implemented in practice such as in highway construction and operation, and high speed rail operation (Devries, 2005).

IoT and cloud computing are widely recognized as a paradigm shift in the way IT services are developed, deployed, scaled, updated, maintained and paid for (Marston *et al.*, 2011). Recent studies suggest that cloud-based IoT technologies would enhance logistics and supply chain performance (Hall et al., 2012; Li *et al.*, 2013; Wang *et al.*, 2006). However, limited literature can be found on how cloud-based IoT works in logistics and supply chains. Our research contributes by developing a new performance-based logistics service business model enabled by IoT and cloud computing.

Performance-based logistics service business model

Given the challenges faced by the industry as noted in the introduction, the cloud-based IoT business model developed in this study is designed to tackle these industry concerns. The idea is to automize those processes which can reasonably be automized in order to improve information flows and supply chain planning. Data and information gathered by RFID technology will provide intelligence for LSPs to fulfill such purposes. Based on literature review, interviews, latest industrial practices and our own analysis, we develop a new business model aiming to enhance LSPs' functionality in supply chain planning so as to contribute to supply chain performance (see Figure 1).

The key parties are the LSP and those 2PLs. All parties and functions are linked to the cloud platform. The LSP operates the service models and assumes the leading and central role in supply chain planning. It engages different 2PLs to provide one-stop logistics services and is responsible for cargo, information and financial flows. Two interrelated models namely the dynamic service evaluation model and the performance-based pricing model are proposed to facilitate the supply chain planning. The goal is to align user evaluations with service providers' performance (Althuizen *et al.*, 2012). Based on the measured data, the overall performance is ensured by applying two service level evaluation models: first, to evaluate the historic performance of partners for contracting and, second, to evaluate the actual service level of partners during operations. 2PLs are paid based on their performance levels, which are measured against certain performance criteria. All the processes including service fee calculations and analytics should be computerized to minimize human errors and to ensure efficiency.

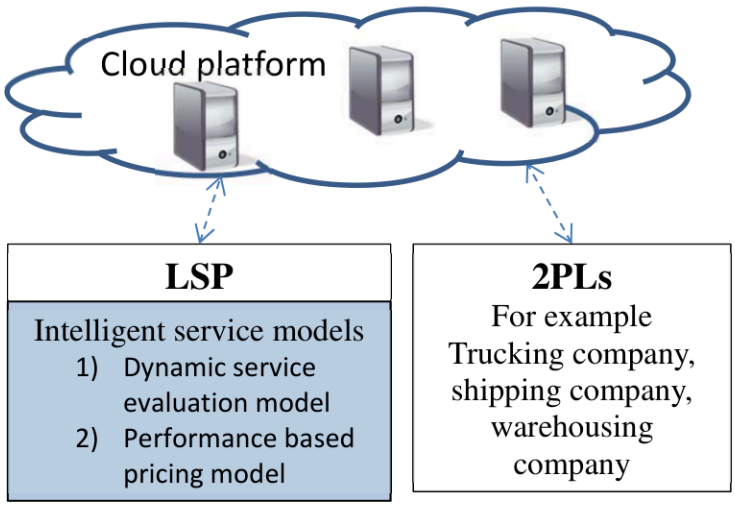

Figure 1: Performance-based logistics service business model

Source: Author

Conclusions

This paper presents an original contribution by developing a performance-based logistics service business model which enhance LSPs' capability in logistics service offering and improve supply chain performance by utilizing IoT networks and cloud computing. In the approach, the LSP serves as the single contact point for shippers and assumes the leading role in supply chain planning with innovative logistics service evaluation and pricing mechanisms. The distinctive feature and major benefit of deploying cloud-based IoT is that cargo status can be reflected directly without human intervention. Also, the analytical outcomes provide market intelligence for LSPs.

To the best of our knowledge, this is the first attempt towards addressing objective logistics performance evaluation by using cloud-based IoT. This overcomes the concern of subjective evaluation in the existing literature. This study contributes to develop the concept of Performance-Based Logistics. PBL is a relatively new concept in logistics. More research can be performed, for example, to empirically investigate LSPs' and 2PLs' behaviour if PBL is adopted. Security of the cloud-based IoT networks is crucial for the implementation of the new decision framework. Future research can be done to analyse security risk and its impact on the decision framework.

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