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**研鑽タイトル Research Title**

Modelling and optimization of supply chain systems using stylized models

**渡航先 Visited Institution**

University of Exeter (Exeter, UK)

University of Liverpool (Liverpool, UK)

**渡航期間 Traveling Period**

From February 17th, 2024 until March 17th, 2024.

**研修概要 Research outline**

The bullwhip effect, characterized by demand fluctuations amplifying as one moves up the supply chain, results in undesirable outcomes such as excess inventory, inadequate supply, and high employee turnover. Empirical evidence suggests that the bullwhip effect could potentially increase upstream production costs by up to 25%. One effective strategy to mitigate the bullwhip effect is through demand smoothing. This entails downstream participants smoothing out their ordering process to benefit those upstream. However, expecting downstream participants to act altruistically is not realistic, as practical firms prioritize individual profit. Cooperation may be rejected if there is no profit incentive for an individual, even if it leads to better global performance.

Professor Stephen Disney at the University of Exeter specializes in the bullwhip effect, forecasting, and inventory management. His research interests revolve around applying control theory and statistical techniques to operations management and supply chain scenarios, exploring their dynamic, stochastic, and economic performance. Professor Disney is among the most cited scholars in the field of supply chain management. Beyond his academic contributions, he has provided counsel to several of the world's largest

corporations on the bullwhip effect, and his research has significantly influenced the material flow of at least 1 in every 7 pounds of UK retail sales. He has collaborated with numerous companies in the UK, US, and Europe, particularly those with globally operating supply chains.

Professor Andrew Lyons, Head of the Operations and Supply Chain Management Subject Group at The University of Liverpool's Management School, brings extensive expertise and research interests to the field of operations and supply chain management and design. His diverse research interests in supply chain management promise to broaden my horizons, providing opportunities to explore research extensions from various perspectives.

In my previous research, I developed a method aimed at enhancing supply chain performance by smoothing demand downstream in the supply chain. I am keen to engage in discussions with both Professor Disney and Professor Lyons regarding the practical implementation of this method.

### 研修先について About the laboratory visited

The University of Exeter is situated in the southwest of England. The Business School at the University of Exeter enjoys a distinguished reputation as one of the foremost business schools in the UK and globally. Professor Disney, who hosted my academic visit, has accrued over 14,000 citations in the research field of supply chain management. He is highly engaged in both research and teaching endeavors in the UK, and he has also held visiting positions at several prestigious universities, including UCLA, Boston University, and the Chinese University of Hong Kong.



Main building of Exeter Business School



Exeter forum

The University of Liverpool, situated in the dynamic city of Liverpool, is a prestigious institution renowned for its illustrious history, academic prowess, and dedication to innovation. Founded in 1881, it holds membership in the esteemed Russell Group of research-intensive universities in the UK. Prof. Andrews Lyons, who hosted my academic visit, is Head of the Operations & Supply Chain Management (OSCM) Subject Group. The Group has a fast-growing reputation for innovative and world-leading research. The chief editor of a top-ranked journal in the research field of logistics, Transportation Research Part E: Logistics, is Professor Tsan-Ming Choi, who is affiliated with the same department as Professor Lyons.



Liverpool's redbrick symbol

University of Liverpool

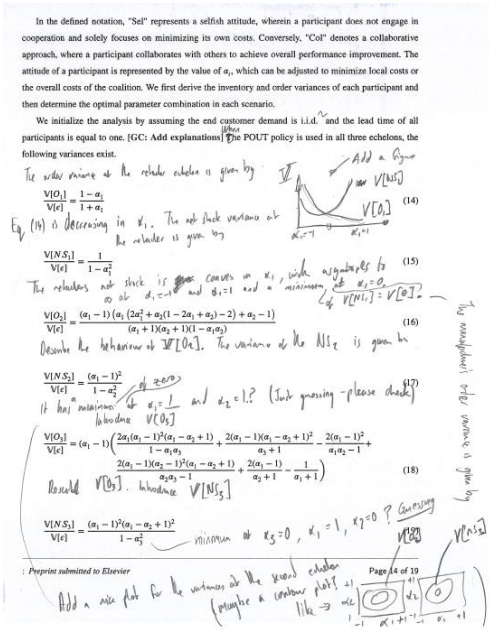
### **研修内容 What you learned**

#### **1. Exeter: Shapley value-based profit allocation for collaborative bullwhip effect mitigation**

During my stay at Exeter, I discussed my idea of applying Shapley values for fair profit distribution in supply chains with Professor Disney. He approved my research idea, and we collaborated on this task. Professor Disney provided me with numerous reading materials to enhance my understanding of stochastic supply chain management, including lecture slides on control theory, the graduation thesis of his Ph.D. student Professor Hosoda, and several published journal papers. In the initial days, I learned how to implement inverse z-transform using the Mathematica software. Subsequently, I made significant progress on my research, and within just three weeks, I developed a manuscript ready for submission to an ABS four-star journal, the European Journal of Operational Research.

In addition to my own research, I actively participated in various activities. I presented

my research on transportation and logistics at the Centre for Simulation, Analytics, and Modelling. I engaged in discussions with numerous scholars, including Dr. Lina Zhang, Ph.D. candidate Yogendra Singha, and visiting Ph.D. candidate Qing Zhu.



Prof. Disney's comments on my paper

Lunch with Prof. Disney and his students

## 2. Liverpool: Supply chain resilience under logistics disruption

During my time at the Logistics Lab at RCAST, we collected data concerning the impact of natural disasters on a beverage company. Upon my arrival at my second destination, Liverpool, I discussed my thoughts on further research with Professor Lyons, an expert in empirical research. Professor Lyons approved my idea and provided me with data regarding supply chain disruptions during the Covid-19 pandemic. He also extended an invitation to a seminar hosted by Professor Li from Houston University, who is editing a special issue of the prestigious UTD24 journal: Journal of Operations Management. Additionally, Professor Lyons recommended tourist destinations such as the Lake District and Chester for me to explore during my visit.



Seminar at Liverpool



Presentation AI in OM given by Prof. Li

### 研修先で特に印象に残ったこと The most impressive thing

During my recent visit to universities in the UK, several aspects of their academic culture surprised me. Firstly, I was surprised by how open the campuses were. Unlike in China and Japan, where campuses are often closed off by gates, UK universities tend to have open layouts with few barriers restricting access. Professor Disney, who has experience in both China and Japan, also noted this difference.

Secondly, I was impressed by how there didn't seem to be much of a gap in status between people with different roles. Students were treated more like colleagues rather than subordinates. I even noticed that some Ph.D. programs were advertised as job positions, suggesting that students actively contribute to the university and are paid for their works during their studies.

Lastly, the casual atmosphere really stood out to me. During seminars, discussions often went beyond the research topic at hand, covering a variety of subjects. What I appreciated most was that everyone's opinion was valued, regardless of their position.

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