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A Model for Mystery Shipping in Logistics

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ABSTRACT

Transparency, security and sustainability in logistics are major trends with increasing efforts in research and business practice. The existing concept of mystery shopping from service quality assessment can be transferred to logistics as a `mystery shipping` concept testing logistics service providers for their reliability (e.g. delivery in time), transparency (validating their track & trace information) and sustainability documentation (evaluating e.g. their CO_2 calculation per shipment). This concepts would require autonomous GPS tracking devices to accompany the shipments used as mystery shipping test setup and an accompanying software system to evaluate e.g. shipment times and CO_2 emissions per shipment.

1. INTRODUCTION

Modern logistics in global supply chains as well as regional and local transport chains is influenced by several trends: Surveys show demand for more transparency and security in supply chains or cooperation with innovative logistics service providers (see DB Schenker Laboratories 2009). In addition, sustainability is a major trend in logistics and relies in many cases on the measurement and reduction of CO_2 emissions. Therefore carriers have to prove a Product Carbon Footprint (PCF) for their transports per shipment (see Aronsson et al. 2008; Sundarakani et al. 2010). Furthermore the importance of track and trace solutions for cargo increases according to the development of satellite based traceability services in logistics (see He et al. 2009; Carlino et al. 2009). The calculation of CO_2 emissions for each shipment is a challenge because of the complexity of logistics services. A lack of traceability on the part of the customer according to load variation or travelled routes makes it nearly impossible to allocate real CO_2 emissions to each item, especially in groupage freight transports (see Lohre, Herrschlein 2010). Nowadays PCF are calculated by the use of linear distances or with theoretical distances on the basis of road maps. But that is not even close to reality: Detours, by-passes of traffic jams or dynamic routing are not included. A possibility to close this gap in CO_2 calculation between theoretical calculated emissions and actual emitted value is the use of a GPS based track and trace system. Because of the documentation of the travelled routes it is possible to reconstruct the real covered distance to calculate travelled-distance-based CO_2 emissions for each shipment. This increased accuracy in CO_2 calculation could be used in order to evaluate for example the carbon footprint specifications of logistics service providers. This could be drafted as a quality control model according to the mystery shopping concept as described below.

2. THEORY OF MYSTERY SHOPPING

The concept of mystery shopping has been an integral part of quality management and quality improvement concepts especially in service industries for quite some time (see for example Erstad 1998; Wilson 1998; Hudson et al. 2001; Wilson 2001; Cook et al. 2002; Beck, Li 2003; Moriarty, McLeod, Dowell, 2003; Norris 2004; Calvert 2005; Van der Wielea, Hesselinka, Van Iwaarden 2005; Gosselt et al. 2007). The following basic *elements* are defining mystery shopping concepts:

- (i) The fact and also specific details like time and place of mystery shopping processes are hidden from the service provider to be evaluated, especially operational personnel in day-to-day business processes.
- (ii) Sufficient and reliable data has to be collected in a systematic manner during the mystery shopping process in order to allow for comparability and benchmarking options.
- (iii) Evaluation mistakes or deception have to be excluded with the highest possible probability (e.g. by loyalty statements, external providers).

This concept can be transferred to logistics as described in the following chapter in order to arrive at similar fruitful benchmarking an quality improvement options as usually addressed in existing mystery shopping concepts in services as e.g. retailing, banking and other service industries.

3. MODEL FOR MYSTERY SHIPPING

The mystery shipping model in logistics can be adapted by referring to the three mentioned basic elements and adjusting them to logistics services as follows:

- (i) The mystery shipping has to be invisible to the logistics service company. A tracking device for service measurement has therefore to be hidden in existing industrial shipments of roughly the size of europallets or skeleton transport boxes.

- (ii) The tracking and information system used for mystery shipping has to allow for at least 30 independently calculated and stored tracking devices in order to provide a representative picture of overall service and information quality of the tested service provider as only or several single shipments may pose an exception. Furthermore the tracking data has to be very precise in order to guarantee a fair evaluation of the logistics service provider.
- (iii) As in other service industries the mystery shipping could be conducted by external consultants and specialists – and also maybe for trial runs by scientific institutions. These have to saveguard the mystery shipping personnel (e.g. sending companies) and processes from any leaks and deception. Furthermore a sufficient storage and documentation of the tracking data is necessary to allow for credibility and therefore service improvements by the logistics service provider.

