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# Position paper Roadmap to tracking based business and intelligent products

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### ABSTRACT

Item-centric tracking is an opportunity to increase visibility and control in different operations of a company. The economical feasibility of item-centric tracking is based on recent technological developments for monitoring the material flow on the item-level instead of the material type-level. It enables companies to track and trace assets over their lifecycle and manage supply chain operations across organizational boundaries. However, the challenge in practice is to find the right areas to start the development of business applications. In this viewpoint paper a means-ends framework for introducing item-centric tracking in business is proposed based on realized track and trace cases. Based on the framework a roadmap for introducing tracking in businesses operations is outlined. The proposed roadmap circumvents the most challenging business cases for introducing tracking and RFID-technology in the supply chain and focuses on asset management as a more accessible route for business.

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# 1. Introduction

Item-centric supply chain management [1] and item-centric control and information management [2] is an approach that offers companies opportunities to better track and trace assets over their lifecycle and to manage their supply chain operations efficiently across organizational boundaries. However, business scenarios for improved material and asset information management across the life-cycle and over organizational boundaries need to be further investigated in order to speed up the diffusion of the approach. Developing clear propositions is essential especially for diffusion of technology to small and medium sized enterprises.

This paper explores the business opportunities that result from shifting the focus of materials and asset management from location based control to item-centric materials and asset tracking [3]. The base principle [4] is to take the tracked item as the basic entity and treat the location as a property of the item. The result is that the item being tracked becomes the object of control instead of inventory and asset accounts in predefined locations. This way of shifting the locus of control to the product or item is a first step towards the intelligent product concept [5].

When in place, item-centric track and trace is a potential new means for companies to set up economically feasible concurrent enterprising solutions. The economical feasibility of item-centric tracking is based on recent technological developments in tech-

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nologies for monitoring the material flow on the item-level instead of the material type-level. Tracking and automated identification are based on different types of bar codes and increasingly the use of radio frequency identification (RFID) technology [6].

To provide control over individual goods and assets it is necessary to develop technology that can maintain the identity of the item and that item properties, such as the location of the item, can be updated in the same way across locations (see Fig. 1). Item-centric supply chain management [3] focuses on the management of individual items instead of the material inventories at predefined locations. It is a proposed solution to the difficulty to develop value offerings over the life-cycle of items and across different enterprises in the supply chain. Fig. 1 illustrates the difference between a location based and item-centric approach to materials management.

There are many opportunities for businesses to benefit from item-centric control. The purpose of this paper is to identify stateof-the-art practices in item-centric supply chain management (SCM) and asset management (AM). Furthermore, we will analyse the identified applications and highlight the functional analogies between different types of applications. Based on the analysis we propose a roadmap for adopting item-centric control in different types of business applications.

#### 2. Research approach

The roadmap for introducing the item-centric control in business, i.e. of tracking based business, is based on a number of state-of-the-art examples that have been presented in professional and academic journals in 2005 and 2006. The state-of-theart cases were found using the Proquest en EBSCO databases. The

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**Fig. 1.** Tracking systems enable a change of control logic from location based to item-centric materials management [3].

search terms used for the initial database queries were 'RFID' and 'tracking'. The cases from the past two years were then screened for further analysis and judged by two criteria:

- 1. The case must present a successful application of a *realized* automated identification based system, instead of hypothetical prospects of RFID and tracking which have been widely published in both academic and trade journals.
- The description provides a presentation of the business case, the business environment, and technical details of the tracking and identification system that is sufficient to identify the type of solution and its rationale.

The structure of the paper is the following. First, we develop a means-ends framework that identifies the factors that we use to analyze and differentiate state-of-the-art cases. This is followed by a more detailed analysis of selected cases that illustrate the main categories as described by the framework. In conclusion we present a roadmap for introducing tracking based business applications in a company.

## 3. Means-ends framework for tracking based business

The search identified altogether 20 different case descriptions that met the defined criteria of a *realized* automated identification based system and a presentation that is sufficient to identify the type of solution and its rationale, i.e. the means-ends proposition ([7], pp. 211) of the case. The identified state-of-the-art descriptions were each analyzed individually and the identification solution and its benefits documented.

The examples of automated identification and tracking based business were categorized based on the system functionality (i.e. the "means") and the type of goods and assets tracked (i.e. the "ends"). The categorization of functionality is based on the observation [6] that the basic functionality in tracking systems is the identification, and tracking itself an application based on identification. The more complex functionality in the analyzed applications allowed the sharing of the items' tracking information via web-portal or system-to-system integration depending on the value to the customer.

Asset management and supply chain management can be seen as different ends that can be achieved by the same means. Fig. 2 illustrates how asset management and supply chain management applications from the item-centric perspective are long-term and short-term tracking applications respectively. Meeting the economic case for investment in tracking is easier for asset management applications than for supply chain applications because the benefits in asset management can accumulate over time.

The first step to tracking based business applications is the identification of the item. After implementing an identification system, the following step to enhance system functionality is to construct information management structures to support the



Fig. 2. From an item-centric perspective asset management and supply chain management are different ends for the same means.

gathering of data from the points of identification. Tracking of goods is based on the centralizing of identification information of various tracking points in a single database. The database can be used to perform queries about the movement of items which serve as basis for analysis on the optimal material usages and routing. The construction of a tracking system requires therefore a change of view from location centric to item-centric materials management, which makes the item the object of optimization instead of the storage location.

The closed circulation of goods in asset management systems is a major point that distinguishes it from supply chain management systems. In closed circulation the number of identified items in relation to the identification points can be kept much lower than in flow-through solutions. This directly affects the investment decisions, partly through the cost of identifier that is used, but also through the cost of creating and setting up the item to be tracked in the tracking system itself. Implementing supply chain management solutions using closed loop assets – such as roll cages and pallets – means that there is an overlap between asset management and supply chain management solutions.

Our proposed means-ends framework is summarized in Fig. 3. The framework identifies eight categories, based on the three divisions of system functionality and the distinctions between asset management, asset based supply chain management, and flow through supply chain management. For each category an illustrative state-of-the-art example is presented and discussed in more detail below.



Fig. 3. Means-ends framework for tracking based business and illustrative state-of-the-art examples.

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