



## Sustainable Agriculture through ICT innovation

### Requirements on a 4PL-Platform in After-Crop Logistics

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#### ABSTRACT

This paper describes a requirement analysis of a possible “Fourth Party Logistics Providers (4PL)” approach implemented with a 4PL platform in the sector of after-crop logistics. The 4PL approach was analyzed on the basis of a systematic literature review. Subsequently an online survey was created with the consideration of criteria from the Technology-Organization-Environment-Framework. Participants in the survey were freight carriers of the sector. The results of the survey describe the possible functions of a 4PL in the sector as well as approaches for information and communication technology (ICT) that are currently being applied and will be applied in the future. Moreover the requirements for freight carriers to enter into cooperation and the economic incentives on the part of freight carriers within the scope of 4PL development are presented. Finally, future research activities are explained in consideration of possible functions of the 4PL approach in the sector.

**Keywords:** Logistics, 4PL, platform, SME, requirements, Germany

#### 1. INTRODUCTION

The volume of bulk freight handled in after-crop logistics in Germany is approximately 55.6 million (t) of grain each year (Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz, 2011). In the process, this raw material that is exemplarily highlighted for the sector of agricultural after-crop logistics was turned over to approximately 59% on the street. The basis of the transport is often a commercial transaction between the actors of the sector. Actors are agricultural traders and cooperatives in the form of small and medium-scale companies who also carry out transportation; storage and transshipment activities in addition to commercial activities through own fleet and/or warehouse capacities. Moreover, freight carriers are active as First Party, Second Party or Third Party Logistics providers in the sector.

The outsourcing approach that is known in industrial sectors and the cooperative work with logistics service-providers (which goes hand-in-hand with it), is implemented in

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the sector only in an isolated manner as well as described using the example of the sector (Picazo Tadeo and Reig Martínez, 2006). As in other sectors, a possible innovation potential through the outsourcing of transport orders and with the cooperative work with logistics service-providers (Wallenburg, 2009) can thus be suspected. Nonetheless, Wagner has clearly displayed that innovation management definitely has improvement potentials particularly in German transport logistics (Wagner, 2008). One innovation option within the scope of transport logistics could be a growing use of information and communication technology (ICT). In the literature is described that the introduction of ICT directly and indirectly impacts the performance of supply chains and supply chain management (Xuan Zhang et al., 2011). Impacts and significant improvements could be established in the most different sectors (Cheng-Min Feng and Chien-Yun Yuan, 2006). With the introduction of these technologies some framework conditions such as the size of the company (Evangelista and Sweeney, 2006) has to be considered so that the use of ICT and the cooperative work with a logistics service-provider succeeds.

It could be detected that so far, no 4PL approach has yet been implemented in the sector and that manual communication tools (fax, telephones, email) are largely being applied. The fourth party logistics (4PL) approach, which communicates with the potential customers of a network using a ICT-platform should therefore be examined as a possible innovative concept for after-crop logistics.

The authors of this paper conducted interviews with experts in June 2012. The aim was to examine a 4PL approach closely in the sector of after-crop logistics. The experts were 2 dealers, 2 freight carriers and 2 freight forwarders.

In the interviews, possible potentials out of literatures for the 4PL approach were reaffirmed for the sector. Potentials were the application of e-marketplaces or resource optimization (Nissen, 2001; Qiuping, 2011). Also the ideas were the introduction of ICT such as transport management systems or telematic systems that may possibly replace the present media paper, fax and email. Mentioned were possible functions of service-providers which facilitate an overview of transport capacities/transport needs, because every actor presently tries to implement transport with own equipment or through the services of freight carriers.

