Prof.dr Jacqueline Bloemhof-Ruwaard

Farewell address upon retiring as Professor of Operations Research and Logistics at Wageningen University & Research on 5 September 2019

WAGENINGEN
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Closing the loop

A never ending story

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Mr. Rector, colleagues, ladies and gentlemen,

It has been less than five years, since I gave my inaugural lecture here in the Aula, entitled: "Sustainable Logistics Management, from Castle in the Cloud to Cathedral" (Bloemhof, 2015). It feels very strange to be here now for my farewell address. I could elaborate on what a pity that is, how difficult life can be, but that is not on the agenda for today. After five years there is not a cathedral yet, but I hope to show how the research and education in the area of Sustainable Logistics Management has developed over the more than twenty-five years that I have been active in the academic world. Moreover, many things we tried to tackle in the beginning of this new field within Supply Chain Management are still very valid, or even more valid now as governments and society are also coming on board. That brings me to the title of this farewell address: Closing the loop: a never ending story.

The overarching theme is "never ending" representations. The Triple Mobius Loop Impossible Geometric Figure (Figure 1) as the pink figure on the cover is called, represents the connectedness of the three dimensions of Sustainable Logistics Management: People, Planet and Profit. It also represents some female touch in the Wageningen green field of flowers.

Figure 1: Triple Mobius Loop Impossible Geometric Figure (Shutterstock)

Looking back at my academic journey, I would like to focus on four areas that are closely connected and evolved one after the other:

1 distribution networks and location and allocation models evolving from forward supply chains to reverse supply chains and later on to closed loop supply chains;
2 the shift to a multi-objective focus in optimization models in Supply Chain Management, i.e. driven by economic prosperity *and* environmental sustainability;
3 the circular economy, that builds upon earlier ideas of Life Cycle Assessment and Cradle to Cradle, and nowadays is very popular in many areas, e.g. circular agriculture, circular industry, circular lightning and circular travelling;
4 sustainable city logistics. It was already a big step from networks to economies, but then I discovered the impact of geographical information in logistics: how to reach sustainability in high density areas that need food, water and energy.

For each of these focus areas I would like to discuss: how I became *involved*, the *impact* on academia since then and how the story goes on: both in *communities* that have been developed and the impact of *education* on students, the decision makers of the future.

Closed loop supply chains

(Involvement)

It all started with Luk van Wassenhove, one of my professors at the Erasmus University Rotterdam, who became interested in the area of Operations Research and the Environment. When he moved to INSEAD, the business school in Fontainebleau, France, I got the opportunity to write my MSc Thesis there in 1991 (Ruwaard, 1991). Instead of seeing the master thesis as the end of my studies Operations Research, it became the beginning of my academic career and started my love for network models. For years, when people asked for an easy explanation of the content of my work, I answered with: "I puzzle with blocks and arrows" (see Figure 2). The thesis led to my first paper in the European Journal of Operations Research: "On the coordination of product and by-product flows in two-level distribution networks: model formulations and solution procedures" (Bloemhof-Ruwaard, 1994).

Luk was acquainted with Paul van Beek, the chair of the Mathematics Department (now the Operations Research and Logistics Group) of Wageningen University, who was able to acquire some financial means for a PhD project, together with Leen Hordijk, chair of the Center for Environment and Climate Studies (now the Environmental Systems Analysis Group). With three promotors and the support of experienced co-authors and companies I was able to defend my PhD Thesis

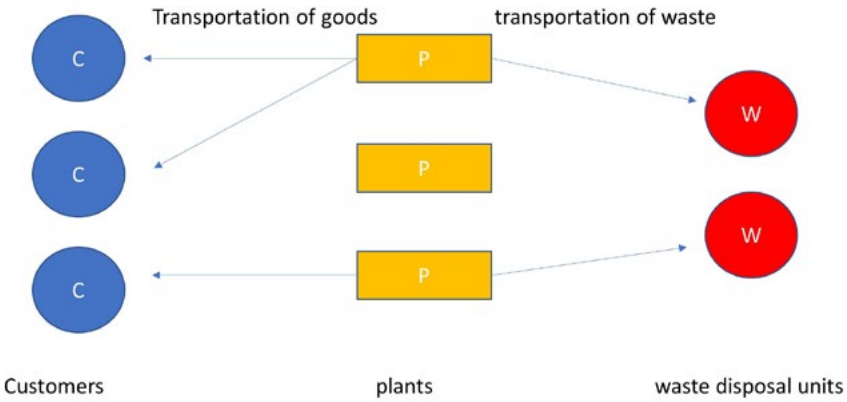


Figure 2: Distribution system for goods and waste (cf. Ruwaard, 1991)

