Chapter 6

Meta-Data Alignment in Open Tracking and Tracing Systems

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ABSTRACT

Many supply chains require open tracking and tracing systems. In open tracking and tracing systems, attributes of objects are not known beforehand, as the type of objects and the set of stakeholders may evolve over time. In this chapter, a method is presented that enables components of tracking and tracing systems to negotiate at runtime what attributes may be stored for a particular object type. Components may include scanning equipment, data stores, and query clients. Attributes may be of any data type, including time, location, status, temperature, and ownership. Apart from simple attributes, associations between objects may be recorded and stored (e.g. when an object is packed in another object, loaded in a truck or container, or assembled to be a new object). The method was developed in two European-funded research projects: TraSer and ADVANCE.

1. OPEN TRACKING AND TRACING

In the present business landscape, companies should not be considered to be independent entities, but parts of supply chains that are interwoven to multi-echelon networks. Material flow transparency, specifically the visibility to inventories and deliveries in the whole supply network, is considered an imperative requirement for successful supply-chain management, and has been associated with significant efficiency and quality improvements (Ala-Risku and Kärkkäinen, 2004; Ballard, 1996; Clarke, 1998; Främling et al., 2004; Kärkkäinen et al., 2004).

Apart from logistics, transparency of the origin of goods and their manufacturing conditions is increasingly required by consumers and regulators. Food safety and food composition are hot topics.

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Consumers wish to be informed under what conditions products were produced and packed, and use criteria such as sustainability, animal well-being, fair trade and worker’s conditions to guide their purchasing (Hiscox and Smyth, 2011).

Manufacturers, on the other hand, need to know where their products are ultimately sold and consumed. They are increasingly held responsible for maintenance, spare parts supply and reverse logistics (Kosk, 2014). In case of defects or quality issues, consumers may need to be warned and products may need to be recalled. Without a system that keeps track of product destinations, too many products must be called back and too many consumers are alarmed unnecessarily.

Tracking products and electronic product representations across enterprise boundaries currently requires substantial manual work, or extensive system-to-system integration work. From an application point of view, tracking functionality is tightly coupled to the systems and practices of the individual supply chain participants, resulting in network level operational processes being rare and expensive. Few companies, regardless of their desire for supply-chain efficiency, have implemented supply-chain transparency solutions (Kaplan, 1998; Gunasekaran and Ngai, 2004). Even fewer have developed solutions for transparent product customisation, delivery or the networks involved in maintenance and repair.

An example in the food industry may illustrate the problem area. Initially, a tracking and tracing system is used to track pallets through the supply chain, from distribution centres to outlets. Each pallet is identified, and is by means of scanning linked to a purchase order, a picking event, a loading event and a receiving event. Supply chain partners upload the scan data to a (centralised or distributed) database that is accessible to all of them. A few years later, the temperature of the pallets is to be controlled by the same tracking and tracing system. The data to be processed after each event is extended with the temperature at the time of scanning. Yet later, the system is to track the products that are stacked on the pallets, their source and their best before date. So an event is added: the stack event. Then at the time of receiving in the outlets, the outlet inventory system is to be updated after scanning the pallet. Again an extension of the data to be processed, both by uploading and by querying systems, is needed. Note that the roll-out of the extra functions may be stretched over a lengthy period, one outlet at the time. During roll-out, systems may need to support multiple versions.

Most present tracking and tracing (T&T) systems are closed. Their use is limited to the supply chain partners of one product brand or function (e.g., transport). Companies that serve multiple brands need to install multiple systems. Systems, dedicated for some function (e.g., transport, anti-theft or product quality) are seldom interconnected.

EPC Global (2014) is a relative open system. Every company may join if they adhere to the conditions and pay a fee. The types of events that may be recorded in the system and the types of data that is stored are extensible. However, extensions should be approved by the EPC Global standardisation committees. Private extensions are allowed, but no mechanism exists to inform supply chain partners of such extensions. In any case, implementation of extensions requires reprogramming of all systems in the affected supply chain.

Note that not only products need to be tracked, but also the equipment that is used to produce and transport the products and the people that are responsible for that (Ilie-Zudor et al., 2011). Events may cause very complex transactions in T&T systems.

As supply chains are interwoven, solutions that are tailored for a specific product or brand are not viable. The same type of product may be sold to factories as components for other products, to wholesalers and directly to ultimate consumers via a web shop. Transport companies may carry goods of various industry sectors.

Trading relationships are not cast in concrete, they are volatile. Smaller companies, such as