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Knowledge sharing in flexible supply networks: a context-based approach*

by

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Abstract: Appearance of flexible supply networks can be seen as a response to changes in global markets, being a step beyond the linear supply chain topography. However, when dealing with multiple organizations and multiple processes within a complicated network, identifying and locating a member that has responsibility and/or competence in a particular part of the network can be a laborious, time-consuming process. Knowledge sharing is aimed to assist in solving this problem. The approach presented is based on application of such technologies as ontology and context management, constraint satisfaction and profiling. Ontologies provide for semantic interoperability between flexible supply network members. Usage of the context makes it possible to consider current situation in order to provide for actual knowledge or information. Competence profiles of the supply network members facilitate knowledge sharing and simplify partner selection. They allow formalizing and sharing member's knowledge and competencies. Constraints are used for knowledge description. This enables usage of constraint solvers for finding solutions in various situations.

Keywords: information integration, production systems, transportation control.

1. Introduction

Modern global companies have to build supply network strategies that provide maximum flexibility and can optimally respond to changes in their environment (Gunasekaran, Lai and Cheng, 2008; Gunasekaran and Ngai, 2005; Christopher and Towill, 2001). The emergence of build-to-order supply networks is one of the consequences of these changes in the automotive industry. Supply networks

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can be seen as a step beyond the linear supply chain topography. The automotive industry is a good example of this phenomenon. Today, one of the most important competitive advantages for car makers is their ability to manufacture customised cars with a reduced lead time. At the same time, it is necessary to avoid significant inventory levels in order to keep costs low. Such a strategy is called Build-to-Order (BTO) and stands for the capability to quickly build customized products upon the receipt of customer orders without precise forecasts, inventory, or purchasing delays. In the BTO supply chain, customer orders are introduced in advance of, or at the start of the production process. An opposing strategy is build-to-stock (BTS), whereby the product is built prior to demand (Sen et al., 2000).

In order to support the BTO strategy, supply networks have to be flexible (Garavelli, 2003; Lummos, Duclos and Vokurka, 2003; Pujawa, 2004). In other words, they have to quickly readjust relationships between their members, responding to changes in the environment (e.g., market needs and requirements, appearance of new technologies). This presents a number of problems. Among the options for maximizing the value from supply networks there are two major strategies: (i) *postponement* (delayed differentiation until customer's demand for specific end products) and (ii) *information sharing* (for faster and more accurate information flow across the supply network). Certain business conditions that favour each strategy are depicted in Table 1 (Billington and Amaral, 2000). In this paper, the information sharing strategy is considered as more appropriate for flexible supply networks.

The most significant problem is to coordinate a large number of independent network members. While dealing with multiple organizations and processes within a complicated supply network, identifying and locating a member that has responsibility and/or competence in a particular part of the network can be a laborious and time-consuming process (Lesser and Butner, 2005). Developing and maintaining a common distributed knowledge directory for all relevant parties, associated with troubleshooting and potential problem solving, can significantly reduce production lead time and enhance network flexibility. Moreover, linking this directory to key decision points and frequent problems can improve its effectiveness (Smirnov, Shilov and Kashevnik, 2008).

Efficient profiling has become one of the major requirements for efficient sharing of knowledge in supply networks (see, e.g., Sandkuhl, Smirnov and Shilov, 2007). The major components of the profile are competence (possibility to perform business processes supported by necessary resources, practice and actions), preferences (e.g., types of tasks a network member prefers to perform), contact and auxiliary information (e.g., time zone and supported languages). Use of this information significantly increases speed and accuracy of negotiation processes of supply network configuration.

Knowledge sharing and exchange in a flexible supply network are highly important and should be achieved at both technical and semantic levels. The interoperability at the technical level is addressed in a number of research ef-

Table 1. Business conditions favouring major strategies for supply network value maximization

Strategy	Current situation uncertainty	Flexibility	Cost of lost sale	Cost of postponement
Postponement	Average-high	Low	High	Low
Information Sharing	Average-low	High	Low	High

forts. It is usually represented by such approaches as e.g., SOA (service-oriented architecture) (*SOA...*, 2007) and on the appropriate standards like WSDL and SOAP (*Web Services...*, 2007). The semantic level of interoperability in the flexible supply network is also paid significant attention. As an example (probably the most widely known), the Semantic Web initiative is worth mentioning (*Semantic Web*, 2006).

Ontologies have proven their efficiency in the area of knowledge sharing and management within the field of supply network management. Ontologies facilitate information retrieval over collections of distributed and heterogeneous information sources; they help to provide for semantic integration of information and facilitate interoperability between heterogeneous knowledge sources at high level of abstraction (Boury-Brisset, 2003; Slade and Bokma, 2001). Ontologies applied to supply chain information integration, in order to provide unified interface for semantic data and to share and reuse knowledge among information resources are described in Yang and Yang (2008). Integration of the supply network management and logistics based on the technology of ontologies is studied in Leukel and Kirn (2008) and Zhai et al. (2008). An approach combining the ontologies with Web services is presented in Ni et al. (2008).