"Integration of Operations Research and Environmental Management" (Bloemhof, 1996) here in this Aula in 1996. I am so lucky that these three "academic fathers" still keep an eye on me.

Via the co-authors of my first paper, Luk van Wassenhove and Marc Salomon, I could start as a post-doctoral researcher at the Rotterdam School of Management of the Erasmus University. There, I met the chair of "vakgroep 1", Jo van Nunen. He joined the group of my "academic fathers" and provided me with part-time jobs during the time my children were little. Sadly, he suddenly passed away in 2010.
In 1997, I got the opportunity to write a proposal for the European Commission, named REVLOG. The proposal was granted, and this was the start of a close collaboration between the Operations Research groups of Rotterdam, Eindhoven, Magdeburg (Germany), INSEAD (France), Piraeus and Thessaloniki (Greece).
At the start, reverse logistics related to the location and allocation of waste flows for landfilling or incineration. Later on, reverse logistics was extended and became known as "the 6 Rs", i.e. Reuse, Repair, Refurbish, Remanufacture, Recover and Recycle (see Figure 3).

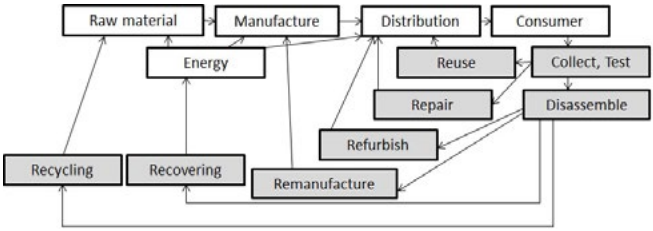


Figure 3. Forward and reverse activities in Closed Loop Supply Chains (Bloemhof, 2015)

(Community)
Although REVLOG was only a four year project to increase collaboration, the REVLOG group is still a very fruitful cooperation, both in research papers and in long lasting friendships with a.o. Rommert Dekker, Ruud Teunter, Harold Krikke and Stefan Minner. In the meantime, the group of six universities from four countries extended to a full European-American Network in 2001, and it was time for a new name: the Closed Loop Supply Chain society, a group of great friends still meeting every 2 years. In this network, I especially worked together with Thomas Spengler (Braunschweig University), Grit Walther (RWTH Aachen) and Michael Ketzenburg (Texas A&M).

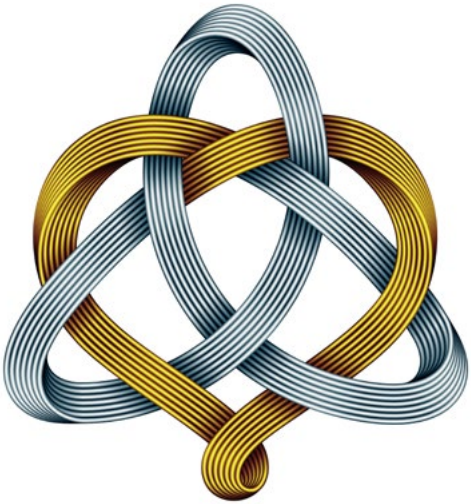
(Education)
One of the best ways to capture good research ideas is to make a new course for students. Around 2005, together with my RSM colleague and dear friend Erwin van der Laan, I started the master elective Closed Loop Supply Chains. A course that up to now is part of the master Supply Chain Management in Rotterdam. By the year 2019, this course also includes tools for understanding trade-offs related to economic, ecologic and social aspects (the triple bottom line of sustainability) and it makes the connection to Cradle to Cradle. Erwin passed away in July and he is dearly missed. I hope RSM finds someone to take over the heritage of teaching this course.

