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Complementing LCA with qualitative organisational study for improving waste management governance – illustrated by a comparative case on metal packaging

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Complementing LCA with qualitative organisational study for improving waste management governance

Illustrated by a comparative case on metal packaging

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Hi! My name is Mathias Lindkvist, and I'm PhD student from Environmental Systems Analysis at Chalmers University of Technology, in Sweden.

I will present a contribution with the title "Complementing LCA with qualitative organisational study for improving waste management governance: Illustrated by a comparative case on metal packaging".

This research has been performed by me and my colleagues associate professor Henrikke Baumann, and researcher Maria Ljunggren Söderman, who is also here at the conference.

Our starting point is that **LCA**, and also more generally life cycle thinking, are **useful** for addressing the **environmental effects of waste management**. LCA covers entire product chains and thereby **increases** the opportunities for **reducing** environmental impacts and **decreases sub-optimisation**. 1:05

And to improve the usefulness of LCA we have found that it is helpful to **also understand** how and why **humans** actually **handle** the material **objects** in these product chains. And the metal scrap in the picture is an example of these material objects.

In this presentation I will first describe our illustrative **case** study on metal packaging, and then describe **why and how** we have developed this **method**.

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Metal packaging recycling

- Sweden & the Netherlands
- 1997–2013

- Already overarching governance focuses differ
  - SE: waste
  - NL: producers

(2:00)

So, our case study is about metal packaging recycling.

We have compared this for the countries Sweden and the Netherlands.

And the period covered is between 1997 and 2013.

To get a first idea of how organisation is of specific relevance in this case, it can be pointed out that the overarching governance differs considerably between the two countries. In Sweden, the waste step of the product chain has been in focus, while producers have been the focal point in the Netherlands.

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Metal packaging recycling – results*

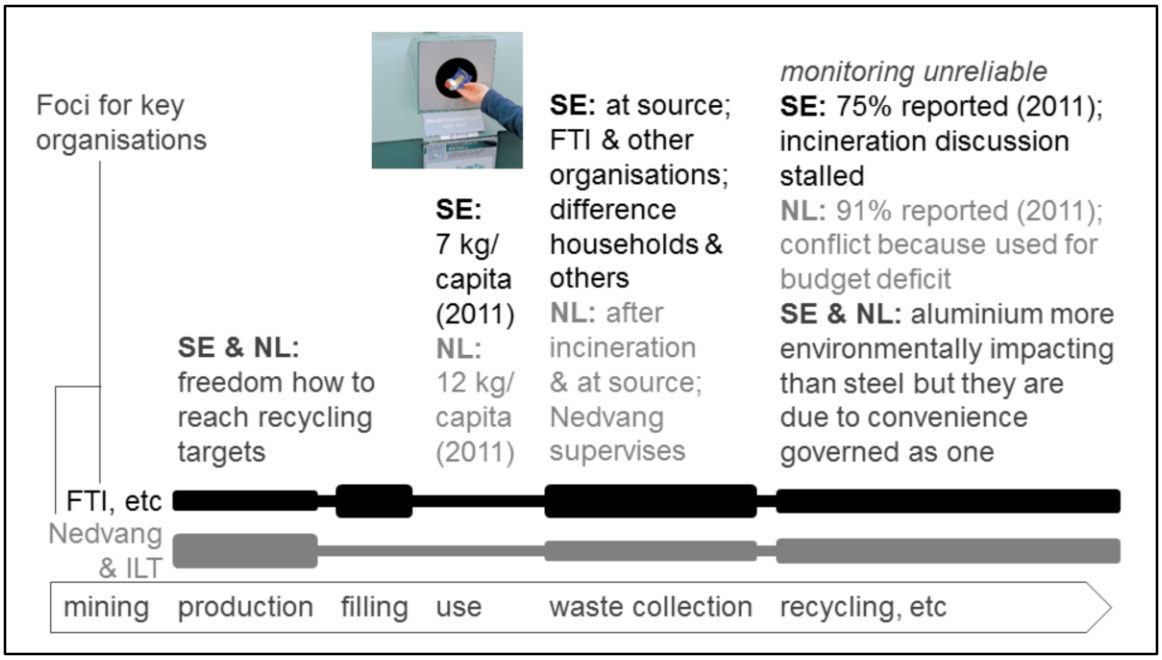
- Organisation + material flows + the environment
- Results as such
- Starting points for further studies

* Sources: Lindkvist (2014), PRO Europe (2011), Verweij (per comm 2013)

And in the following slide, I will present example results from this case study.

These results show the combination of organisational aspects, material flows, and environmental impacts.

And they are both results as such, and can be used as starting points for further studies.



(2:40)

So, first, this is a simplified product chain for the metal packaging in our case study. It reaches from mining, via among other production and use, to waste management.

