the experiences made.

3.1 eProcurement Scenario

3.1.1 Scenario Outline

The eProcurement scenario builds on the scenario provided by AIDIMA in ATHENA pilot B5.6. It is a furniture industry process and focuses on the procurement of raw material and finished furniture. The involved partners are the furniture manufacturer, the retailer and several suppliers that deliver raw material to the manufacturer. Figure 1 illustrates the scenario and the main interactions between the parties involved. The interactions between the partners show the business documents exchanged. The scenario can be briefly outlined as follows:

- A retailer receives a customer request for particular furniture. He sends a Request for Quotation to the manufacturer who answers with a quotation specifying e.g. a price and an estimated delivery date. If the customer is satisfied with this offer, the retailer sends an order on behalf of the customer.
- After receiving the order, the manufacturer checks if there is enough material on stock to produce the furniture. If that is not the case, the interaction between the manufacturer and its supplier starts. The manufacturer sends a request for quotation to each supplier involved (in the scenario illustrated below two suppliers are involved). Each supplier answers with a quotation that is followed by an order sent by the manufacturer and an order confirmation from each supplier.
- Only after the manufacturer has received the order confirmation he can send the order confirmation with the promised delivery date and the final price to the retailer.

One goal of this scenario is to define a set of business documents to be used for the electronic procurement between the partners. These documents define an industry best practice that all partners that want to participate in the scenario should follow. Thus, it provides a good test case for the evaluation of the A7 results in the area of business documents. Furthermore, the eProcurement...
scenario has already been used in the A2 demonstrator at the M18 review where we have demonstrated how to model the cross-organisational business process. Also the AIDIMA pilot makes use of specific A2 and A5 results for modelling and enacting the cross-organisational business process (in particular Maestro [7], Gabriel [9], Nehemiah [8] and Johnson [10]). In the following, we therefore focus on the A7 specific results for business documents complementing the modelling and enactment of cross-organisational business processes. We also describe some results on modelling business protocols and linking them to business processes.

3.1.2 A7 Results Applied Within Scenario

As described above we focus on a scenario in which the manufacturer, the retailer and two suppliers are involved. This setting allows us evaluating different use cases in which A7 results can be applied. Figure 2 summarizes the scenario and shows which specific A7 results each partner uses. In the following we describe in more detail the different use cases and the interaction between the partners.

We start with the Retailer. The Retailer uses the Metis/AKM tool together with the Metis/AKM Enterprise repository to import, model and store the service definitions and messages he uses to interact with the manufacturer. Therefore the Retailer executes the following steps:

- He imports a WSDL file describing the interface provided by the Manufacturer. This contains also XML schema description of the business documents used, in particular the request for quotation, the quotation, the order and the order confirmation.

- In a second step he maps the business document parts of WSDL to enterprise model types describing the information that is available in its information systems.

- In the last step he populates the repository by invoking the Web service interface providing access to the repository.

The Retailer represents the use case where a partner gets interface and document definitions from the business partner and directly implements them. Thus, only technical staff is involved in implementing the interaction with the manufacturer at the Retailer.

At Supplier 1 business level experts are involved in defining the documents that are to be used for the interaction between the partners and esp. between the suppliers and the manufacturer. Therefore Supplier 1 uses the Maestro extension Maestro for BDM (Maestro for Business Document Modeling). Maestro for BDM is a graphical modeling environment that implements the component-based modeling method described in Deliverable D.A7.2 ([1]). As it is implemented as an extension for Maestro the document models can easily be linked to the models of the cross-organizational business process demonstrated earlier.
Supplier 1 models the documents. Figure 3 shows an example of the model for the quotation document that is used in the eProcurement scenario. To re-use the document in a different scenario he could add a different business context and specify which data fields are to be used in that different document.

To exchange the business document models with the partners Supplier 1 stores the models of the business documents in the common P2P-repository from which the other partners can retrieve the models. If one partner needs a technical level representation of the documents he can use the XML export functionality that transforms document models created with Maestro for BDM to XML schema representations.

Supplier 1 illustrates the use case in which business experts are involved in modeling the documents to be exchanged. Therefore, means are needed to transform the business level representations to more technical descriptions. Depending on which types of models are needed by the partners, the different types of models can be exchanged via the common P2P repository.

This is the entry point for the Manufacturer. He uses an internal data format that is very expensive to adapt. The application that is used by the Manufacturer is not based on XML schemas. Therefore he has to find a way to make it comparable and map it to the documents sent to and from the retailer. The Manufacturer follows these steps:

- The Manufacturer retrieves the document models specifying the documents, e.g. the quotation shown above, from the common P2P repository.
- He creates an XML schema description for these documents using the XML export functionality described above.
- He creates an XSD of the related internal document formats and annotates it with DFDL.
• By using the automatic mapping he generates a first proposal for the mapping between the annotated XSD of his internal data format and the XSD specifications provided by the retailer. He can then further refine the mapping in the map generator.