(Impact)
The invited review of Fleischmann et al. (1997) on quantitative models for reverse logistics in the European Journal of Operational Research has become a key paper in this area which has been cited almost 1000 times in the Web of Science Core Collection and 2300 times in Google Scholar, still also in 2019.

When I moved from the Erasmus University to Wageningen University, now exactly 10 years ago, I mentioned it was a pity I could not work on closed loop supply chains any more as food, the main topic at the Operations Research and Logistics group, cannot be recycled or remanufactured. I am really pleased that I have to take back my words:
In 2017 one of my former PhD students, Aleksander Banasik, published, as far as I know, the first paper in the Closed Loop area related to agricultural supply chains (Banasik et al., 2017). The title "Closing loops in agricultural supply chains using multi-objective optimization…" shows the development to the second topic I would like to discuss: optimizing the multiple objectives of economy and ecology.

Economic and Environmental optimization

The ultimate aim of closing loops is to be profitable and at the same time to prevent waste, extend lifetime of products and reduce the use of scarce or polluting virgin materials. It is, therefore, a small step to a new research question: how to optimize closed loop supply chains in such a way that they are both economic and environmentally viable. This asks for multi-objective optimization. In the book *Reverse Logistics* of 2004, Harold Krikke, Luk van Wassenhove and myself called this field: OR models for eco-eco closed-loop supply chain optimization (Bloemhof et al., 2004). More or less in the same timeframe, the concept of Sustainable Supply Chain Management arised. The definition of Sustainable Supply Chain Management by Elkington (2004) states that firms should focus not only on the maximization of economic value, but also on environmental security and social equity.



The Celtic knot of Figure 4 represents the interlinkages between the three dimensions of People, Planet and Profit. By managing the Triple Bottom Line in such a way that all parts are balanced, a coherent supply chain can arise.

Figure 4: The triple bottom line of Sustainability (Shutterstock)

(Involvement)

My first encounter of using environmental impacts in a business optimization routine was during my PhD thesis working at Unilever. The Unilever Research Lab used a Linear Programming model to define the cheapest blend of oils and fats to make margarines. The Centre of Environmental Studies of Leiden University was using Unilever at the time as a pilot case to introduce the concept of Life Cycle Analysis (LCA) (Heijungs et al., 1992). Using Life Cycle Analysis and the method of Analytic Hierarchy Process (AHP) (Saaty, 1996) resulted in one of the first sustainability indices published. These indices together with economic input data enabled to optimize blends based on environmental impact or costs (Figure 5).

The obvious next step has been to combine costs and environmental impacts in one objective function. Together with Harold Krikke, I worked on the eco-eco optimality of the recovery of refrigerators (Krikke et al. 2003). At that time, we solved this multiple objective problem using goal programming and weights. If we could have been able to solve this two-dimensional model to optimality, we would have obtained the so-called Pareto curve for the economic and environmental objective (Figure 6).

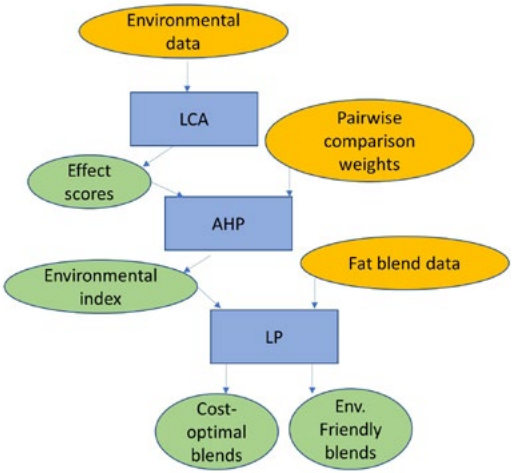


Figure 5: Combining LCA with AHP and LP (Bloemhof et al., 1995)