The main idea of the approach presented here is to apply up-to-date findings in usage of ontologies for knowledge and terminology description. The approach also relies on the ontological knowledge representation for its sharing. The conceptual model of the proposed ontology-driven knowledge sharing is based on the earlier developed idea of knowledge logistics (Smirnov et al., 2004). It correlates with the conceptual integration, developed within the Athena project (Ruggaber, 2005). The ontology describes common entities of the enterprise systems and relationships between them. As a result, it is possible to treat all available knowledge and competencies as one distributed knowledge base.

Besides, the dynamic nature of the flexible supply networks requires considering the current situation in order to provide for actual knowledge or information. For this purpose, the idea of contexts is used. Context represents additional information, helping to identify specifics of a current transaction. It defines a narrow domain that a particular person is working with.

The paper is structured as follows. Section 2 introduces definitions of major terms used in the paper. Section 3 presents the main ideas of the developed approach. Competence profiles are described in Section 4. Application of the constraints for problem representation is discussed in Section 5. Estimation of the efficiency of the approach proposed is given in Section 6. Major results are summarised in conclusions. The paper extends the earlier research through the coupling of the profiling and context management technology with ontological knowledge representation in the domain of flexible supply networks.

2. Major definitions

Constraint network (CN) is a triple $CN =< P, Q, R >$ (Chen et al., 2005), where

- P: finite set of variables
- Q: list of possible values for each variable (domain)
- R: set of constraints on P.

Context is any information that can be used to characterize the situation of an entity where an entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves (Dey et al., 2001).

Ontology is a content theory about the sorts of objects, properties of objects and relations between objects that are admitted in a specified knowledge domain. It provides potential terms for describing the knowledge about the domain (Chandrasekaran et al., 1999).

Ontology Slice is a portion of an input ontology for use in a new application or new ontology (Chaudhri et al., 2000).

Profile is a collection of appropriate data associated to a specific user/company/subject (Wikipedia, 2009).

3. Proposed approach

The ontology forms the core of the model. It describes common entities: objects, facilities, products, processes, etc. (Section 4) of the flexible supply network members, and relationships between them. In order for the ontology to be of reasonable size it includes only most generic common entities of the participating companies. For modern decision support systems, personalized support is important. It is usually based on application of the profiling technology. For organizing a multi-tier flexible supply network, a company profile structure including description of company's responsibilities and competences is proposed. The access to internal data models of the flexible supply network members is provided through their competence profiles. Profiles contain such information as the flexible supply network members' capabilities and capacities, terminological specifics, preferred ways of interaction, etc. As a result, it is possible to treat all available knowledge and competencies as one distributed knowledge base.

Each person or information system works on a particular problem or scenario, represented via a context. The context defines a narrow domain the user of the knowledge management platform works with. It may be characterised by a particular customer order, its time, requirements, etc.

The difference between the here presented approach and the other existing approaches lies in using prior knowledge about a particular application domain and task-oriented information organization. It uses constraint satisfaction technology instead of inference engine. Knowledge within the approach is represented in a declarative way. Application of object-oriented constraint networks (OOCN) formalism, representing knowledge in a declarative way (Smirnov et al., 2004), simplifies domain formalization, since most of the tasks in the areas of planning, management, etc. are described in terms of constraints. According to the formalism of OOCN, ontology is represented by a set of classes; a set of class attributes; a set of attribute domains; and a set of constraints. The set of constraints comprises (1) taxonomical ("is-a") relationships, (2) hierarchical ("part-of") relationships, (3) class cardinality restriction, (4) class compatibilities, (5) associative relationships, and (6) functional relations:

$$A = (O, Q, D, C)$$

where:

O – a set of *entities* or *object classes* ("*classes*"). Each of the entities in a class is considered as an *instance* of the class. The set $O = O^I \cup O^{II}$ consists of two subsets: $O^I = \{o : \exists\ \text{instance}(o)\}$ – a set of *non-primitive* classes, i.e. classes which can have instances, and $O^{II} = \{o : \neg\ \exists\text{instance}(o)\}$ – a set of *primitive* classes i.e. classes which cannot have instances;

Q – a set of class attributes ("*attributes*");

D – a set of attribute domains ("*domains*");

C – a set of *constraints*; six types of constraints are defined: $C = C^I \cup C^{II} \cup C^{III} \cup C^{IV} \cup C^V \cup C^{VI}$:

$C^I = \{c^I\}$, $c^I = (o, q)$, $o \in O$, $q \in Q$ – accessory of attributes to classes;

$C^{II} = \{c^{II}\}$, $c^{II} = (o, q, d)$, $o \in O$, $q \in Q$, $d \in D$ – accessory of domains to attributes;