For further verification the requirement analysis of the concept of a 4PL platform was done, on the basis of the Technology-Environment-Organizational (TOE) framework. The TOE framework was developed by Tornatzky and Fleischer for the purpose of investigating the adaption of technological innovations (Tornatzky and Fleischer, 1990). The analysis takes technological and organizational aspects and impacts of the environment into consideration. This approach was adapted for the extensive view of the 4PL approach for the after-crop logistics. The aim of the investigation is to specify possible standards required on a 4PL platform in the sector of after-crop logistics as well as to analyze the technological and organizational properties of the sector and the impacts of the environment.

For this purpose, an online survey with 148 freight carriers of agricultural bulk freight logistics was conducted within the scope of this paper using a standardized questionnaire. The freight carriers interviewed were taken from the data pool of the wholesale sector because they are responsible for a large part of transports in the sector due to the

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consolidation function of the harvest volume. This paper is aimed at researchers investigating the development of 4PL platforms as well as practitioners of the sector of after-crop logistics who commit themselves to the 4PL approach.

## 2. TERMINOLOGY

The term 4PL is a term introduced by Accenture. It describes a logistics service-provider, which operates as a supply chain integrator (Olander and Norrman, 2012). The core function of 4PL consists in the management of own as well as third-party (service-provider of a network) resources, abilities and technologies, to facilitate the emergence of a comprehensive supply-chain solution. The main feature of 4PL is the freedom of asset (Win, 2008). To enable this, the 4PL employs the services of the respective service-provider of a network on a neutral basis and in accordance with efficiency aspects.

## 3. RESEARCH METHODOLOGY

For the research work the authors of this paper carried out a systematic literature review (Webster and Watson). The terminology of a 4PL and possible platforms to successfully implement the 4PL approach were investigated. Publications covering the period 2000-2011 were taken into consideration for this purpose. A, B and C-ranked articles of the rankings of the German Academic Association for Business Research (*Verband der Hochschullehrer fuer Betriebswirtschaft e.V.(VHB)*) from the partial ranking of logistics and partial ranking of Business Informatics were taken as data basis. The list of Business Information Systems Engineering of 2008 (Business Information Systems (WI) orientation lists) has also been considered. It was assumed that the selected areas completely describe the scope of the investigation. Keywords for the search were 4PL, Fourth Party, Transportation Management and IT Infrastructure, Outsourcing and 3PL. Literature presenting the 4PL approach and IT infrastructure could be found on the keywords. Altogether, 74 articles could be identified for the context of 4PL/- platform. With the restriction that the approach is not be implemented in the sector and that a platform can have different requirements the TOE framework approach was adapted based on examples out of the literature (Chan and Chong, 2013; Bernroider and Schmöllerl, 2013). The TOE framework required technological standards, organizational standards and standards that are relevance to the environment. The required technological standards cover criteria for examining the information and communication technologies that are applied in the sector and subdivided into hardware structures and software applications. The organizational criteria examine the possible cooperative and economic requirements of the 4PL. Under coverage of the environmentally-relevant standards required for a 4PL platform, the criteria of corporate development examine how far possible investments can be imagined.

Freight carriers who worked for the wholesale of the branch as service-providers within the past three months (July to September 2013) were selected and invited for the survey. It was to be ensured – due to the period – that only certified freight carriers (Good Man-

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ufacturing Practice – GMP) were selected because the goods transported were either feeds or foods.

The first draft of the questionnaire was worked out on the basis of the facts gathered from the literature review, the examined requirement analysis and initial expert interviews in the sector. This draft was critically discussed with further experts of the sector and suggestions of changes were implemented. This was followed by a preliminary test with two freight carriers of the sector, through which further changes were made on the questionnaire. The final version of the questionnaire could then be sent to the remaining 146 freight carriers. The online questionnaire was classified into three sections and was made available via the tool LimeSurvey. The first section contained general questions on the company’s profile. The second section examined issues of the 4PL approach with subdivision into technical, cooperative, economic requirements as well as issues of corporate development. Remarks and suggestions could be made by the interviewees in the third section.