• To executing the transformation at runtime the manufacturer creates a Java program that will then be used at runtime to map the data.

This use case demonstrates how a user can include also non-schema-based documents in the interaction. Additionally it demonstrates the support of automatic mapping procedures in creating mappings for documents.

Supplier 2 focuses on the protocol part of the A7 results. He uses a prototype for model-driven protocol development, called View Process Demonstrator (VPD, see [1]). The aim is to derive protocols that are synchronized with the internal business processes of Supplier 2.

In the VPD, enterprise internal business processes (Private Processes) can be described with the Event-driven Process Chain EPC. In order to derive a view process, the elements of these private processes can be annotated to indicate in which form they should appear in the view process. For example, elements declared as “hidden” will not appear in the view process and elements annotated as “aggregation” will only appear as one single element in the view process. Based on this EPC View process, a so called technical EPC View process can be created. In order to do this, the EPC can be enriched with BPEL-typical elements, e.g. functions can be annotated with the Web Service which executes this function and XML documents can be specified as input or output of the Web Services. Further on, the view processes can be refined with further elements to describe interactions with partners. For example, where the private process only contains the function “Agree on Meeting Date”, the view process could further specify the messages that are exchanged to fulfil this function (for example a loop could be modelled, that is executed until both parties agree on a meeting date). Based on this technical View process BPEL protocols can be derived by automatic transformation (see [16]).

The EPC model and the technical EPC models are stored in an XML format created for EPCs (EPC Markup Language - EPML). Since various modelling tools exist that export EPML, the VPD can also import models created with by other tools. Figure 4 illustrates the various models involved in the protocol creation. For illustrative reasons two enterprises are shown, but the VPD only captures the models of one enterprise.

![Figure 4: The different model types and their relations to be captured by the VPD](image)

In the eProcurement scenario the VPD can be used by Supplier 2 in the following steps:

• First, he creates an EPC view process from an EPC private process to show the manufacturer on a business level what interface he can provide.

• In a discussion with the Manufacturer it turns out that even on the business level (EPC) the view process has to be changed.

• Accordingly, Supplier 2 changes the EPC view process as well as the internal EPC process corresponding to the view process.

• Further on, the Manufacturer already had specific XML documents and Web Services in mind that should be used in the interaction. Thus, Supplier 2 adds this information to the EPC and creates a technical EPC view process.

• The Manufacturer also requests a more detailed interaction description for a particular step: the price negotiation was only contained as a single function in the view process, now
Supplier 2 models this as a loop, including a special confirmation message for the final agreement.

- Finally, Supplier 2 automatically generates a BPEL protocol from the technical EPC view process. He delivers this both to his internal IT department and to the IT department of the Manufacturer, where the corresponding IT systems can be configured precisely to the described protocol.

As the format of the business documents to be exchanged with the Manufacturer is not the same as used internally at Supplier 2, Supplier 2 uses the Semaphore tool (see [11]) to create mappings between the XSD provided by the Manufacturer and the internal one. The data format used internally at Supplier 2 is described in an ontology representing the internal data format. To create the mapping the ontology is imported from ATHOS. Additionally, the target XML format is opened. Then, the Semaphore tool is used to automatically create the transformations between the two document formats. The transformations are stored in an XSLT document that can then be used during runtime.

The scenario part of Supplier 2 demonstrates how partners can agree on business protocols describing the detailed interaction in their business scenario. Using the ARIS models business people can be involved in agreeing on the high level interaction. Then technical specialists can continue with creating the protocol definitions and linking them to execution level models. Regarding the documents involved the scenario demonstrates how ontologies can be used to support the creation of mappings on the technical and execution level. Again, the specification of the mappings happens on execution level document models and thus requires technical experts. The technical document models are exchanged between the partners using the common Peer-2-Peer repository that is linked to the modeling tool.

### 3.2 CAS Pilot

#### 3.2.1 Scenario Outline

Before the 1st of October 2002, the block exemption regulations governing the distribution of motor cars allowed car manufacturers to select their car dealers and to let them benefit from a system of exclusivity on their sales territory. In fact, such a specific distribution organization was typically combining “selectivity criteria” with “exclusivity criteria”. As a consequence of the enactment of the Directive 1400/2002, the car manufacturers have no longer had the possibility to combine the two criteria. From now on, they are rather forced by the European rules to make an exclusive choice between these two options. Under such new circumstances, the distribution system based on a “selective” approach has probably the preference of the car manufacturers, as this allows them to select the elements of their distribution chain according to their own quality and quantity criteria. With the selective distribution model, each car manufacturer will have to define its respective quantitative criteria beforehand, e.g. sales quota, as well as qualitative criteria, e.g. size, showrooms, which will be used to objectively and neutrally select its dealers.