$C^{III} = \{c^{III}\}$, $c^{III} = (\{o\}, \text{True} \vee \text{False})$, $\mid \{o\} \mid \geq 2$, $o \in O$ – classes compatibility (compatibility structural constraints);

$C^{IV} = \{c^{IV}\}$, $c^{IV} = \langle o', o'', type \rangle$, $o' \in O$, $o'' \in O$, $o' \neq o''$ – hierarchical relationships (hierarchical structural constraints) "is a" defining class taxonomy ($type = 0$), and "has part"/"part of" defining class hierarchy ($type = 1$); the most abstract class is "thing";

$C^V = \{c^V\}$, $c^V = (\{o\})$, $\mid \{o\} \mid \geq 2$, $o \in O$ – associative relationships ("one-level" structural constraints);

$C^{VI} = \{c^{VI}\}$, $c^{VI} = f(\{o\}, \{q\}) \rightarrow \mathit{True} \vee \mathit{False}$, $\mid \{o\} \mid \geq 0$, $\mid \{q\} \mid \geq 0$, $o \in O$, $q \in Q$ – functional constraints referring to the names of classes and attributes.

In the above, $|\,c\,|$ is the number of parameters included in a constraint (constraint cardinality), while $o \in O$, $q \in Q$, $d \in D$ are considered as ontology elements.

A constraint network with the above structure can be described as $CNet = (A, I) = (O, Q, D, C, I)$, where I – is information content of the constraint network. Information content is a set of instances with fixed attribute values (known or not).

Below, some examples of constraints are given:

- an attribute *cost* (q_1) belongs to a class *component* (o_1: $c_1^I = (o_1, q_1)$;
- the attribute *cost*(q_1), belonging to the class *component* (o_1), may take positive values: $c_1^{II} = (o_1, q_1, R^+)$;
- a class *body* (o_2) is compatible with a class *body production* $(o_3) : c_1^{III} = (\{o_2, o_3\}, True)$;
- an instance of the class *component* (o_1) can be a part of an instance of the class *facility* $(o_4) : c_1^{IV} = \langle o_2, o_3, 1\rangle$;
- the *body production* (o_3) is a *resource* $(o_5) : c_1^{IV} = \langle o_2, o_3, 0\rangle$;
- an instance of the class *body* (o_2) can be connected to an instance of the class *body production* $(o_3) : c_1^V = (o_2, o_3)$;
- the value of the attribute *cost* (q_1) of an instance of the class *facility* (o_4) depends on the values of the attribute *cost* (q_1) of instances of the class *component* (o_1) connected to that instance of the class *facility* and on the number of such instances: $c_1^{VI} = f(\{o_1\}, \{(o_4, q_1), (o_1, q_1)\})$.

The relationships between the major components of the approach are illustrated below.

Ontology can be presented by a set of slices:

$$A = \{Slice : Slice = \langle O', Q', D', C'\rangle\},$$

where O' is a setof *entities* or *object classes*; Q' is a set of class attributes; D' is a set of attribute domains; C' is a set of *constraints*.

Then, a single context corresponds to each slice at a time instant and ontology A can be mapped to a set of contexts K:

$$A \xrightarrow{f_1} K.$$

Network member profile (see Section 3) consists of ontological and archive constituents. The ontological constituent of the member profile is described on the basis of ontology (A). Hence, a set of ontological constituents of member profiles (OPP) can be mapped to A:

$$OPP \xrightarrow{f_2} A.$$

So, a set of ontological constituents of member profiles (OPP) can be mapped to K:

$$OPP \xrightarrow{f_2 \circ f_1} K.$$

The mapping diagram of the main elements of context-oriented knowledge sharing system is shown in Fig. 1.

Mapping functions of the context-oriented knowledge sharing system are shown in Table 2.

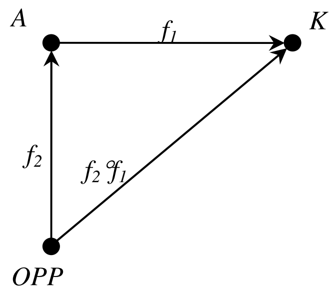

Figure 1. Mapping diagram of the main elements of context-oriented knowledge sharing system

Table 2. Mapping functions of the context-oriented knowledge sharing system

Function	Description
f_1	Function of context formation from the ontology
f_2	Function of mapping of the ontological constituent of the member profile to ontology. This function connects member profile and ontology for the possible usage of information from the member profiles in the knowledge sharing system
$f_2 \circ f_1$	Function of context instantiation with the information from the member profiles

We shall now describe the scenario of operation of the approach presented. A user (a representative of a network member) (Fig. 2) submits a request to the system (1). Based on this request, the available ontological model of the problem domain and the current situation, the context is built (2), which is a description of the user request and current situation in terms of the ontological model. The ontological model in the knowledge sharing system provides the main terms used for supply network description and relationships between them. Since the terminology used by users may differ from that used in the ontological model, it is necessary to map these terminologies to each other. Synonyms can be used for this purpose. The request terms are searched for in the ontological model and found fragments are combined to form the context (Sandkuhl, Smirnov and Shilov, 2007).