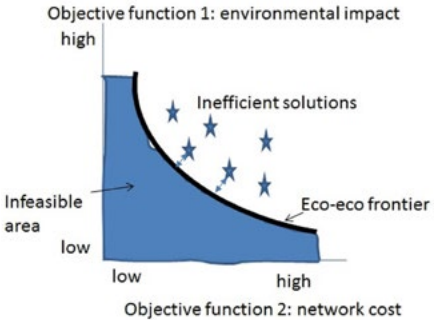


Figure 6: Pareto eco-efficiency curve (Bloemhof, 2015)

(Impact)

Nowadays, the concept of Pareto efficiency is an important topic in the research of the ORL group, and much progress has been made to obtain the Pareto eco-efficiency curve and to find quick and good heuristics to approach this curve, even including the impact of uncertainty (e.g. Mu et al., 2018).

Multiple-objective optimization models can show decision makers which goals can be obtained (at which costs) and which are not yet reachable (see e.g. Oglethorpe, 2010). Further improvement steps need to answer the question 'how to redesign logistic networks and supply chain strategies to move from current to preferred performance'.

Some industry sectors have been frontrunners in the field of sustainability, especially in recovery and waste management, e.g. the car industry, the paper industry and the electronic industry (copiers, refrigerators, cell phones, etc. (Quariguasi et al., 2010)). From 2009, more and more industries and consumers

stressed the importance of measurable sustainability in product chains, including the food and retail industry. In the US, Walmart and two universities came together to define sustainability in a practical way, better than confusing 'green' labels.

(Community)
The sustainability consortium (TSC)[1] was born, aiming to offer tools and services to help companies address product sustainability in their supply chains. Nowadays, the Sustainability Consortium aims for more plastic packaging recycling, recycling of batteries and electronics, less food waste, responsible pesticide management and two rather new topics: waste management in cities and creating the circular supply chain. The number of members from business, academic, government and the NGOs have increased a lot since the start. Eight years ago, TSC launched a European hub with partnership of Wageningen University and my colleague Imke de Boer has played an important role in there.

That brings me to the many opportunities that Wageningen University offers to do joint interdisciplinary work. When I came to Wageningen, ten years ago, I started in the first Tenure Track Development Programme for Associate Professors to become Personal or Chair Professor. The four women in the group promised to each other to aim for joint projects even if we came from very different research areas. And yes, we did quite well in that. With Imke de Boer, I have been lucky to supervise Wenjuan Mu in the project 'Benchmarking the integral sustainability performance of Milk Supply Chains' (Mu, 2017). With Marianne Geleijnse, I have been involved in the supervision of Ante Ivancic in the project SHARP: Sustainable Healthy Affordable Reliable and Preferable diets[2]. Karin Schroen is still on the bucket list, but I am happy that I haved worked together with her colleagues of the Food Process Engineering group.

The method of life cycle assessment hasn't been a usual tool in the toolkit of the ORL group, but now we have a SIMAPRO license and more and more students combine optimization models with environmental impact assessment. I am happy that in a few weeks Sonja Rohmer will defend her PhD Thesis related to the GREENDISH project on Sustainable Food Chains using detailed information on the environmental sustainability and dietery food quality to optimize food diets from multiple perspectives. (Rohmer, 2019)

1 *www.sustainabilityconsortium.org*

2 *www.tifn.nl/project/sharp*

(Education)
The course Sustainability in Food Chains (FPE-31806) has been one of the first Wageningen courses in which I took part in the development and teaching. For me, this is a great example of the Wageningen Education System in which a Management and Economy professor teaches Food Technology master students quantitative supply chain management topics such as multi-modality optimization, multi-objective optimization and LCA to evaluate food chains (Bloemhof et al., 2016). The collaboration that started almost 10 years ago has never stopped and became very fruitful. Three of the food technology students decided to apply for a PhD project within the ORL group, and have done some real interdisciplinary work (Jonkman, 2018, Stellingwerf, 2019, Buisman, 2019). I am convinced that the combination of Operations Research, Food and Sustainability Assessment will continue to exist and will be very useful in the challenges of current society.