### 4. RESULTS

Out of 148 freight carriers, 31 (21%) freight carriers fully completed the questionnaire in the period from October 2013 to November 2013. In the process, all freight carriers were twice called upon to participate within the period. The respondents were employees in management positions either as Dispatchers or Logistics Managers. On the average, the companies had 11 to 40 employees and turnover ranged from €250,000 to more than €5,000,000. A similar range was available in the number of trucks. For instance, 13 respondent companies had 1 to 5 truck(s), 12 companies had 6 to 20 trucks and 2 companies had up to 40 trucks. The companies transported an average of approximately 310,000 tons of bulk freight each year (from 5,000 to 2 million tons), which is equivalent to approximately 12,400 transport units/company.

The introduction of the questionnaire described the 4PL approach and the motivation of the survey. In the process, the companies were able to choose from 31 different functions for a possible 4PL and assess them in accordance with the criteria based on the Likert scale: “absolutely incorrect” (1), “more incorrect than otherwise” (2), “partly correct and partly wrong” (3), “more correct than otherwise” (4) and “absolutely correct” (5). Table 1 shows a selection of the assessment of the possible functions of 4PL in accordance with the mean value in descending order. The complete table can be found in the appendix via the link.

Table 1: Desired functions of a 4PL service-provider

Planning of turnaround schedule	3.86	Optimization of order-placement sequence	3.56
Generating orders	3.72	Improved flow of information	3.53
Route optimization	3.71	Organization of service chains	3.53
Job controlling	3.59	Acquisition of new customers	3.41
Asset sharing	3.56	Planning of loading and unloading	3.37

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Following the general expression of the functions the additionally questions were based on the TOE-Framework. Within the scope of technological consideration, the question focused on the information and communication structures that are currently being applied (Hardware/Software). A question was also asked with regard to ICT use to be imagined for the future. Table 2 describes a selection of the ICT that is being applied with the accumulated mean values as well as possible future ICT in ascending order. The complete table with all criterions and a description can be found in the appendix.

Table 2: ICT - Criterion Technology applied

Hardware applied	Mean value	Software applied	Mean value	Future ICT	Mean value
Telephone	4.8	Software for route optimization	4.5	Internet	4.2
Fax	4.8	Software for word processing	4.4	Telephone	4.0
Mobil telephone	4.8	Spreadsheet software	4.2	Fax	3.9
Email	4.5	Software for transport management	3.3	Online platform	3.9

Respondents were asked about the following cooperation targets (as organizational standards) and the economic standards required for a 4PL.

Table 3: Criterion Organization

<i>(Organizational standards)</i> <i>Support of cooperation approaches by 4PL for:</i>	<i>Mean value</i>	<i>(Economic standards)</i> <i>Standards required of 4PL as network coordinator:</i>	<i>Mean value</i>
Planning and control function (Broader term)	2.9	Turnover boost	3.8
Minimization of costs along the supply chain	2.7	Expansion into other markets	3.1
Presentation of the cross-company view of stocks and resources	2.4	Increasing the number of new customers	3.2
Minimization of warehouse stock	2.0	Process improvement of transport processing	3.8
Boosting of delivery-readiness	2.6		
Generation of competitive advantages through combined service provisions	2.9	Improvement of flexibility	3.4
Generation of consultancy and service functions	2.6	Improvement of Customer Service	3.4
Implementation of cross-company trainings	2.6		
Introduction of new technologies (technologically)	2.7	Increased resource utilization	3.8
Introduction of new technologies (organizationally)	2.7	Reduction of empty vehicle mileage	4.0
Development of standards/ Certifications	2.8		

The analysis of the environmental impacts is described in the appendix (Table 8).