As a result, the competition will be enhanced between the dealers of the same single car brand whereas dealers selling more than one car brand will have a real opportunity to gain new market shares.

The business case we are looking at in this pilot are these multi-brand dealers, more specifically the situation at AVAG. Multi-branding seamlessly offers products of different brands in one coherent sales process. This establishes a certain level of comparability among products of different brands and provides added value to the customers, thus strengthens the competitiveness of multi-brand dealers. However, multi-branding calls for an increased level of interoperability among the dealer on one side and the different manufacturers on the other side.

Today’s multi-brand dealers are, however, faced with a simple multiplication of IT systems to support their pre-sales, sales and after-sales processes. This includes a set of typically isolated systems for car configuration and order processing provided by the different car manufacturers together with a dealer specific IT landscape such as dealer management systems and CRM systems.

As a consequence, one of the desired advantages of multi-branding, namely to seamlessly offer cars of different car manufactures and to establish comparability among the different products is seriously put at stake. We rather observe the phenomenon of "early brand selection" that is, a customer has to choose one brand very early and then go all the way through the brand-specific
product configuration and order process. Changing the brand later requires starting the process all over from the beginning.

Using ATHENA methodologies and tools, we propose an integrated scenario, where multi-brand dealers use inter-operable services provided by the different car manufactures and plug them into an integrated dealer system.

As pilot application we focus on an electronic business process between a car dealer that sells cars of different brands and one or more car manufacturers. When a client visits a car dealer, his idea of the car he wants to buy will generally be rather vague. The problem for the dealer is to find the car among the many options, which are available from different manufacturers that will maximise the customer’s satisfaction. By asking the client a couple of questions the dealer can reduce the available options of suitable cars to a manageable number. He can present these to the client, who can then select a specific car to inspect in more detail.

The product data and available customisation options are retrieved online, directly from the manufacturer, whenever a client is interested in looking at a specific car in detail. A simple business protocol can be defined that describes the flow of interaction between the dealer and the manufacturer. Different manufactures may prescribe different forms of interaction how model information may be retrieved from them online. In order to make this transparent to the dealer and allow him to interact in the same way with different manufacturers it makes sense to introduce a process integrator instance. The integrator resides between the dealer and the different manufacturers and enables interaction of the dealer with the manufacturers.

![Interaction Diagram](image)

**Figure 5: Interaction diagram of the scenario process**

As a concrete example, a dealer D can be considered that wants to integrate the manufacturer services M1 and M2 into its sales room system. Figure 5 shows an interaction diagram that outlines the interaction of the dealer and the software he uses, the integrator, and a manufacturer. When the dealer starts a new process by selecting a specific car in his dealer software, also the integrator and the manufacturer in turn are initialised with that product. Optionally, an arbitrary number of modifications can be made to the selected product by inserting or deleting elements from the product description. When the dealer has finished configuring the car (in correspondence with the client) the dealer software triggers a check with the manufacturer if the selected configuration is valid. The manufacturer can return a number of alternative products that match the specified configuration.

If no alternatives are returned, the dealer needs to reconfigure the product. If more than one
alternative is returned, the dealer needs to select one among them and enter his choice into the
dealer software which forwards it to the manufacturer. After that, or if only one alternative was
returned after checking the configuration, the process terminates successfully and further actions
can be taken based on the successful selection of a specific car for the client, which are not part of
the process introduced here.

In the described process, the integrator basically just forwards all requests from the dealer to the
manufacturer M1 and returns the corresponding results from the manufacturer. In this way the
integrator transparently mediates the access to the service of the manufacturer. This is valuable if
access to a second manufacturer M2 needs to be integrated.

For simplicity we assume that M2 has just one operation analyzeConfiguration that returns
either success or failure, depending on whether the supplied configuration is available or not. Instead
of having to change the dealer software, only the integrator needs to be adapted to also provide
access to M2.

In this scenario it is assumed that M1 and M2 are exposing Web services with the names
ProductConfiguratorService and ProductConfiguratorServiceDoc respectively. A convenient way to
implement the integrator is to provide it as a Web service ProductIntegratorService that is
straightforward for the dealer to access, but is implemented using agent technology. Note that the
interface of the ProductConfiguratorService is identical with ProductIntegratorService. The overall
process for the integrator is specified in a PIM4SOA model and transformed to an agent platform.