One of these challenges is the end of the so-called linear economy of "take-make-waste". To ensure there is enough food, water and energy in the near future, it is necessary to prevent waste by reusing products and materials and to obtain raw materials in a sustainable way such that the natural and human environment is not damaged, in other words to move to a so-called circular economy.

Circular Economy

The idea of a circular economy is often explained by the shape of a butterfly. A butterfly consists of quite some closed loops (Figure 7). In chaos theory, the *butterfly effect* is the sensitive dependence on initial conditions in which a small change in one state of a deterministic nonlinear system can result in large differences in a later state. The term, closely related to the work of Edward Lorenz (Lorenz, 1969), is derived from the title of one of his presentations: Does the flap of a butterfly's wings in Brazil set off a tornado in Texas? The metaphor suggests that predictability is inherently limited, and I think that Lorenz is right in that.

Figure 7: Designed butterfly (Shutterstock)

The Circular Economy Diagram of Ellen Mac Arthur[3] also resembles a butterfly. It shows the continuous flow of technical and biological materials through the value cycle. The technical loop, being the right wings of the butterfly is basically a representation of the closed loop supply chain as discussed before. The biological loop, the left wings of the butterfly, represents the way nature reuses materials. This loop relates to the Bio-based Economy: i.e. the sustainable production and collection of biomass and its conversion into food, feed, bio-based materials and bio-fuels (Langeveld et al., 2012). Ellen Mc Arthur combined the Closed Loop Supply Chain and the Bio-based Economy in order to find a new way to design and make things within planetary boundaries. Research related to the transition to a Circular Economy is an urgent topic for both Dutch and European Science Foundations. The issue is complex and requires almost by definition a multi-disciplinary approach.

The huge impact of logistics has always been clear in our research related to Closed Loop Supply Chains. It is very difficult to reuse batteries or to refurbish I-phones, without the logistics to make sure that all returned parts are at the right quality, the right quantity, at the right place, at the right time. Research related to the Circular Economy has focused a lot on product design (e.g. The Cradle to Cradle products (McDonough and Braungart, 2002)). Research related to the Bio-based Economy focused on the supply part of the chain (farms, organic waste and dedicated crops), the bioprocessing technologies and the demand part of the chain (car industry, fuel industry or chemical industry) but not the intermediate transportation steps. Therefore, bio-based logistics and logistics related to the Circular Economy has been an open area.

(Involvement)
To cite my inaugural lecture: it was time that the castle in the cloud moved into the start of building a cathedral. In other words: from dreaming to doing. Both in research and education we have made this shift.

(Community)
Three years ago, I met Antoine Heideveld, the director of "Het Groene Brein"[4], a community of researchers dedicated to the transition to a circular economy. We were asked by TKI Dinalog to write a proposal for the Accelerator Call on Knowledge and Innovation in the area of logistics to connect the field of Logistics with the field of Circular Economy via an active exchange between companies,

3 *www.ellenmacarthurfoundation.org*

4 *www.hetgroenebrein.nl*

governmental bodies and scientists. The LogiCE project was born. Again a very interdisciplinary project in which MSc students from Urban Environmental Management, Food Quality and Supply Chain Management worked on the optimization of logistics networks for the collection of waste and other by-products.

One of the deliverables of the LogiCE project is the extended value hill (Figure 8). In the context of the Value Hill, value is added while the product moves uphill and circular strategies keep the product at its highest value for as long as possible. When a product is ready to start its downhill journey, it is done as slowly as possible so that its useful resources can still be of service to other systems. For every situation, the optimal configuration of a supply chain requires an optimal position on the following axes: i) central versus decentral networks, ii) coordinated versus cooperative decision making and iii) product-oriented versus service-oriented (Het Groene Brein, 2019).