4. TESTING CONCEPT WITH GPS TRACKING

As outlined before, the use of hidden GPS tracking devices with an autonomous power supply for the length of the transport process are necessary for implementing a mystery shipping concept in logistics. Since 2011 the ild Institute for Logistics and Service Management of FOM University of Applied Sciences, Essen/Germany, owns a GPS based track and trace system by AIS Advanced InfoData Systems GmbH, Ulm. To use the system and to analyse the results, a laboratory was installed at the institute under the name `GPS.LAB`. The specifications of the system are the following:

- The system contains in the basic setup 40 independent GPS modules to track individual shipments in a logistics transport situation.
- Furthermore these modules have high-capacity recharge-able batteries which make it possible to track a shipment over a period of up to 48 hours depending on the communication rhythm interval (GPRS mobile phone SIM card for data transmission with the mobile phone network).
- This data transmission interval can be defined by different parameters in the system, e.g. by a time interval (e.g. every ten minutes), a transport distance (e.g. every three kilometers) or after a change of direction of a defined angle (e.g. more than 45 degrees).
- The modules are equipped with a high GPS receiving and broadcast performance for receiving satellite position signals even out of boxes and containers (steel hull) in order to allow for transfer and packing of shipments in one vehicle (e.g. truck, also train).
- The data communication ('live tracking') is ensured as described by telecommunication via GPRS (mobile phone network).
- The modules are storing and also communicating a multitude of information about position, altitude, speed and the duration of stops regarding a single shipment in logistics.

By reason of these specifications the tracking data now reaches an accuracy which could not yet be realised so far. Using the software `map & guide` by PTV Planung Transport Verkehr AG, Karlsruhe, the GPS performance data can be mapped as a basis for further analysis and calculations. In fact, with the help of such a system logistic processes would be analysed well-founded as the data is verified by real transport and not by simulation (figure 1).

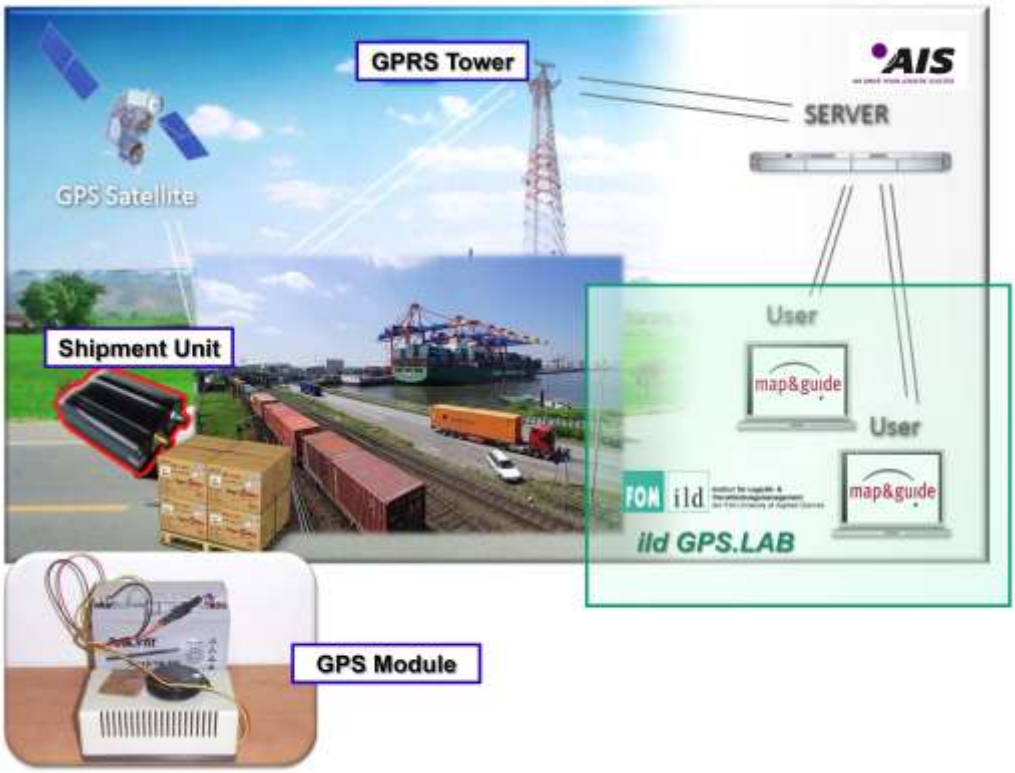

Figure 1: Testing Setup for Mystery Shipping in the ild GPS.LAB

Thererfore due to battery power the GPS.LAB makes it possible to track goods down to the level of pallets, cases, cartons or ideally items during the whole transport to retrace the logistic process in detail and to analyse the performance of supply chains. This will be tested in first trials, when the tracking modules will be tagged at several shipments to make sure that the whole GPS based track and trace system runs with a very high service level and to check the performance of the system for identifying possible applications which are mentioned in the following paragraph.