3.2.2 A7 Results Applied Within Scenario

The business protocol between dealer (dealer software), integrator and manufacturers is
specified as PIM4SOA model. In order to execute collaborative processes specified on the PIM level,
the first step consists of a transformation from PIM4SOA to agent models (developed in A6 and
further extended in A7) that can be directly executed by specific agent execution platforms. In our
case, the Jack Intelligent agent framework [1] is used for the execution of BDI-style agents. The
constructs of the PIM4SOA metamodel are mapped to BDI agent systems represented by the Jack
metamodel (JackMM).

We used the Graphical Editor developed in the ATHENA project by SINTEF to edit and alter the
model (see appendix for the PIM4SOA model). The model is then transformed to a JACK agent
model with the model-to-model transformation developed in ATHENA (see appendix for the resulting
JACK model). The following sketch outlines the metamodel mappings.

![Figure 6: The main transformation rules that map PIM4SOA models to executable JackMM models](image)

We concentrate on the five transformation rules that are illustrated in Figure 6:

At first glance an agent seems to be the best match for a service provider, but since
ServiceProvider references Roles, it is recommended to assign it to a Team. The name of the
service provider coincides with the name of the team, its roles are the roles the team performs and
the team makes use of the roles specified in the CollaborationUse, in which it participates, as bound roles.

A Collaboration is mapped onto a team that may again consist of any number of agents. Although the metamodel for PIM4SOA allows specifying constraints on the behaviour of the participating collaborations and their roles, up to now it is unclear how these constraints might look like.

Besides introducing a role in JackMM for each role a service provider and collaboration performs, we define a team and two TeamPlans for every role service providers and collaborations make use of. The atomic team is only represented by the corresponding role in the PIM4SOA. The team plans specify how the requested service is invoked and how the corresponding team reacts on a service request.

The Process of a PIM4SOA can easily be transformed into team plans. The roles a team plan uses are extracted from the bound roles in the collaboration use the corresponding team interacts. As a first approach, we transformed the sequential process structure of a PIM4SOA model into a sequential team plan.

Finally, Messages that are sent by the roles we already have transformed are mapped to Events in JackMM.

The process integrator and the manufacturers are modelled as Web services. Their interface is described by WSDL descriptions (see appendix). In the pilot, only the process integrator is executed by JACK agents which are wrapped by a Web service, whereas the manufacturer services are pure Web services. For integrating Web services into the JACK agent platform and publishing the platform as Web service, we used the WSDL2JACK tool developed in ATHENA ([12],[13]) for automatically creating stubs and parts of the required agent model (especially teams and events related to messages) which are then incorporated into the model generated with the help of the PIM4SOA transformation outlined above.

Integrating several manufacturers leads to a further problem. As can be seen from the different WSDL descriptions of the manufacturer services, the data structure and also the operations offered by the services are different. The differences in the operations are mediated by the PIM4SOA model whereas the differences in the data structure need a separate solution. We used the Semaphore tool developed in ATHENA ([11]) in order to specify a mapping between different data schemas. The mapping is then exported as XSLT transformation and used by the agents during run-time to transform requests to manufacturers and transform back their replies.

3.3 Strategic Sourcing Scenario

The strategic sourcing is that part of a product development process in which the product is designed up to the level where the involvement of suppliers is required. This includes particularly the selection of suppliers and, thus, a strategic orientation regarding partnering strategies. In this context strategic sourcing refers to acquisition of components and their technical specification based to the OEM's requirements, the continuously progressing product definition, and the supplier involvement.

The ATHENA Automotive Scenario is described in detail in [5], Chapter 4 and particularly 4.2. The strategic sourcing scenario is the part of the whole product lifecycle process section which is located within the red borders in the figure below showing the OEM view of the process.
As Figure 7 depicts, the sourcing scenario overlaps several early phases and extends into the development phase. It excludes the phases "Product Planning", "Alternative Choice", and "Styling" but it touches the Model Concept development phase, in the figure above wrongly designated as "Archetypes Concepts". All involved phases are cooperative phases since both the OEM and its supplier(s) are involved.

On the other hand, the supplier side has its own private process that implements its product lifecycle. It ranges from "Acquisition" via "Development" to "Production", as sketched in Figure 8. In a more fine grained view, the supplier site process addresses the phases "Opportunity Selection", "Acquisition and Quotation", and "Concept" development as the strategic sourcing counterpart to the OEM. Moreover, the supplier is in a central position because it in turn employs suppliers. Unless the first tier supplier is employed exclusively by one OEM, it has to handle several customers including their individual business document formats.

From the point of view of the OEM, there are first tier and second tier suppliers whereas the first tier supplier acts like a hub according to its business relations with several customers or OEMs and (second tier) suppliers. The scenario details follow in the next section.
### 3.3.1 Scenario Outline

The Strategic Sourcing Scenario was developed in ATHENA Project B5.5. This project specified the use cases and test cases of the Automotive Pilot which implemented a distributed Strategic Sourcing scenario. The scenario is just a small extract of the full process; here it terminates with a contract between the first and second tier supplier. The full process is displayed in Figure 9.