The overarching organisational difference between the countries lies in where the key organisations focus their activities. These key organisations are in Sweden FTI and several other organisations that represent fillers and importers, and in the Netherlands Nedvang that represent producers and importers and the public analysis and guidance agency ILT. For FTI and the other organisations in Sweden, the fillers and importers have been given the responsibility and the activities are mostly target on waste collection. For Nedvang in the Netherlands, the producers and importers have been given the responsibility and the activities are mostly target on producers and to some extent on waste management.

Looking at the different product chain steps, the producers, fillers and importers have been given considerable freedom regarding how to reach the recycling targets that have been set.

Regarding the size of these product life cycles, around 7 kg of metal packaging was used per person in 2011 in Sweden, and the corresponding figure for the Netherlands was 12 kg.

For waste collection, it has in Sweden been based on collection at the source of waste creation, was carried out by several organisations, and differed between households and other waste generating actors. The picture shows a detail of one common type of collection infrastructure used in Sweden. In the Netherlands, collection has been performed both after waste incineration and at the source of waste creation, and it has recently been supervised by an organisation that represents producers and importers.

(4:35)

When it comes to the outcome of the recycling, this could not readily be compared between the countries since their monitoring has differed. In Sweden, 75% was reported to be recycled in 2011. We also found that there had been discussions about environmental impacts reductions through collection after waste incineration in Sweden. But these had stalled due to among other lack of communication. In the Netherlands, 91% was reported to be recycled in 2011. Further, we found that conflicts between public and private actors had increased since packaging fees were used to cover national budget deficits. And for both countries, we found that aluminium and steel due to convenience were not governed separately despite that the former is much more environmentally impacting.

So, taken together, this overview shows important relations between environmental impacts and organisational aspects that our method can unfold for a case of waste management.

Metal packaging recycling – conclusion

- Already this overview shows a complicated landscape of product chains, environmental impacts and organisation
- Our method helps to identify this landscape that cannot easily be seen only from LCA or management

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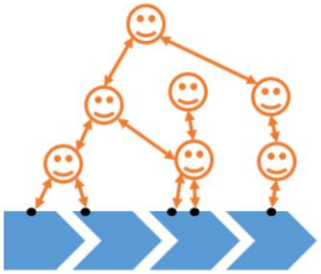
Method – why?

- LCA
  - Systems view environmentally
  - No actors => No guidance on governance
- Actors in waste management
  - Uphold the technical systems …
  - … via **socio-material interaction points**
  - Many: private, public, consumers, etc



(6:05)

So, why have we developed this method?

When it comes to LCA, it is useful since it gives a systems view environmentally. But it doe not cover the different actors, and therefore it gives no guidance on the actual governance of product chains.

And in waste management, actors are important. Without them the technical systems would not exist. And they are directly connected to the technical systems through what we call socio-material interactions points. These are shown as black dots in the figure. And further, there are many different actors in waste management, such as private companies, public authorities, and consumers. Therefore, there are complicated nets of actors that seem in need to be further understood.

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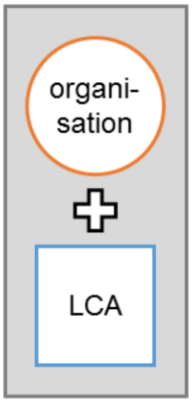
Method – how

- **Product chain organisation (PCO)**
  - LCA + qualitative organisational study
  - How actions influence system environmental performance
  - Actions via material flows, machines, etc
  - LCA + field studies (e g, interviews, visits)
  - Supported by socio-materiality research
  - Part of research on LCA + actors



(7:25)

And how is the method designed?

So, first, we have given it the name product chain organisation.

And at the overarching level it combines LCA and qualitative organisational study.

It is focussed on how human actions influence system environmental performance.