The knowledge map defines references between the ontological model (3) and knowledge sources (4). This makes it possible to use uncoordinated sources as a single distributed knowledge base. Knowledge and information are acquired from appropriate sources (5). Network member serves as a knowledge source and provides services for the system to access the owned knowledge. Information about the member is obtained from its competence profile. Based on this information a decision can be made whether this member is suitable for a particular supply network configuration.

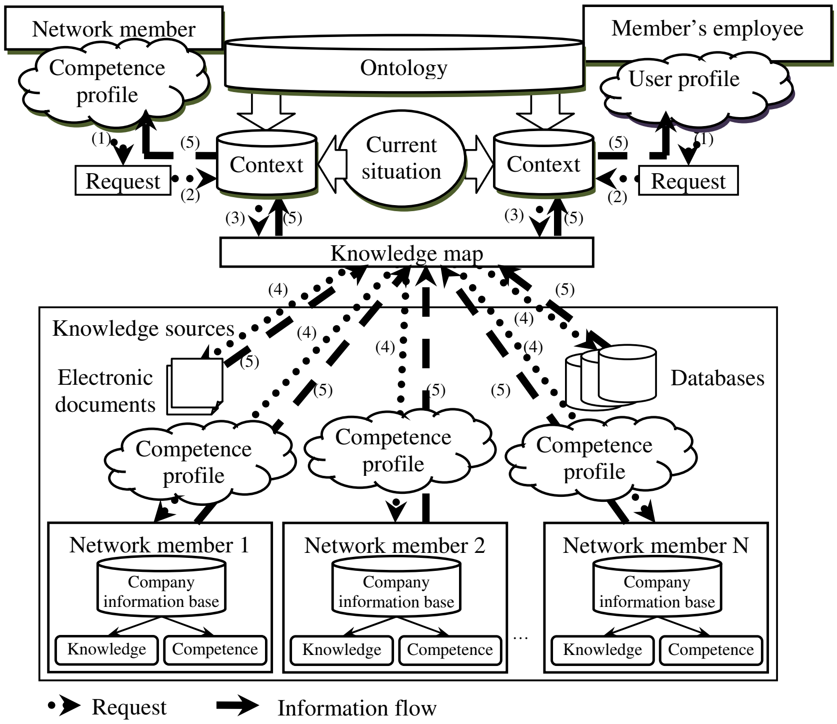

Figure 2. Conceptual model of context-based knowledge sharing

4. Competence profiles

The structure of the network member profile is given in Fig. 3. Competencies and preferences of the network member are important for determining, which network member is capable of carrying out a specified task and, hence, can be chosen as a team member. Member competence is determined by capabilities, capacities, price-list and quickness. The network member profile comprises: *General Information*, *Network Member Information*, *Request History*, *Network Member Preferences*.

- The *General Information* part contains information about a network member organisation, i.e. name of organisation, organization identifier in the system, date the organization was founded, and URL to the organization web page.

- *Network Member Information* is a set of tuples describing information about network member. Each tuple has the following properties:
  - Member Name – a name of a network member;
  - Location – current geographical location of a member, it can be taken into account for estimating the speed and quality of request processing in a particular situation.
  - Time – time zone of a network member;
  - List of Languages – languages for contacting a network member;
  - Rights – knowledge area that a member can access;
  - Group – a member can be part of a group, based on its capabilities;
  - Phone Number, E-mail – contact information;
  - *Network Member Competencies* includes the following properties:
    - Capabilities – types of operations that a network member can implement;
    - Capacities – capacity of network member (in case of evacuation how many people this network member can evacuate);
    - Prices – prices for implementing operations by the member;
    - Velocity – velocity of implementation operation by this network member.
- *Request History* is also a set of tuples. Each tuple possesses the following properties:
  - Request – a request to a member;
  - Context – is used to analyze performance of a member (other members can see solutions generated in particular situations) and to identify detectable member preferences;
  - Network Member Preferences – stores member preferences at the moment of request initiation. They contain a snapshot of all the properties of the category "Network Member Preferences";
  - Network Member Information – stores specific information about a member at the moment of request initiation. It contains a snapshot of all the properties of the category "Network Member Information".
- The *Network Member Preferences* part consists of Explicit Preferences and Tacit Preferences. Explicit Preferences describes member preferences that are manually introduced by a member. These preferences are used for choosing a member for a particular situation, and contain the member preference for arrival time, volume of work, and capability constraints.

The latter stores several capabilities and logical restrictions from a list of all the capabilities for the domain. *Tacit Preferences* describe the automatically detectable member preferences.

