Supply chain engineering research area:

The supply chain engineering research area focuses on achieving excellence in supply chain research through high-impact, innovative, industry relevant research aimed at improving the triple bottom line (economic, social and environmental performance) of global supply chains. Research topics currently considered include supply chain design methodologies, supply chain modelling and optimization, intelligent logistics, humanitarian logistics and reverse supply chains.
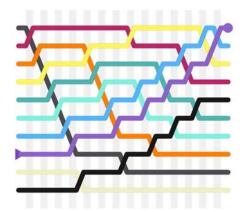
Examples of past projects include:

- Wilna Bean, Johan Joubert and MK Luhandjula investigated inventory management under uncertainty in a military context. The purpose of the developed model was to determine the required stock levels for a single item amid demand uncertainty due to extreme events. The total cost, total number of shortages and minimum inventory level required over three specified scenarios, were minimized.

- Another study aimed to apply proven decision-making methods to a logistics outsourcing decision. The purpose of the research was to make recommendations to tactical decision makers about the use of decision-making methods when executing company logistics strategies. The research was conducted by Naomi Bloem (under the supervision of Wilna Bean).

- Jacques Fauré (under the supervision of Wilna Bean) examined the mobilisation of an international urban search-and-rescue team. A comprehensive mobilisation document was developed for Rescue SA's mobilisation phase executed in the case of a disaster. With each role player's activities clearly allocated, it becomes a simple task of attributing the responsibilities to a member of the management team.

- Yolandi le Roux (under the supervision of Jacomine Grobler) conducted a study on the improvement of an avocado supply chain in South Africa. This project considered the avocado supply chain of Bertie van Zyl (Pty) Ltd (more commonly known as ZZ2). ZZ2's avocado production was rapidly expanding and the company started introducing ripe-and-ready avocados to the market. The aim of this research was to analyse the supply chain to identify possible areas for improvements, and to develop suggested solutions for the problems relating to tree health and avocado ripening.

- Ricardo Batista (under the supervision of Jacomine Grobler) solved a routing problem for the South African Post Office. A number of route optimisation tools and techniques were evaluated and assessed for the transportation of parcels from retail outlets to mail centres across South Africa. Various heuristics and a meta-heuristic algorithm were evaluated and promising results were obtained. The model was also validated by means of an in-depth sensitivity analysis.

- Sandrine Mpita, Sarma Yadavalli and Wilna Bean developed a model for integrated facility location planning and demand assessment for humanitarian logistics operations in the Democratic Republic of Congo.

- Jacomine Grobler recently developed a multi-objective hyper-heuristic algorithm for the flexible job shop scheduling problem (FJSP) with sequence-dependent set-up times, auxiliary

resources and machine down time. Throughout the optimization process, the hyper-heuristic algorithm self-adaptively selects the best algorithm from a set of possible meta-heuristics, thereby solving the scheduling problem and the "which algorithm is best?" problem, simultaneously. The algorithm was evaluated and benchmarked on real customer datasets and compared favourably with other state-of-the-art algorithms previously used to solve this problem.

- In 2016, Nandie Coetzee (under the supervision of Wilna Bean and Jacomine Grobler) developed a green probability framework to quantify the impact of green supply chain management in South Africa.

Promising areas for future research:

- The use of advanced artificial intelligence based algorithms for supply chain optimization, with a specific focus on dynamic real-time optimization and dominance based multi-objective optimization.
- Development and testing of artificial intelligence based algorithms for supply chain data mining applications.
- Development and benchmarking of large scale scheduling algorithms capable of scheduling thousands of operations.
- Development of supply chain frameworks for improved supply chain management and design.

For more information with regard to the Supply Chain Engineering focus area please contact Jacomine Grobler at jacomine.grobler@up.ac.za or Wilna Bean at wilna.bean@up.ac.za.