#### Figure 9: The sourcing process

The Automotive Pilot shows a subset of the process which starts with the RFQ (Request for Quotations) business document. The RFQ is generated from an SOR (Specification of Requirements) business document by the OEM. It is sent to the first tier supplier using a web service-based interaction that applies getRfQ and addRfQ messages. The RFQ business document is decomposed into several RFQ documents necessary for describing the subsystems of the system specified in the RFQ generated by the OEM. The interaction between first tier supplier and its second tier suppliers proceeds in the BRMF process execution environment which implements a Peer-to-Peer overlay network. Thus the first tier supplier registers a quotation subscription in the Peer-to-Peer network and then registers the sub-RFQs.

The second tier suppliers which registered a RFQ subscription receive notifications about the availability of a new RFQ from the first tier supplier. They may retrieve and fetch the RFQs and process them internally. As results, business documents containing the quotations are generated by the second tier suppliers and then registered in the Peer-to-Peer network.

Due to the subscription for quotation documents, the first tier supplier receives notifications and may retrieve and fetch the quotations. According to the original RFQ from the OEM, the first tier supplier composes a joint quotation document which then is sent to the OEM via web service interaction.

The Automotive Pilot has been implemented and successfully presented at the ATHENA Audit in Brussels in October 2006. A more detailed description of the test case and use case is given in [5]. The Peer-to-Peer-based business resource management originates from ATHENA A6 and is described in [2] and in [13].

Within the quite rigid process described above, some flexibly upcoming events may occur that
make the whole process much more dynamic. These events are:

1) A change request is made by the OEM while the RFQ is being processed. All relevant parties are informed and re-adjust their work.

2) An inconsistency is detected by the second tier supplier’s engineering department. A change in the technical specification is proposed and communicated to all relevant parties. The OEM accepts the change, all parties are informed and the work is re-adjusted.

3) The document server at the OEM side, which logically hosts the master version of the technical specification, is temporarily unavailable due to a system crash. Using P2P replication, partners are still able to get access to the most recent version of the RFQ / Technical Specification information.

While the latter event does not generate any kind of business document as it is generated by some system fault, the first and the second one add a new type of business document to the ones already mentioned.

3.3.2 A7 Results Applied Within Scenario

The following types of business documents are used in the Strategic Sourcing scenario and in the Automotive Pilot:

- Lean SOR document
- Feedback document (to Lean SOR)
- Updated SOR document
- 1st SOR document
- RFQ document (1st or 2nd release, from OEM)
- First tier supplier RFQs documents (addressed to second tier suppliers)
- Second tier supplier quotation document (addressed to first tier supplier)
- First tier supplier quotation document (addressed to OEM)
- Change Request document
- Offer document (second tier supplier to first tier supplier)
- Contract document (between first and second tier supplier)

So there are eleven different types of business documents of which some may appear in different formats according to various standards. For example the RFQ documents sent by the first tier supplier to second tier suppliers must comply with the number of subsystems and – for each second tier supplier considered for one subsystem – with the format readable for the particular receiver. A comprehensive overview of standards and formats is summarized in ATHENA Deliverable D.A7.1 on industry best practice; see [3].

Though this is quite a simple scenario, it already applies numerous business documents in various formats. There are three types of actions:

1) generating business documents,
2) mapping business documents, and
3) generating business documents by special mapping

Ad 1: Generating business documents refers to the usage of a tool that creates data unit that represents some kind of business content. The generation mostly runs interactively with the user who applies an editor tool.

Ad 2: Mapping business documents refers to transferring a business document from one into another format. In the example with the RFQs, a first tier supplier has to map a subsystem RFQ into the formats that receiving second tier supplier are able to handle. Particularly, the source format may be a proprietary format while the target formats may comply with different standards. In a different process, the first tier supplier just publishes the subsystem RFQs and leaves the task of mapping to
the business documents to the receiver. The semantics of the source and the target business document – provided there is anything like that – are requested to be identical.

Ad 3: One particular treatment of business documents occurs when one type of business document implies the generation of another one. Assume an RFQ document is processed by a second tier supplier in order to generate a Quotation document. This may be supported by a mapping tool that reads the RFQ document and interactively generates a Quotation document. The benefit is that users do not need to copy-paste or retype the content. Such a tool could also help decomposing an OEM RFQ and generating second tier supplier specific RFQs though they may refer to the same format and standard.

The usage of such mapping tools and editors was highly advantageous regarding the Strategic Sourcing scenario and the Automotive Pilot.