The first trial results runs for the new GPS.LAB will be presented to demonstrate the benefit of using a real-time track and trace system in production alliances and supply chains according to the following examples in order to evaluate logistics service providers against their promises:

- The consequence of goods tracking is a route of transport tracing, so that a tour can be illustrated on a roadmap with software support. Because of this presentation it is easier to understand complex transport chains, for example to divide a groupage freight tour in forerun, mainhaul and post-carriage distribution. Furthermore a specific hub and spoke structure of a logistics network or the position of delivery on the last-mile can be considered in the context of a PCF calculation. This will be the main using context of the system.
- Moreover the real-time tracing of the shipments makes it possible to estimate the arrival of goods in a production network with several locations, like a concurrent enterprising alliance, so that production planners get a better support, for example to synchronise the delivery of material and preliminary products with the production scheduling. With the information about position and speed, conclusions can be drawn according to the time of arrival at the production. In addition the storage of historic routes provides extra information and supports production planners in future planning challenges.
- A conceivable application for the introduced GPS system in logistics practice is due to the context of 'Supply Chain Event Management' (SCEM). Existing concepts basically focus - among other things - on real-time information (see Klumpp et al. 2010). Thereby the task of such systems mostly lies in realizing data along a supply chain as a prerequisite for (semi-)automated management systems. Supply Chain Management (SCM) needs a smooth information flow for an efficient functionality within a delivery chain (see Nissen 2002) and SCEM has to ensure a permanent monitoring of material and goods flow along the entire chain to make coordinated management action possible (see Beckmann 2003).

Due to the fact that GPS at present is mostly used in logistics for fleet management, the tracking functionality is restricted to a single vehicle. A shipment-based version would enforce the range of functions/features of real-time event management. Regarding the desire of rising the percentage of multimodal transports and the thereby caused carrier exchanges, a real-time determination of the place of residence of goods is possible by using shipment-based GPS-systems with many feasible advantages like e.g. true geofencing. So a GPS-based track and trace system as described above is required for a practical implementation of the drafted mystery shipping model in logistics.

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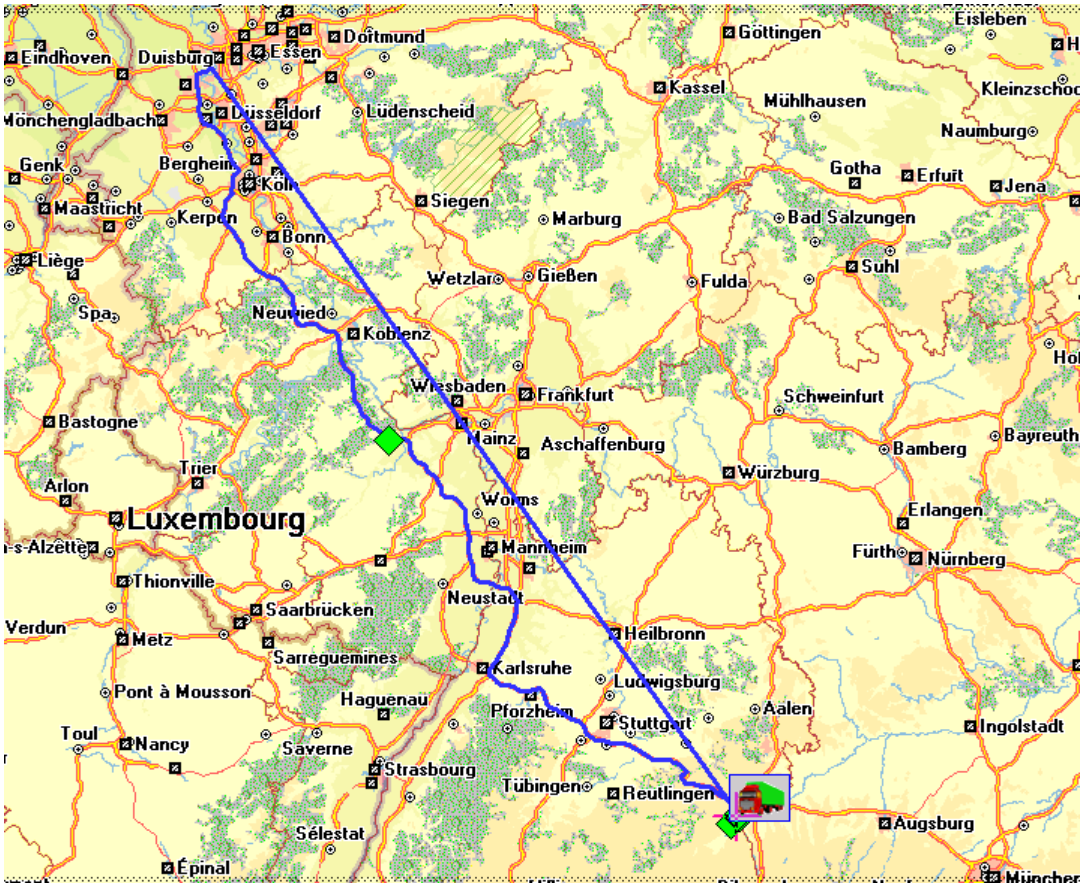