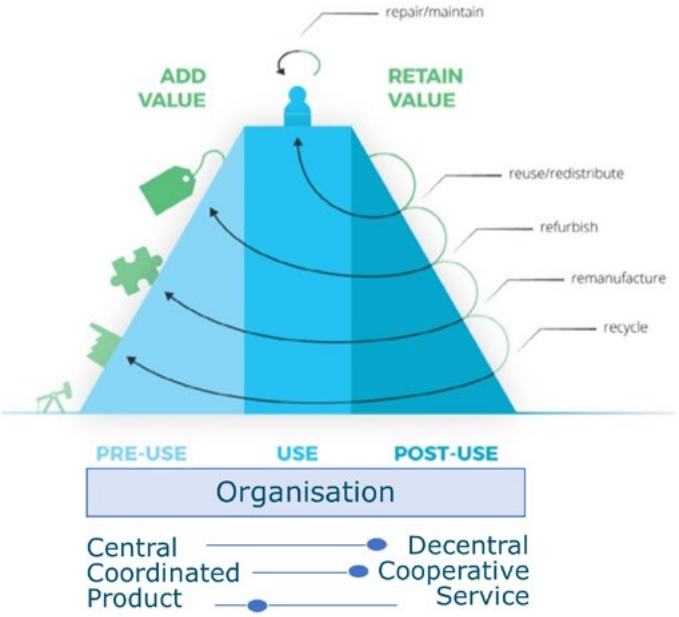


Figure 8: Optimal configuration of a value hill for circular products (adapted from Achterberg et al., 2016).

(Education)

For education, the Center for Bio-based Economy and the board of Wageningen University made a big shift possible with their decision to develop new interdisciplinary courses to enhance the transition to a Bio-based Circular Economy. Only five years ago, we – the ORL group – were asked to create a course related to

the impact of logistical structures and concepts on bio-based supply chains, in other words Bio-based Logistics. It includes an efficient reuse of available resources, the valorization of byproducts and the redesign of supply chains for a bio-based economy. This was a huge challenge as there was no comparable course found so we had to start from scratch, writing teaching materials ourselves, basically based on some preliminary research. I can really recommend developing these kinds of courses!

(Impact)
In 2015, I had the opportunity to act as the anchorwoman of the online lecture series 'To a biobased society' which is still visible on YouTube. This has been an idea of Wageningen University to give highschool students with an interest in biotechnology insights in this new area. The new biobased courses and the experience of the Dutch Highschool MOOC led to the idea to create a Micromaster, a set of MOOCs related to the Biobased Economy that can be followed online. The 'Micromaster' team is a very enthusiastic group of people that is not afraid of some challenges. A new course related to the expertise of the Social Sciences department was needed: *Circular Economy*. My son (at that time studying at the TU Delft) got the opportunity to work as a student assistant to create an Agent Based Model on waste management as part of this course. More and more people of the ORL group got their first dive into studio-work in the green room. An obvious but huge next step is to use the micro-master as part of an official new campus master Bio-based Sciences. It has been a very intensive time, but the award of the official launch of the MSc Biobased Sciences in 2018 has been great. This master programme is multi-disciplinary and is based on the production of biomass, bioconversion, biorefinery and the societal, logistical and economic transition processes needed.

My biggest learning experience in this theme is that Operations Research can and will be value-adding in many complex societal transitions. OR started in the army, and moved to the decision support of businesses, especially focusing on maximizing profit or minimizing costs. The application area of Sustainable Supply Chains shows that OR can really add in waste management, food technology, sustainable and healthy diets, and the circular bio-based economy. This brings me to the next and last topic: sustainable city logistics.

Sustainable city logistics

(Involvement)
For many years, I have only been interested in the design of sustainable chains and networks, knowing of course that the real world does not exist of only blocks and arrows. However, closing the loop, especially in food chains, also requires more

operational models such as Vehicle Routing. Xiaoyun Bing and Marlies de Keizer developed for the first time a vehicle routing model for Waste Management in the city of Ede (Bing et al, 2014). Mehmet Soysal worked on the idea of a two-tier vehicle routing model where large trucks can deliver food from warehouse to satellite hubs at the edges of the cities, and small electric vehicles take care of the distribution to local supermarkets in the city of Utrecht (Soysal et al, 2015). We learned that the routes with the lowest distance did not always have the least time, costs or emissions. Those first researches triggered for more. The immense growth in on-line shopping led to a new branch of logistics: *the last mile logistics* focusing especially on the delivery of parcels to households in an urban environment (Figure 9).

