Proposal for a Postdoctoral research position

Supply Chain Optimization based on data science for spare parts of business aircraft with uncertain demand

Optimisation de la chaîne logistique basée sur la science des données pour les pièces de rechange des avions d'affaires avec la demande incertain

Researched laboratory	LIRIS
Supervisor	Armand BABOLI, Associate professor, Habilitation
Industrial partner	Dassault Falcon Jet (DFJ)-USA
Funding	Scholarship internship (2000-2500 euro/month depending on your experiences)
Starting and ending date	12 months with the possibility of extension for an additional 6 months
Application deadline	31/10/2019
Conditions for application	The candidate must to be a PhD in Industrial and System Engineering, Computer science, Supply Chain management, statistical and data engineering
knowledge Requirements	Probability and statistics, Prediction methods, Inventory Control, Service level optimization, Supply Chain Management, Data science
Requested documents	CV (with detailed concerning the university course, work experience and internships), a cover letter describing background and motivation, ID card or Visa/resident card and 3 most relevant publications
Keywords	Service level optimization, Supply Chain and Inventory Optimization, Spare parts, Uncertainty and Unpredictability, Data science
Context	Cost-effective management of spare parts is very important for all manufacturing and service companies. One of the most difficult challenges for this objective is accurate prediction and optimized supply planning decisions to achieve best availability level for spare parts. For a better prediction and optimization, it is necessary to consider other criteria such as service level, fill rate, criticality of parts, customer satisfaction level, etc. However, these criteria could complicate achieving the cost-effective management of spare parts. This problem is more complex for aircraft spare parts management, because of disproportional high stock out cost (compared to their value). It's become more and more complex for business aircraft spare parts due to their intermittent, sporadic and lumpy demand (infrequent demand arrivals). That is why the traditional forecasting methods (as exponential smoothing method) and inventory control of spare part (as ABC classification and economic order quantity (EOQ); or still order up to level, etc.) cannot be the appropriate methods for all parts and hence, can increase the risk of accumulating large holdings or obsolete stocks. Therefore, it is important to develop specific methods, with more accuracy for the aircraft industry and specifically for business aircraft. These specific methods are developed either at the stock keeping unit or demand class levels. There exist

	research works proposing specific forecasting methods and inventory management techniques for aircraft spare parts. However, it is important to note that there are some great differences between airliner and business aircraft spare parts. The main different lies in regular using vs. irregular usage of business aircraft as well as irregular utilization and unpredictable location of aircraft at the planed time for preventive maintenance (based on predicted failures estimated by manufacturers). The inventory management techniques (EOQ, order up to level etc.) are inherently compliant with normally distributed demands; however, these could easily turn into increasing or decreasing of target stock levels (TSL), service rate, fill rate and customer satisfaction. It is also important to find a compromised between global investment and individual fill rate while increasing costs due to unpredictable and uncertain spare parts demands. At present, this is addressed by defining thumb rules to define target stock levels and network fill rate by taking into account the demand forecasts for a given planning horizon.
Details of requested work for this internship	Our recent study mainly focused on adapting existing inventory management techniques for unpredictable and uncertain spare parts demands of business aircraft and assess its validation over multiple planning horizons. We proposed some methods to define the replenishment policy in conjunction with demand forecasts and optimize the TSL for a given service level, fill rate, investment and customer satisfaction. This post-doctoral position is proposed to develop the methods by using data science and operational research approach for service level and fill rate optimizing in supply chain of DFJ, known as highly uncertain and unpredictable demand of spare parts supply chains of business aircraft. This research will start by studying the detailed analysis of historical data, made by our previous researchers, to identify the demand patterns (smooth, intermittent, erratic and lumpy) and estimating their distributions at demand class or SKU levels. The focus will be to extend the current research on global fill rate optimization and minimization of global investment. In this way, it is necessary to define the best fill rate for each group of products (called in DJJ as location network). It is also necessary to take into account our industrial partners' constraints, to develop and simulate a multi-objective inventory optimization model. As presented, the main challenge concern to identify the best fill rate for each location network in order to maximize the global fill rate and minimize the global investment. The next point concerns the identification of best location after receiving ordered spear part. In fact, inventory optimization at SKU level depends to replenishment strategy and ordering policy. Knowing that the lead-time for spear part in business aircraft is long (between 3 months to 2 years), the TSL, calculated before ordering cannot be optimal after receiving the parts. That's why, it is necessary to develop a dispatching method by taking into account the last information of consumption as well as the transportation strategy (cost vs time and uncertainties). Finally, it is desired to develop a decision support system, easily customizable and usable for our industrial partner. The proposed tool must communicate with our in-house developed demand forecasting and inventory optimization tool. The existing platform, developed by previous researchers of this project used R and Shiny, hence, it is desirable to continue whit R.

Specific Conditions	The postdoctoral researcher will work with Dr. Armand Baboli, in collaboration with our industrial partner, Dassault Falcon Jet (DFJ), USA. You must sign the confidentiality and non-disclosure agreement and you cannot communicate data and developed methods during and after your internship without our agreement. High level scientific publications are also sought during the post-doc period.
Contact Information	**Armand BABOLI,** Armand.baboli@insa-lyon.fr, Tel. 04 72 43 62 01, cell phone: 06 98 13 41 64
Résumé en Français	Cette position postdoctorale est proposée pour développer d'une part des modèles mathématiques, permettant d'optimiser le niveau de satisfaction des clients des pièces détachées d'avions d'affaires avec une demande très incertaine et imprévisible. Les méthodes proposer doivent permettre d'identifier le meilleur niveau de satisfaction (et le fill rate) pour chaque groupe de produits, nommé comme « *Location network* ». L'accent sera aussi mis sur l'optimisation de stocks en tenant compte des contraintes spécifiques de notre partenaires industriels pour développer et simuler des modèles d'optimisation multi-objectifs. Le principal défi consiste à identifier le meilleur *Fill Rate* pour chaque *Location network* afin de maximiser le *Fill Rate* global et de minimiser l'investissement global. La recherche se concentre également sur l'identification de meilleur emplacement de stockage au niveau du monde pour chaque pièce et la quantité optimal dans chaque stock. Un outil d'aide à la décision, facilement utilisable pour notre partenaire, doit également être développé.