Figure 2: Mystery Shipping Test Run Duisburg-Ulm

5. TESTING RESULTS

For testing purposes a simulation mystery shipping from Duisburg to Ulm in Germany was scheduled and implemented with the help of the German logistics service provider DB SCHENKER as depicted in the above positioned figure 2.
Actually DB SCHENKER did not know about the test run (on an operational level by process-related personnel).

6. EVALUATION OPTIONS

Naturally, as outlined above, many different aspects of a service as e.g. a transport service can be tested and evaluated by GPS-based `mystery shipping`. But several of these generally possible objectives can be highlighted as specific data from the GPS measurement seems to implicate their use:

- Check of start, transport and delivery times (comparison to track & trace data provided or other forms of information from the LSP).
- Check of transport routing (especially in cases for example with exact kilometer-based invoicing as often the case with special, time-critical and courier transports).
- Check of delivery and geographic status in case of transport hindrances.
- Check of eco-performance measures such as GHG emission figures by an exact route-based approach as developed below in table 1. As this first test example shows, an evaluated difference of CO_2 emissions of 33,78% has been shown for the shipment from Duisburg to Ulm.

Pos	km total	km diff.	vehicle	EC empty [l Diesel]	EC loaded [l Diesel]	utility max [pallet]	utility actual [pallet]	CO_2e-emisions [kg]	*Info*
1	525,0	525,0	40t (Euro 4)	20,9	31	36	36	14,349	*DB DU --> DB UL*
2	530,5	5,5	7,5t (Euro 4)	15,5	19,4	15	15	0,226	*DB UL --> stop 1*
3	533,1	2,6	7,5t (Euro 4)	15,5	19,4	15	14	0,113	*stop 1 --> stop 2*
4	534,4	1,3	7,5t (Euro 4)	15,5	19,4	15	13	0,060	*stop 2 --> stop 3*

5	536,4	2,0	7,5t (Euro 4)	15,5	19,4	15	12	0,098	*stop 3 --> AIS*
								14,846	***Shipment based CO_2e emissions***
Air distance	*406*	*406*	*40t (Euro 4)*	*20,9*	*31*	*36*	*36*	***11,097***	***Air distance based shipment CO_2e emissions***
			Difference					**3,749**	***33,78% deviation***

Table 1: GHG Emission Calculation on GPS Tracking Basis for Eco-Evaluation

7. CONCLUSION AND OUTLOOK

The general idea of mystery shipping in logistics holds many promises of evaluating service quality, transparency and also sustainability parameters communicated today by logistics service providers to their customers. Further research has to establish the practical feasibility of this quality assessment concept in logistics with the described facilities of the ild GPS.LAB. This is planned for test implementations with several logistics companies in Germany during 2011 and 2012. These further test results will be re-evaluated and integrated into the described mystery shipping model in order to allow for a sustained and high-quality improvement process for a successful implementation and use in the logistics industry in the future.

Besides this streamlining of the suggested model a lot of supplementary functions are generally possible and can briefly be outlined (see also Wang, Potter 2008; Stopka 2009):

- An auditing approach by a (new) third party institution especially regarding the CO_2 documentation of logistics service providers (e.g. as the German 'Stiftung Warentest' or other public auditing institutions).
- Furthermore real-time tracking data could contribute to dynamic scheduling and quality assurance in production and production networks, especially in the new evolving global production supply chains (see e.g. Brewer, Sloan, Landers 1999; Meers, Hennes, Nyhuis 2010; Wannenwetsch 2010).
- Also such audits and even rankings of logistics service providers are feasible on the basis of the described real-time tracking – showing hubs and transport networks and maybe even enabling social audits by the way of evaluating transit spaces, countries and regions (e.g. if one LSP has established an international hub in a specific low-cost-country location, see Hillbrand, Schoech 2007).
- And even further in the future even short-term production networks could decide about their specific set-up in the light of real-time GPS-tracking information of shipments (see Kärkkäinen, Ala-Risku, Främling 2004).

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