Figure 9: Circle panorama view on the urban city skyline (Shutterstock)

(Impact)
The logistics in a crowded area as a city links very easy to the logistics in airports, ports or the flower auction. In a very short amount of time, products or people have to move from one place to another in the most effective and efficient way. The PhD project of Viet Nguyen, defending his thesis tomorrow, studies the value of information to improve daily operations in high-density logistics (Nguyen, 2018). This work bridges the field of logistics with the field of business analytics.

Starting at my Master thesis in 1992, the journey is almost at the end: we are now very close to those topics that I only initiated but, due to my long period of illness, have developed with me only at the sideline.

When the city of Arnhem asked me whether the ORL group could help them to make the last mile traffic in the city more sustainable and livable, my first reaction was: 'no, that is not our discipline…' but after some thought, I decided to get involved in this last mile project also to learn from practice and to build a network with other disciplines and the applied universities. My colleague Karin Pauls found out that the urban consolidation center is often a good option to have less vehicles in the city and less deliveries to each customer.

(Education)
I had the same experience when the people from AMS, the Amsterdam Institute for Advanced Metropolitan Solutions, came to introduce themselves and asked for my contribution. These almost accidental meetings which did not seem to be interesting for the core business of the ORL group, appeared to be in hind side the start of something that is really developing into new academic research and education. The Roboat[5] project is a collaboration between AMS and MIT. It investigates the potential of self-driving technology to change our cities and their waterways. Applications that are very interesting for Wageningen University are e.g. a floating food and flower market, waste collection via the canals and instant bridges to transport people. Although we are not (yet) involved in the MSc programme MADE, it is clear that this master programme fits very well for our students: it focuses on the challenges of sustainability and quality of life in metropolitan regions with issues like logistics, mobility, water and waste management to develop a circular city.

5 *www.roboat.org*

(Community)
The joint Dutch universities together with the Dutch National Research Agenda have formulated a research agenda for the Digital Society. The aim is to secure the Netherlands a leading international position in the field of human-centered information technology. The seven themes range from eHealth to responsible algorithm design. Together with Liesbeth van Zoonen from the Erasmus University Rotterdam, "we" are responsible for the theme of Digital Cities and Communities: how to build smart, sustainable and enjoyable cities. Related to this theme is the PhD project of Joost Goedhart on omnichannel retailing in the fashion industry. One of the new supply chain concepts in the city is to have brick-and-mortar stores only displaying clothes and let them be home-delivered after sale. This requires less urban freight transport while stores are not disappearing from city centers, which are both key factors in the livability of cities.

A never ending story

And now, it is up to you, dear reader, to write new chapters of the never ending story of Closing the loop. I use this opportunity to give some directions:

- keep dreaming; without a dream, a castle on the cloud, many technical developments would have never taken place;
- think big, start small, act now: a transition to a circular economy or a sustainable planet is very complex, like building a cathedral. Don't hesitate because of all the unknowns, the risks or the huge amount of bumps on the road. Just start, with your strengths and your goodwill, with the activities that are at hand.
- research and education are much more interesting if they deal with topics a bit out of your comfort zone. Make bridges to other disciplines, especially here in Wageningen with so many opportunities, and you can reach much further than you think.
- Academic work, especially a PhD project or a scientific paper, doesn't have a one-to-one fit with the urgent questions of governments and the time to respond of firms. However, long-distance achievements, like the 'Elfstedentocht', make impact. Keep the link with society, e.g. via the calls of the National Research Agenda and look for opportunities like the Accelerator calls to build knowledge networks with businesses that remain.