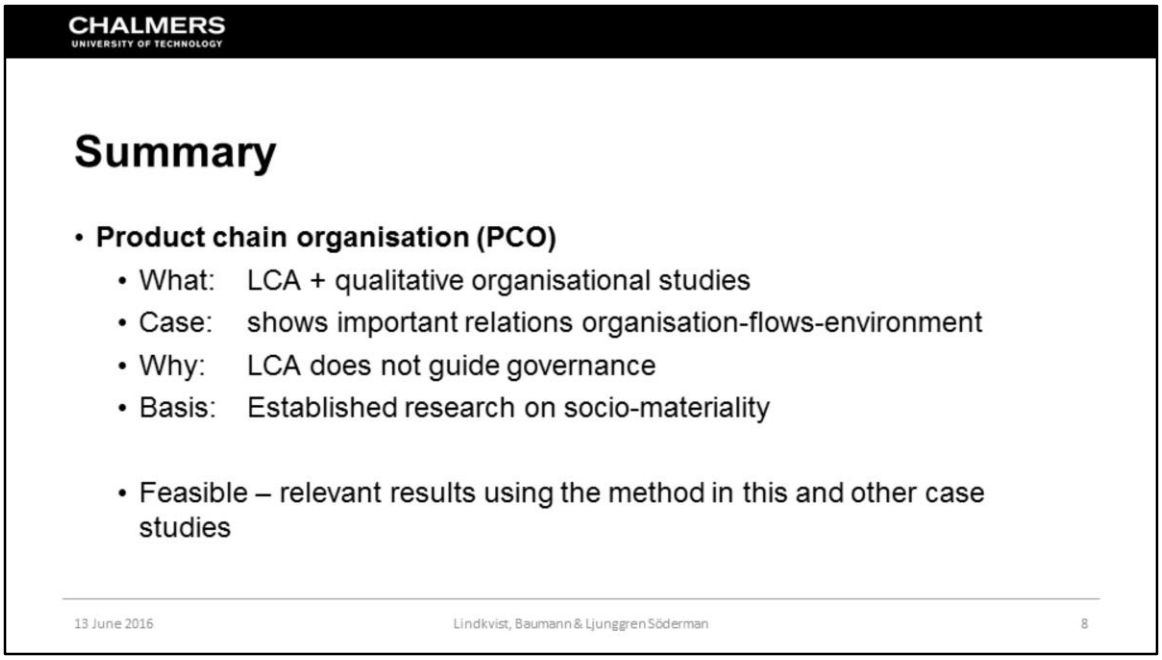
And these actions are studied via, among other, material flows, and machines.

(7:55)

Regarding study techniques, the method combines LCA with different types of field studies, such as interviews, and field visits.

And our approach to combine an engineering method with social science studies is supported by the established research on what is called socio-materiality, in the social sciences and humanities.

Finally, the method belongs to a broader research portfolio. It is not only for waste management, but this is one important area for the method. And our research group has developed several different methods on LCA and the influence from and on actors.



(8:55)

To sum up, I have presented and exemplified a novel method for more environmentally effective governance of waste management, and we call it product chain organisation.

It combines LCA and qualitative organisational studies.

And the case study on metal packaging that I have described shows important relations between organisational aspects, material flows, and environmental impacts.

And a main reason for developing the method is that LCA does not give actual guidance on how to perform governance of product chains.

Further, the basis for our method is established research on socio-materiality in the social sciences and humanities.

Finally, and taken together, our method seems to be feasible. Relevant results have been produced using it both in this and in other case studies.

Baumann, H (2004). Environmental assessment of organising: towards a framework for the study of organizational influence on environmental performance. *Progress in Industrial Ecology 1*(1/2/3): 292–306.

Baumann, H, B Brunklaus, M Lindkvist, R Arvidsson, H Nilsson-Lindén, and J Hildenbrand (in preparation). *Populated life cycle methods – an anthology*.

Baumann, H, B Brunklaus, M Lindkvist, R Arvidsson, H Nilsson-Lindén, and J Hildenbrand (2015). Populating the life cycle perspective: … about new methods for analysing social/organisational dimensions of product chains for management studies … *International Society for Industrial Ecology Conference 2015, Guildford, UK, 7–10 July 2015*.

…

Thank you!

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Lindkvist, M (2014). *The influence of management practices and policy on the environmental performance of metal packaging waste management: the cases of Sweden and the Netherlands* (Report - Department of Environmental Systems Analysis, Chalmers University of Technology, no 2014:11). Gothenburg, Sweden: Chalmers University of Technology.

PRO Europe (Packaging Recovery Organisation Europe) (2011). *Producer responsibility in action. Final web version, 15 Aug 2011*.

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Case study – main organisations

	SE	NL
Product chain	FTI + others	Nedvang (umbrella)
Monitoring	Swedish EPA	Nedvang
Analysis	Swedish EPA	Nedvang + Agency ILT
Producer dialogue	-	Agency ILT
Enforcement	Municipalities + Swedish EPA	Ministry IenM

FTI = Packaging and Newspaper Collection Service, Förpacknings- och tidningsinsamlingen AB

ILT = Human Environment and Transport Inspectorate, Inspectie Leefomgeving en Transport

IenM = Ministry of Infrastructure and the Environment, Ministerie van Infrastructuur en Milieu

Case study – the environment

- Global warming potential (GWP)
- Energy use
- Resources
- Waste

Case study – main flows 2011*

	SE waste	SE recycled	NL waste	NL recycled
Steel	35 kton	83%	170 kton	95%
Aluminium	26 kton	66%	22 kton	63%
- whereof cans**	17 kton	87%		
- whereof other**	8 kton	23%		
Total	61 kton	75%	193 kton	91%