Besides business documents some sections are mentioned in the scenario that can be interpreted as business protocols. These are:

- SOR Approval (OEM and first tier supplier)
- Technical Review (all three parties)
- Supplier Conference (first and second tier supplier)
- Negotiation (first and second tier supplier)

However, all of these phases are not closer described in the scenario descriptions. Assumed there is an electronic voting support tool, people involved in the SOR Approval conference could at least use it to get an impression of a common sense. Eventually, the OEM is responsible for the final decision but a voting protocol could support the previous work.

The negotiation phase between first and second tier suppliers could be also a subject of formalization. Though there is also no closer description of that work phase, there is, however, a formal negotiation protocol. In Jennings, J., Norman, T., Faratin, P., O'Brien, P. & Odgers, B. (2000): Autonomous Agents for Business Process Management, Journal on Applied Artificial Intelligence, No 14, pp. 145-189, Copyright Taylor & Francis, 2000, Jennings et al. described a generic formal approach which can be adapted easily to a first and second tier supplier negotiation. As shown in Figure 10, the first tier supplier could take the role of the client while the second tier supplier acts as the server.

![Formalized negotiation process](image)

Figure 10: Formalized negotiation process
Two further issues from ATHENA A7 can improve the sourcing scenario. Firstly, it would be useful for each partner potentially involved in that process, if they published the business document format and standards they are able to handle. This would hold perfectly for first and second tier suppliers in the Automotive Pilot as they could easily publish resources containing the information in the Peer-to-Peer network. For the interaction between OEM and first tier supplier, which runs via web services, this information must be included into the addRFQ – getRFQ protocol. Publishing supported formats and standard in advance would significantly ease the collaboration process of business partners as no discussion or formal negotiation is necessary.

On the other hand, collaboration among business partners could fail due to a lack of necessary mapping tools at one partner’s site. This is a serious and – caused by the huge number of formats and standards – a quite likely situation. Assumed there are 25 standards frequently used in a larger business community, as identified in [3]. This would imply $25 \times 24 (= 600)$ mapping tools to get a complete coverage of all possible document format interchanges. Each single partner had to run $2 \times 24 (= 48)$ mapping tools. A feasible solution could be supplied by a format mapping service provider. The service has to be a secure and trusted entity which acts as an on-demand translator. It accepts business documents in any format and would return them in the desired format using the up-to-date format versions and mapping tools. It could even deliver the reformatted business document to the addressed business partner. However, such a service is highly needed to act neutrally and equitably.

Finally, the repository would provide a high impact to the Strategic Sourcing scenario since all mentioned business documents are subject of storing, retrieval, removal, modification, and update. This holds of course for company internal document treatment and private processes, but also for document exchange. A distributed repository as the one based on Peer-to-Peer could help to manage business documents while the messages just contain references to the repository. The versioning mechanism could be used jointly with a mapping tool service to provide one business document in its original format combined with semantically identical documents in various other formats. The repository fits perfectly in such an environment since it supports local workspaces and a distributed Peer-to-Peer-based workspace. Regarding the Automotive Pilot there is no real big difference since the business process enactment between first and second tier suppliers is run on top of the BRMF layer which is in turn based on the same Peer-to-Peer platform as the repository.

3.4 Outcome

We close this section with a summary of the main findings and outcomes of the application of A7 results to ATHENA scenarios.

The eProcurement scenario provided a good basis to demonstrate the different results of A7 targeting business documents in an integrated way. As it is based on a concrete cross-organizational business process it also provides the basis to demonstrate results in the area of business protocols.

One of the outcomes of implementing the scenario was that we have to consider different use cases in which the results can be used. Depending on the available infrastructure the partners will use mapping technologies to map to their existing formats or rather model new documents. This modeling can either involve business experts that need a high-level component-based modeling language supported by a graphical tool. Or the documents are directly modeled on a technical respectively execution level by IT experts. Then they can directly work on XML type documents.

As A2 results are also highly relevant for this scenario, the scenario showed that the target of A7 to produce results that complement the A2 results has been achieved. The business content that has been produced in this scenario, i.e. mainly the models of the business documents, is available via the A7 repository for business documents and protocols.

The CAS pilot provided a good basis to evaluate in particular results in the area of business protocols. In the pilot application, we model and execute an electronic business process between a car dealer that sells cars of different brands and one or more car manufacturers. The various levels of the problem are tackled with the help of different solutions developed in the context of ATHENA:

- PIM4SOA as metamodel for service-oriented architectures
- The Graphical Editor for specifying PIM4SOA models
- PIM4SOA to JACKMM transformation for generating executable agents
- WSDL2JACK for integrating agents into a service-oriented environment
- Semaphore to mediate between different data schemas
The pilot application showed that the A7 results are suitable to address business problems in real industry scenarios.