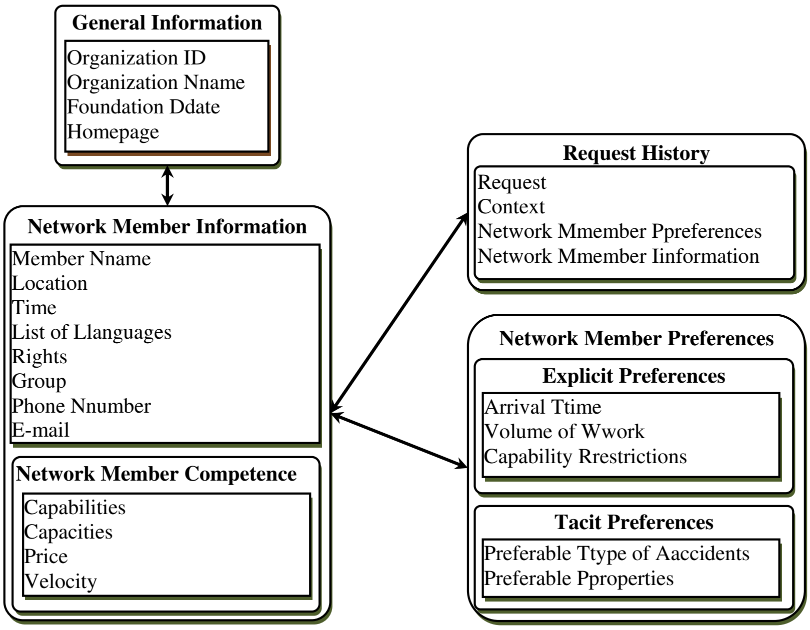

Figure 3. Supply network member competence profile

5. Analytical estimation of the efficiency of the context and profiling usage

Choice of suppliers for a member k among other network members is shown in Figs. 4 and 5. In the first case the member k uses traditional knowledge sharing system without context. Member k interacts with other flexible supply network members, able to provide the necessary produce. Knowledge sharing system provides only information about possible suppliers without any specific information to member k. The time of this process can be defined as:

$$T_k = \sum_{i=1}^{N} t_i,$$

where t_i – time of interaction between members i and k, and N – number of suppliers.

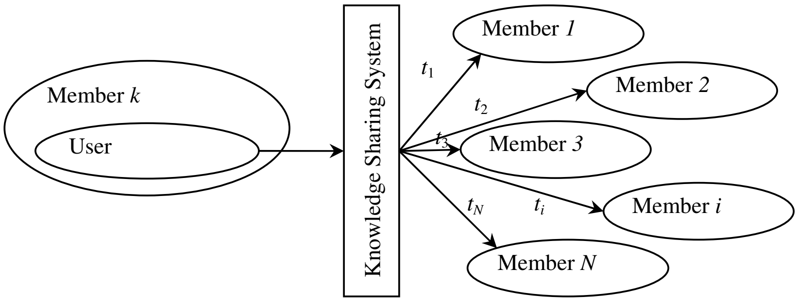

Figure 4. Member k chooses suppliers using knowledge sharing system (*without context*)

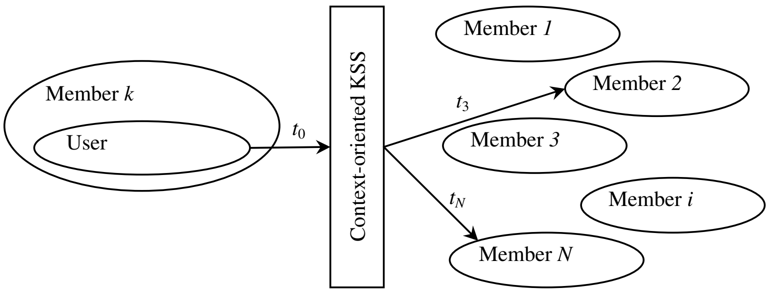

Figure 5. Member k chooses suppliers using knowledge sharing system *(with context)*

In the second case the context-oriented knowledge sharing system is used (Fig. 5). In this case the time of choosing suppliers can be defined as:

$$T'_k = t_0 + \sum_{i=1}^{N'} t_i,$$

where t_i – time of interaction between members i and k, t_0 – time of analysis of possible supplier profiles by the user of the supplier k, and N' – number of suppliers selected.

Diagrams of dependencies of supplier selection time on their quantity in cases of using and not using context in the knowledge sharing system are shown in Fig. 6. To simplify visualization, the following assumption is made: the interaction time between any pair of members is the same and equal t_{av}. Then, the time of supplier selection in case of using the knowledge sharing system without context is equal $T = t_{av}N$.

In the second case, a member k chooses N' suppliers for the time t_0 and after that interacts with them. Then:

$$N' \in \left[1, \bar{N}\right], \text{ where } \overline{N}\text{– number of alternative suppliers.}$$

Then, for $N' < \overline{N}$ the interaction time is as follows:

$$T = t_0 + N' \cdot t_{av},$$

and for $N' > \overline{N}$, as follows:

$$T = t_0 + \overline{N \cdot} t_{av}.$$

It can be seen that the major variables the time of supplier selection depends on are t_0 and $\overline{N}$. The proposed approach makes it possible to minimize these by storing essential information in the competence profile and context in a structured way.