* Source: Lindkvist (2014) ** Figures for 2010

Case study proxies 1 – GWP 2011 (kg CO_2-eq)*

	SE	NL
Total	14 kg pp	12.4 kg pp
National share	0.21%	0.11%
Reduction potential steel recycling	1.0 kg pp	0.8 kg pp
Reduction potential aluminium recycling	7.8 kg pp	4.0 kg pp

* Source: Lindkvist (2014)

Case study proxies 2 – energy use 2011*

	SE	NL
Total	250 MJ pp	220 MJ pp
National share	0.11%	0.11%
Reduction potential steel recycling	11 MJ pp	9 MJ pp
Reduction potential aluminium recycling	140 ML pp	72 MJ pp

* Source: Lindkvist (2014)

Case study proxies 3 – resources 2011*

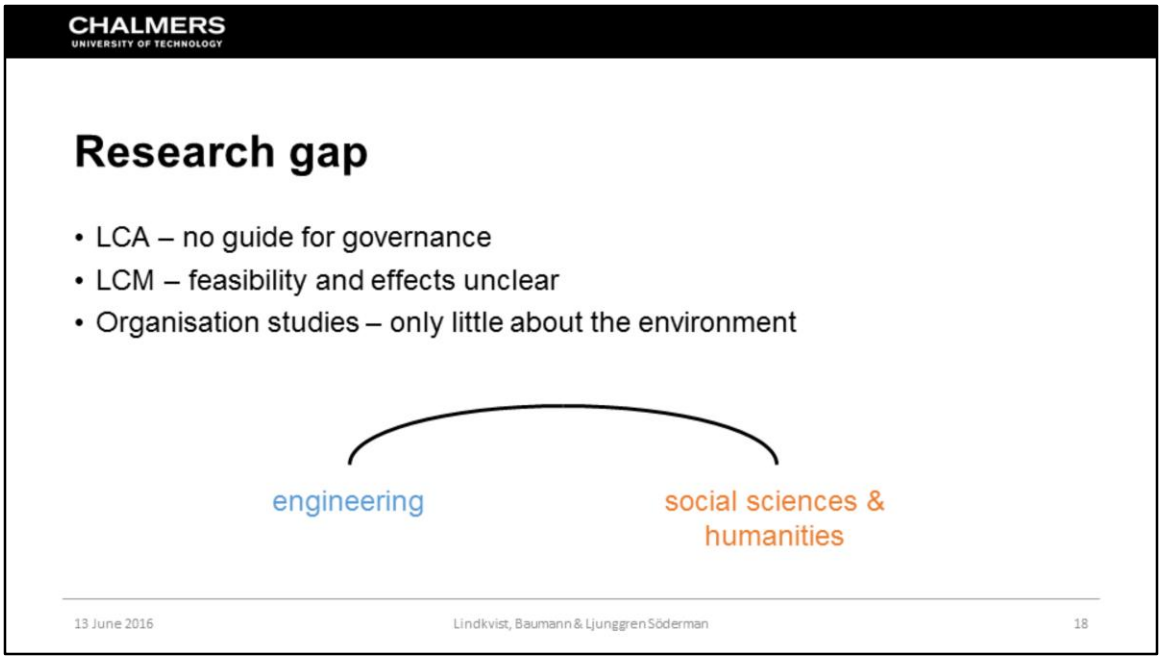
	Iron ore	Bauxite
Packaging SE	0.6 kg pp	1.0 kg pp
Packaging NL	0.5 kg pp	0.5 kg pp
All products globally	150 kg pp	6 kg pp
Reserves	80 years	110 years
Resources	220 years	250 years

* Source: Lindkvist (2014)

Case study proxies 4 – waste 2010 (Mton)*

	SE	NL
Metal packaging not recycled	0.015	0.021
Landfilling (except mining waste landfill and waste treated externally to producer)	3.3	
Landfilled or released to environment		1.8

* Source: Lindkvist (2014)



In this presentation I will first describe our illustrative case study on metal packaging, then describe the method further, and finally talk about the research gap that we try to bridge.

Figure:

The overarching research gap that we have found it useful to try to bridge for a more environmentally effective waste management.

Further case study – rare earth metals (1/2)

- From 2011
- Use in permanent magnets and NiMH batteries for electric vehicles
- Looked at prospects for expansions in the study

- Complicated metal extraction since not metals in nature
- Intellectual capital mostly in China
- Joint venture etc since no official trade market and expensive

Further case study – rare earth metals (2/2)

Eriksson, T, and D Olsson (2011). *The product chains of rare earth elements: used in permanent magnets and NiMH batteries for electric vehicles* (Report - Department of Environmental Systems Analysis, Chalmers University of Technology, no 2011:8). Gothenburg, Sweden: Chalmers University of Technology.