The results of ATHENA A7 have also significant impact on the Strategic Sourcing scenario as partially implemented in the Automotive Pilot. Document standards and their mapping as well as the repository help business partners to manage their internal business document processing and the interaction among each others. The huge number of business document types multiplied by the number of documents standards shows the complexity and helps to estimate the overhead caused by document transformation compared with actual document processing. The Peer-to-Peer repository helps managing this complexity as it offers distinction between local and distributed workspaces. Furthermore, it provides versioning features for document management in terms of chronological and format characteristics.

At the final review we will show results from the eProcurement scenario in the specific A7 demonstrator and results from the car configuration scenario as part of the outbound logistics pilot.
4 A7 Results Applied to STAR

In this section we describe the application of A7 results to an industry standard not related to a scenario of an ATHENA user partner. We have selected the STAR (Standards for Technology in Automotive Retail, [15]) standard from the automotive industry as it is already quite wide spread in the US and is gaining more acceptance also in Europe in the area of automotive retail. This scenario is also of relevance for SAP Industry Business Unit Automotive. They are investigating how a standard-enabled communication between dealers’ SAP Dealer Business Management and their automotive manufacturers’ equivalents could be realized using service-based interfaces.

The goal of STAR is

“to use voluntary information technology (IT) standards as a catalyst in fulfilling the business information needs of dealers and manufacturers while reducing the time and effort previously required to support this activity.”

(see http://www.starstandard.org/index.php?n=STAR.About)

This matches very well with the target of A7 to provide methods and tools that support an efficient and easy management of business documents representing business information that is exchanged between the business partners. Therefore, we have selected one sample scenario, ordering of a new vehicle, for which STAR provides business document specifications. We have then used A7 results to model the business documents and evaluating how well A7 results can be used to support implementation of a standard. As the STAR document specifications also describe the cross-organisational business process in which the documents are exchanged we also applied A2 results to model and document the process. In the following we describe the scenario and the business documents involved.

4.1 Scenario Outline

The scenario involves two partners, the OEM and the dealer with their respective IT systems. We focus on the process for ordering a new car for a customer. Figure 11 gives an overview of the scenario.

Parties: OEM Dealer

Systems: OEM IT systems (e.g. ERP) Dealer IT systems

Figure 11: New vehicle ordering with parties involved

The process model in Figure 12 illustrates the new vehicle ordering process. The dealer enters the order data into his system. Based on the order data, a purchase order is created. The purchase data is sent to the vehicle manufacturer (OEM), where the purchase order is processed. The OEM has to decide whether the purchase order is valid, invalid or partly valid (e.g. if one purchase item does not make sense).
In case the purchase order is valid, the OEM sends an Acknowledge and confirms the shipping date. In case the order is invalid, the process is aborted. A Cancel message is sent to the Dealer. After receiving the Cancel message the dealer also terminates the process. If the order can be fulfilled partially, the OEM acknowledges the order including a list of invalid parts. The Dealer can correct invalid parts by changing the order via sending a change message, or cancel the order.

Based on the change message the OEM can decide whether the changes are valid. If changes are invalid, he can either cancel the purchase order or request further corrections. Once the order is clarified the OEM sends out an Acknowledge that does not contain any errors, i.e. the complete purchase order can now be further processed.

When the car delivery is started, the OEM sends another message to the dealer notifying of the delivery and starts the invoicing process. When the Dealer receives the notification, the process ends. Until the Dealer receives the delivery notification, the Dealer can request the status of the order or cancel the order.
Figure 12: CBP model for ordering a new vehicle

Figure 13: STAR messages relevant for the new vehicle ordering scenario
4.2 Messages

Figure 13 illustrates which messages specified in the STAR documentation are exchanged during the process for ordering a new car from the OEM. In the following we describe the messages that are exchanged in this particular scenario in more detail.

We start with the description of the general structure of the messages. STAR Business Object Documents (BODs) are based on the Open Application Group Interoperated (OAGI) development methodology. BODs are the business messages or business documents that are exchanged between application components. The BOD provides a common message architecture which is used across multiple industries and is independent of the communication mechanism. Automotive retail is one of these industries. STAR adopted the BOD concept within their standard.

STAR BODs are component-based. Thus, they can easily be modelled with the business document modelling approaches developed in A7. The basic components of a STAR BOD are illustrated in Figure 14.