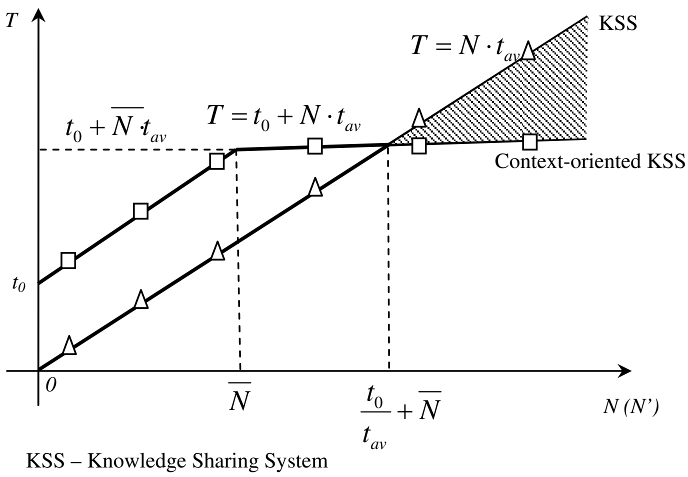

Figure 6. Dependencies of supplier selection time on their quantity in cases of using and not using context in knowledge sharing system

6. Usage of constraints for problem description

Fig. 7 presents the approach in the context of flexible supply network configuration problem. Within the study reported, the following important interrelated

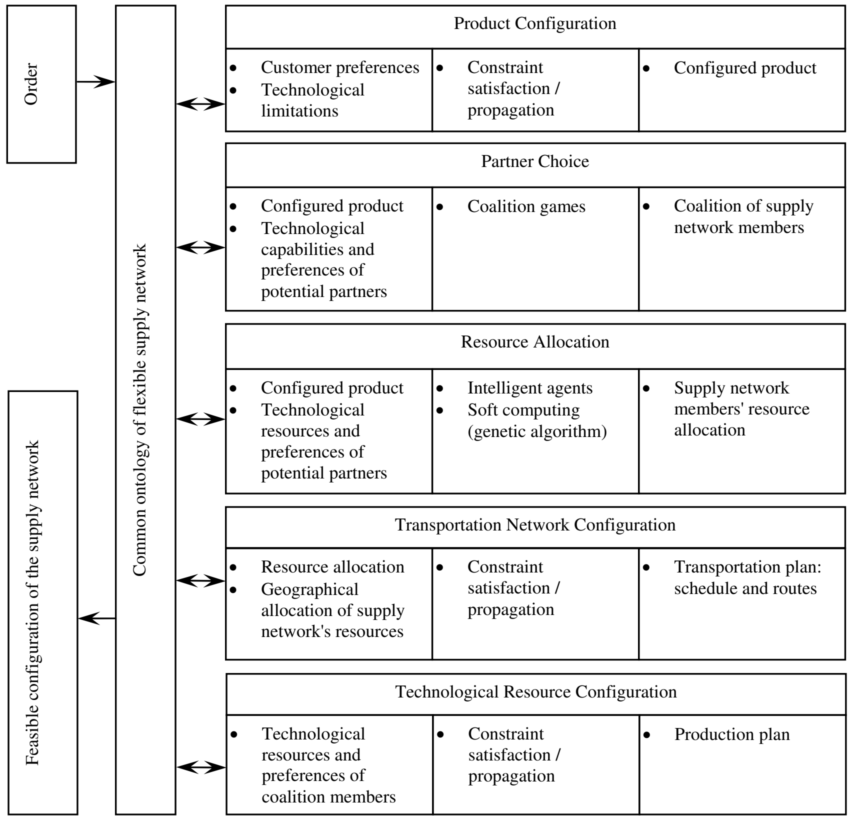

Figure 7. Flexible supply network configuration tasks

tasks, required for the flexible supply network configuration were identified: (1) product configuration in accordance with the customer requirements, (2) partner selection among available companies – potential network members, (3) resource allocation, (4) transportation network configuration, and (5) technological resource configuration. The above tasks are integrated using the common integrated ontological model. In the figure, each task is represented as a rectangle with three boxes in the bottom: input data (left), task solving method (middle), and output data (right). Solving these tasks results in generating a feasible supply network configuration for a given order.

The common ontology built (a macro level fragment) is shown in Fig. 8. Three of the above described tasks can be seen in the left bottom part of the figure. “The Resource Allocation” and “Technological Resource Configuration” tasks are out of the scope of the presented research. The figure represents classes (boxes), attributes (bullets) and relationships (arrows) between classes.