### 5. INTERPRETATION

The analysis of the desired functions of a 4PL service provider shows that possible service-provider activities such as the planning of turnaround schedule, route optimization as well as job controlling are definitely desired by freight carriers. This would require an outsourcing of such activities (Wallenburg, 2009), which in turn, would facilitate the

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execution of these functions by a possible 4PL service-provider. The sectoral structure of small-scale and micro-sized enterprises as reported by the experts and the present application of communication media could be confirmed, and this may help explain the present use of ICT (Evangelista and Sweeney, 2006). Initial requirements could be worked out conceptually for a possible 4PL Service Provider with the help of the TOE framework, through which functions can be deduced for a 4PL platform.

The application of an online platform is technologically imaginable even though this communication medium is currently being applied only partially. A possible 4PL platform should also integrate the present communication mediums. Both requirements from the branch could be attributed on one hand, to the uncertainty of the scope of a platform and on the other hand, to the rather conservative structures of the sector.

The analysis of the criterion "Organization" shows that the sector is behaving rather cautiously from the point of view of cooperation. Only the planning and control function of a 4PL were supported within the scope of cooperation efforts. On the contrary, the aspect of the economic standards required for a 4PL platform is more precisely assessed by the respondents. Functions which support the reduction of empty vehicle mileage, increased resource utilization, process improvement of transport processing and which facilitate turnover boosting were focused upon as required standards. This could be pointing out a possible potential of a 4PL as well as a possible functions of a platform. An imaginable function could be a transport order management which covers the planning, management and control of transports and resources.

The build-up of a 4PL as well as the provision of a transport order management for the sector would require investments in the sector. The sector would support this in the course of transport optimization and route optimization which improve the economic situation. Nonetheless, requirement analysis uncovered that limited investment was made in technical improvement, which contains navigation and the application of GPS. Newer ICT approaches such as the use of Apps and the complete registration and processing of orders through terminal mobile devices enjoy rather less initial support, which can be explained by the factor of uncertainty because such systems are not yet applied in the sector. On the contrary, there is perhaps, a tendency of supporting investments regarding cooperation efforts.

In summary, the requirement analysis has led to the identification of potentials for the sector through the development of a 4PL approach, based on a ITC-platform. In addition to the desires and suggestions of freight carriers, there were however, also fears about a possible drifting down of prices. Statements such as "The centralization of data, volume and orders has so far, always led to a drifting down of prices" and the call for "Fairplay" underscore this aspect.

## 6. CONCLUSION

### 6.1 Limitations

The survey is confined to the North German bulk freight logistics in agriculture and can therefore, not directly be applied correspondingly to other countries. Moreover, freight

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carriers were questioned in their role as an actor in the chain. Other results based on other set objectives are imaginable if other actors are questioned. With the TOE framework, one possible method was chosen for the analysis of the 4PL-approach. Other methods, for instance, the theory of Resource-Based View (RBV) for the preparation of questions may lead to other results and findings.

### 6.2 Further Research

Requirement analysis for the 4PL approach in the sector of after-crop logistics was able to uncover possible requirements and desires on the part of the carriers. Leading opportunities for a 4PL are noted within the scope of the functions planning and managing of activities in different areas. This was discernible in the requirements of freight carriers, economic requirements, supportive cooperation approaches as well as within the scope of readiness for investment on the part of freight carriers. Further research work should therefore be devoted to the function of transport management implemented on a 4PL platform. In addition to the consideration of different functions such as the planning of vehicle turnaround schedule processes, route optimization, job controlling, improved flow of information etc. the options of applying new ICT should be verified and analysed. The planned transport order management system should be divided into different sub-domains for this purpose. These are transport order forecast, transport order planning, transport order processing and transport order controlling. On the basis of this subdivision, the usage of forecast methods for the advanced planning of transport orders as well as the possible usage of transport algorithms for the planning of transport orders should be duly taken into consideration for the sector. Possible ICT should be applied on a prototype basis for order processing within the scope of transport order processing. In addition to the development of key figures, the fears of respondents should also be duly taken into consideration within the scope of transport order controlling in future development. Since a possible 4PL with an appropriate platform can only operate successfully within an existing network as a neutral integrator.

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