Figure 14: General structure of STAR BODs

A Business Object Document (BOD) consists of two child elements, Application Area (ApplicationArea) and Data Area (DataArea). The Application Area contains information that an application may need to know in order to communicate in an integration of business applications. It is used at the application layer of communication and not at the Web Services and middleware communication layer. The Application Area is a common component that is used in all STAR Business Object Documents. The Application Area consists of five sections of information:

- Sender (required): Identifies characteristics and control identifiers that relate to the application that created the BOD.
- CreationDateTime (required): Provides date time stamp that the BOD was created.
- Signature (optional): Allows attaching a digital signature to the BOD.
- BODId (optional; Best Practice - required): Provides a place for a Globally Unique Identifier (GUID) that will make each BOD instance uniquely identifiable.
- Destination (required): Identifies characteristics and control identifiers that relate to the application that receives the BOD.

The Data Area carries the business specific payload or data being communicated by the BOD. It contains a single Verb (the action) and one or more occurrences of a Noun (the object):

- The verb identifies the action that the Sender application wants the Receiver application to perform on the Noun (e.g. Process)
- Nouns identify the business specific data that is being communicated (e.g. VehicleOrder)
For the considered scenario “Ordering a new vehicle” the relevant noun is Vehicle Order. The STAR specification defines a list of verbs (actions) that can be combined with this noun. The following list contains all possible verbs. Information exclusively related to the action (attributes and elements) is stored with the verb:

**Process**
- request processing of the associated noun by the receiving application
- **Attributes:** confirm (optional) - “Always” “OnChange” “Never” / acknowledge (optional) - “Always” “OnChange” “Never”

**Acknowledge**
- used to acknowledge the application receipt of a Process request
- **Attributes:** confirm (optional) - “Always” “OnChange” “Never”
- **Elements:** OriginalBODId (optional)

**Confirm**
- used to respond to a request to confirm receipt of information

**Change**
- request (by not owner of the data) for the document to be changed
- must refer to original document and/or Items
- assumes replacement of fields sent, with exception of Noun identifying fields
- **Attributes:** confirm (required) - “Always” “OnChange” “Never”

**Get**
- request for an existing piece of information to be returned
- **Attributes:** confirm (required) - “Always” “OnChange” “Never” / show (required) - “Always” / ReturnCriteria (required)

**Show**
- used when sending the information about a specific instance of a business document
- may be used to respond to a Get or in a publish scenario, where it pushes information based on an event
- **Attributes:** confirm (required) - “Always” “OnChange” “Never”
- **Elements:** OriginalBODId (optional)

**Cancel**
- request (by not the owner of the data) for the document to be canceled
- **Attributes:** confirm (required) - “Always” “OnChange” “Never”
Figure 15 shows a template for the business document ProcessVehicleOrder modelled with Maestro for BDM. It contains both possible attribute values for the verb process. Details on the noun VehicleOrder are omitted to reduce complexity.

Figure 15: ProcessVehicleOrder document template modelled in Maestro for BDM
Figure 16 illustrates a concrete business document ProcessVehicleOrder that has been agreed on between two partners. It contains only one attribute value `confirm` as the partners agreed on not exchanging the acknowledge information.

We do not show all possible messages here. An overview of all messages exchanged during the process of new vehicle ordering and their detailed structure can be found in the STAR specification.
Summary

This final Deliverable of project A7 presented some results and experiences of applying A7 results to ATHENA scenarios and industry best practice. A7 has produced technical results to support efficient modelling and management of business documents that are exchanged in cross-organisational business processes. These results have been applied in the following scenarios:

- eProcurement scenario from the AIDIMA pilot
- strategic sourcing scenario from the CRF pilot
- new vehicle ordering based on the STAR standard

A7 has also produced results on modelling and executing business protocols as a more detailed specification of cross-organisational business processes. These results have been applied in the following scenarios:

- eProcurement scenario from the AIDIMA pilot
- car configuration scenario from the CAS pilot

The overall experience made was that the results achieved in A7 are well suited to handle industry scenarios and standards. They were able to address the requirements specified by the ATHENA user partners in the interviews executed in work package A7.1. A7 results also made a significant contribution the CAS pilot.

A further result was that A7 results are well-suited to complement results from project A2 on modelling and executing cross-organisational business processes. In particular, A7 results contribute to close gaps in the area of modelling the information exchanged between business partners. A7 results provide means to also involve business user in the modelling effort thus abstracting from the purely technical representation provided e.g. by XML messages exchanged via Web services. To also support business users in creating mappings between external and internal data formats, semi-automatic mapping approaches have been developed.

The protocol related results allow specifying the interaction between partners modelled in a cross-organisational business process in more detail. They also target different execution platforms for protocols such as agent platforms or BPEL protocols thus considering different infrastructures already existing at partners.

All evaluated scenarios showed that the Peer-to-Peer based repository for business documents and protocols allows the partners to easily exchange their document and protocol models. The Peer-to-peer infrastructure provides a robust platform for this distributed repository.
6 References