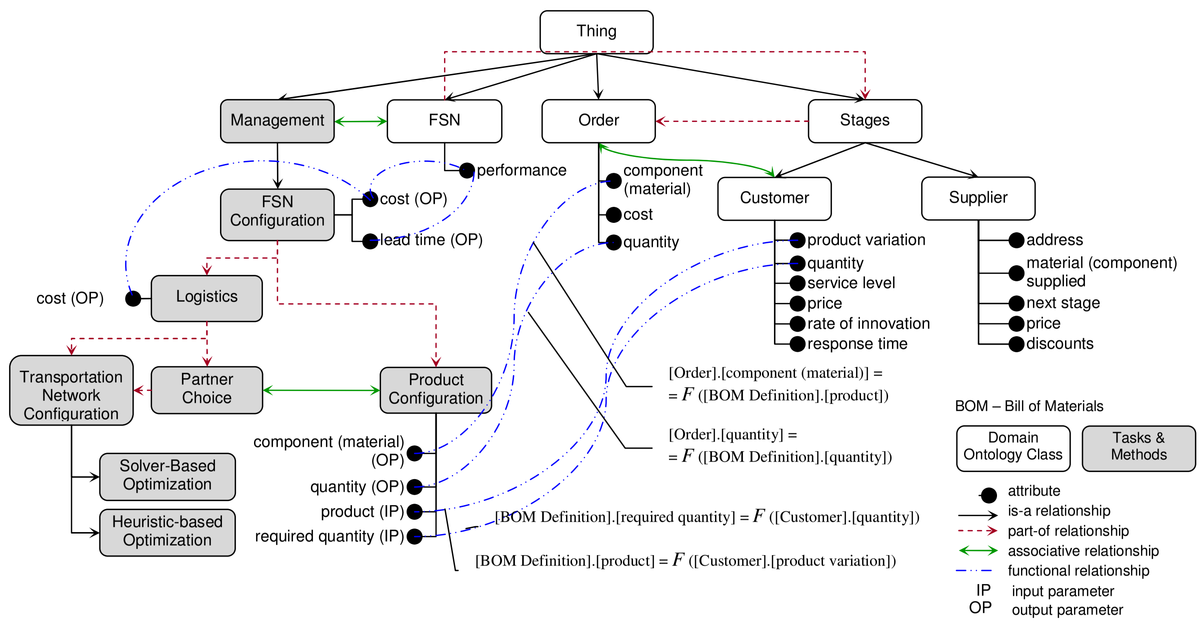

Figure 8. Common ontology of flexible supply network (a fragment)

The ontology consists of two parts: domain ontology (white boxes), describing notions of the considered domain, and tasks & methods ontology (grey boxes). Formalisation of the "Transportation Network Configuration" task by means of OOCN is described further on in detail.

The problem, formalised by OOCN can be processed as a *constraint satisfaction problem* (CSP). A simplified example of CSP for determination whether a road is available or not under current weather conditions is shown below. A set of solutions for the road availability task will comprise a set of available roads. CSP in general form is represented as (V, D, C), where V – a set of variables (a Cartesian product of O and Q), D – a set of variable domains, C – a set of constraints have to be satisfied.

In the example, clause (1), as given below, specifies that in the abstract context there is class *Road* with attribute *Available* that can take value of *True* or *False* (represented by d_{11} domain). Constraints c_{11} and c_{12} restrict the domain of the attribute. They specify that only instances of class *Road* that have *True* in the attribute value are of interest (c_{11}) and that the value for this attribute is determined by *Route availability* task (c_{12}).

$$\begin{aligned}
&v_{11} \in V : \text{[Road].[available]};\\
&d_{11} \in D : \text{[Road].[available]} \in \{\mathit{True}, \mathit{False}\};\\
&c_{11} \in C : \text{[Road].[available]} = \mathit{True},\\
&c_{12} \in C : \text{[Road].[available]} = \mathit{Route\ availability}(\text{[Road].[flooded]}) \qquad (1)
\end{aligned}$$

$$\begin{aligned}
&v_{21} \in V : \text{[Road].[flooded]};\\
&d_{21} \in D : \text{[Road].[flooded]} \in \{\mathit{True}, \mathit{False}\};\\
&c_{21} \in C : \text{[Road].[flooded]} = \mathit{Road\ floodability}\\
&(\text{[Road].[floodable]}, \text{[Weather].[precipitation]}) \qquad (2)
\end{aligned}$$

$$\begin{aligned}
&v_{31} \in V : \text{[Road].[floodable]};\\
&d_{31} \in D : \text{[Road].[floodable]} \in \{\mathit{True}, \mathit{False}\} \qquad (3)
\end{aligned}$$

$$\begin{aligned}
&v_{41} \in V : \text{[Weather].[precipitation]};\\
&d_{41} \in D : \text{[Weather].[precipitation]} \in (0, 100);\\
&c_{41} \in C : \text{[Weather].[precipitation]} = \mathit{Get\ Precipitation}\ () \qquad (4)
\end{aligned}$$

In turn, the the *Route availability* task has the current state of a road as its input argument. In the constraint c12 road state is represented as attribute *Flooded* of class *Road*. Clause (2) above specifies attribute *Flooded* of class *Road*, domain of this attribute and a constraint related to the attribute. This constraint says that the value for attribute *Flooded* is determined by task *Road floodability*. Input arguments of this task are values for attribute *Floodable* of class *Road* and for attribute *Precipitation* of class *Weather*. In other words, in order to solve the task *Road floodability* it is needed to know the intensity of precipitations and whether the road is floodable.

