Company
The project was commissioned by DSM a Dutch multinational company active in the fields of health, nutrition and materials. DSM was represented by Rob van der Hoeven - Senior Scientist at DSM Biotechnology Center.

Case Title
Search for new enzymes for sustainable use of industrial waste streams (Valorisation of waste from the shrimp processing industry: an enzymatic perspective)

Participants
The consultancy team was selected by scientific advisors of the workshop and it was comprised of six members: Magela Odriozola, Andrada But, and Pamela Ceron from Delft University of Technology, Mamou Diallo from Wageningen University, Bauke Gaastra from Groningen University and Matthieu Zeronian from Utrecht University.

Problem description
Every year 20,000 tons of shrimp are caught and processed for meat production. The meat represents only 35% of the total weight of the shrimp and the other 65% is wasted. The shrimp waste is composed of the shells, tails and heads that are removed from the meat during the peeling process. Shrimp waste of *C. crangon* and *P. borealis* contains about 40% proteins, 28% minerals, 18% chitin and 10% carotenoids. Therefore, shrimp waste has a high potential for valorization.

The shrimp peeling process is mostly done manually under inappropriate working conditions. The automatic peeling machines available in the market are less efficient than manual peeling and 5% less meat is obtained during the peeling process. A 5% decrease in meat yield represents 350 tons per year that translate into a yearly 3,500,000 euros lost in the shrimp industry.

Approach
The valorisation of shrimp waste and the improvement of automatic peeling process using enzymes was investigated during the one week workshop ‘Life Science with Industry’ organised by Lorentz Center. The research was mainly based on a critical literature review and input from the group members based on their expertise.

Promising solution(s)
The solution was using enzymes to improve the automatic peeling process. The enzymes loosen the interaction between the meat and the shell and more meat could be obtained during the peeling process. However, further experimental work should be performed, which is outside the scope of this workshop. Therefore, the team provided DSM with recommendations for further research and implementation of the solution.
The team proposed a process to valorise the shrimp waste by separating the different fractions to obtain commercial products, namely pigmented oils, hydrolysed proteins, minerals and chitin. Shrimp waste protein hydrolysates are known to be nutritionally superior as feed ingredients due to a high amount of essential amino acids. The pigments from shrimp can be used in the food or/and pharmaceutical industry. *C. crangon* and *P. borealis* waste contain several types of carotenoids: β-carotene, canthaxanthin, astaxanthin, lutein, zeaxanthin, and a form of xanthophyll. Chitin is a long-chain non-soluble polymer of N-acetylglucosamine, it is biocompatible, biodegradable, and bio-absorbable, with antibacterial and wound-healing abilities with low immunogenicity. Additionally, promising research is conducted in which chitin is used as a replacement for plastic films. Therefore, it can be used for a broad range of applications from food technology to material science, microbiology, agriculture, wastewater treatment, drug delivery systems, tissue engineering and bionanotechnology.

The organizers of the workshop Life Science with Industry 2019 (at the Lorentz Centre in Leiden on 11-15 November 2019) and Royal DSM N.V. are not liable for any kind of claims for damage caused as a result of the application of these results or the application of any other information provided during this workshop.