Words of Gratitude in Dutch (Dankwoord)

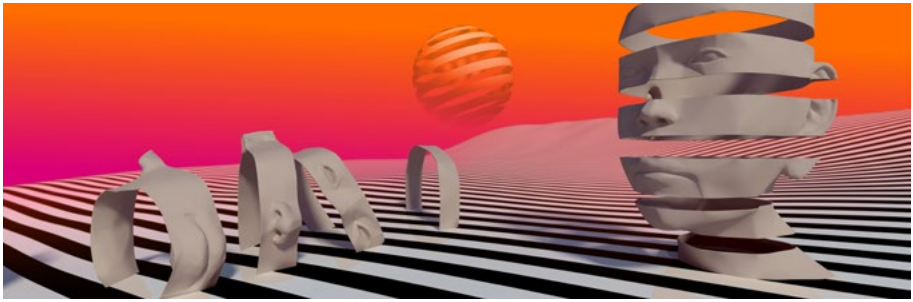


Figure 10: Abstract heads lines, inspired by Escher's Bond of Union (Shutterstock)

Afscheid nemen is een beetje sterven; Sterven aan dat waarvan je houdt. Je laat een beetje van jezelf achter in ieder uur en elke plaats (Haraucourt, 1891). Plannen vallen als brokstukjes uiteen. De lijnen vervagen aan de horizon. Het leven lijkt zijn kleur verloren te hebben, enkel nog zwart en wit. Toch schijnt de zon op de achtergrond (Figure 10).

Ik wil van deze gelegenheid gebruik maken om mijn grote dank uit te spreken naar een ieder die deze afgelopen drie jaar dat ik ziek ben, heeft meegedacht, meegewerkt en meegeleefd. Dank aan de rector en de directie van het departement Social Sciences, Jack en Martijn, voor de gegeven mogelijkheid om stap voor stap afscheid te kunnen nemen. Dank aan het zorg team: Eric Kuitert, bedrijfsarts, Elsbeth Kuneman, bedrijfsmaatschappelijk werkster en Colette Muchall, HR manager; eigenlijk wist ik tot drie jaar terug niet eens dat jullie bestonden, maar we hebben elkaar de laatste tijd veel gezien en wat heb ik veel kunnen praten en uithuilen bij jullie. Heel fijn dat jullie met jullie expertise en ervaring deze weg mee wilden lopen. Veel projecten en besturen hebben er last van gehad dat ik lang niet altijd fysiek aanwezig was op bijeenkomsten buiten Wageningen. Dank voor jullie geduld en creatief meedenken zodat ik toch op de hoogte kon blijven van de belangrijkste dingen.

En dan de Operations Research en Logistiek groep… Nadat Jack van der Vorst in september 2015 een andere positie kreeg, werd ik jullie interim-leerstoelhouder. Met elkaar hielden we het schip op koers. In juni 2016 werd ik ook 'officieel' jullie leerstoelhouder en een paar maanden later moest ik me helaas ziekmelden, iets wat ik zelden deed, en daar is eigenlijk nooit meer een einde aan gekomen. Ik kijk met trots naar jullie vermogen om de zware werklast op te vangen en het groepsbelang hoog te houden. Misschien hebben jullie wel eens gemopperd over deze situatie,

zeker toen het echt lang bleek te gaan duren, maar ik heb alleen maar begrip en steun van jullie ervaren. Ik wil ook Hans van Trijp bedanken voor het waarnemen van de leerstoel sinds september 2018. Ook al is het een vreemd idee, ik hoop dat er snel weer een nieuwe bewoner van kamer 6011 komt.

Een speciaal woord van dank voor mijn huidige en voormalige PhD-studenten: jullie zijn hier (bijna) compleet aanwezig. Gelukkig stonden er (co)promotoren op om jullie goed te begeleiden, maar ook jullie hebben behoorlijk zelfstandig jullie werk moeten doen. In deze maand hopen drie van jullie te promoveren, een mooiere laatste 'maand in dienst' had ik me niet kunnen denken. Jullie onderzoeksgebieden liggen mij na aan het hart. Ik hoop van harte dat jullie de liefde voor Duurzame Logistieke Ketens mee nemen in jullie verdere carrière.

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Prof.dr Jacqueline Bloemhof-Ruwaard

'The field of Sustainable Logistics Management has evolved from Reverse Logistics in waste management to Closed Loop Supply Chains to logistics in a circular economy. Sustainability, i.e. optimizing economic, environmental and social values, asks for multi-objective optimization models. The complexity of the transition to a circular economy requires a multi-disciplinary approach where Operations Research can act as the linking pin between the social and natural sciences. A never ending story!'

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