Correspondingly, clauses (3) and (4) give specifications for attributes *Floodable* and *Precipitation* and the classes these attributes belong to. Additionally, clause (4) specifies that the value for attribute *Precipitation* is determined by task *Get Precipitation*. This task returns information about the precipitation intensity using rating scale (0, 100).

When the required information is computed, the entire OOCN, which basically describes a constraint satisfaction problem, can be put into constraint satisfaction/optimization software to produce a solution/set of solutions.

To demonstrate implementation of the approach in a prototype related to the flexible supply network configuration, the "Transportation Network Configuration" task is considered. In the case study the knowledge acquired from a number of sources is shared in order to find a feasible solution.

In flexible supply networks the current situation is constantly updated. It is therefore important to use shared information and knowledge from various sources. In order to provide for interoperability at the technical level the Web-service interface and mobile communication technologies are used. The sources of shared information and sources include warehouse management systems (information about free warehouse capacities), GPS-based systems (information about current vehicle locations), RFID (information about current statuses of deliveries), local GIS system (information about the local transportation network and current traffic situation).

For purposes of testing the applicability of the approach a table imitator that allows performing of different experiments has been built. The scheme of coupling the table imitator with the presented technological framework is given in Fig. 9. RFID tags, installed on trucks and containers are read out by readers. A PC with installed specialized software processes this information to define current locations of the trucks and containers (in real life this can be combined with GPS or similar systems) and statuses of deliveries. This information is used by the DSS to update delivery plans and schedules. For this purpose, DSS also acquires information about the road network of the region provided by a Geographical Information System (GIS), traffic situation is acquired form an Intelligent Transportation System, current weather conditions are provided by a weather service, available warehouses and their current capacities are acquired from a special directory. Currently, the table imitator is equipped with two RFID readers ID ISC.M02 and ID ISC.PR101, and RFID tags RI-I11-112A-03. The characteristics of this equipment can be found in FEIG Electronic (2007) and Texas Instruments (2007). Car models are used for movement imitation.

7. Conclusions

The paper proposes an approach to ontology-based knowledge sharing in flexible supply networks. It is based on the ontological knowledge representation and incorporates such technologies as ontology and context management, constraint satisfaction and profiling. Ontologies facilitate information sharing between dis-

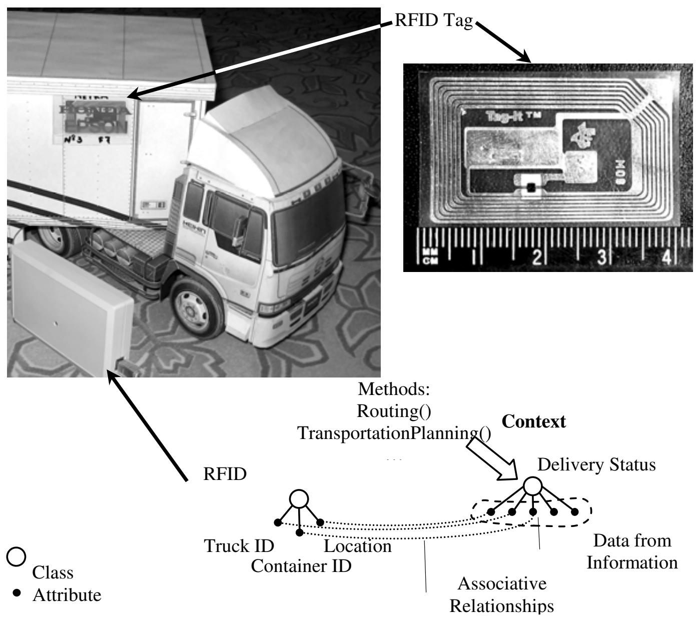

Figure 9. Coupling RFID table imitation with technological framework

tributed and heterogeneous information sources and facilitate interoperability between heterogeneous sources at high level of abstraction. Context management allows the knowledge management platform to account for specific information about the current situation that is normally highly dynamic for flexible supply networks. Usage of competence profiles increases the speed and accuracy of the negotiation processes related to supply network configuration. Describing knowledge via constraints makes it possible to apply constraint satisfaction technology to knowledge processing, including problem solving and optimization tasks. Based on the results of the efficiency estimation presented in Section 5 it can be concluded that application of the approach would increase the efficiency of configuring the flexible supply networks.

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