3 Life-cycle assessment in eco-labelling:

Between standardisation and local appropriation

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Over the last decades the demand for green and fair products by consumers has steadily increased and governments have undertaken greater efforts to devise green policies as well as to create incentives for industry to lessen the environmental impact of production processes (Finkbeiner, et al. 2006). Companies and large-scale multinational corporations, as well as national governments and local businesses are thus increasingly urged to account for the ecological footprint they leave behind and to actively improve their environmental performance.

Consequentially, national and international eco-labelling schemes have been established in order to earmark products and services that are environmentally sound (Neitzel, 1997 & Jensen et al., 1997). On the one hand, the aim has been to help consumers to be able to identify, as well as consciously support and differentiate between products with claims to environmental friendliness. On the other hand, the great diversity of eco-labels and the equally diverse processes that lie behind their certification might often be a cause confusion (Williams, 2004). While some labels are self-approved by the company that uses them for their products, others are governmental and certified by independent second or third party institutions. Furthermore, while eco-labels are supposed to act simultaneously as an incentive for the consumer to buy more environmentally friendly – thereby exercising a kind of soft power on the industry to adjust their environmental performance accordingly – eco-labels are likewise being used for marketing purposes. Thus, to be successful, eco-labels are in constant need of a strong basis upon which to establish their credibility. In order to establish and maintain their credibility, the initiators of eco-labelling schemes have in many instances entrusted science to act as the legitimising force behind the assessment and certification of the criteria for a label's environmental performance. On the same note, the public increasingly demands that eco-labelling schemes are held accountable to scientific evidence. In this respect, eco-labelling reflects a more general trend towards the scientification of public problems in contemporary societies. As Sergio Sismondo argues, "almost no action can be undertaken unless some claim can be made that it is supported by a study, whether it is in areas of health, economy, environment or defense." (Sismondo, 2004, p.56) There exists a large variety of different scientific methods to analyse the environmental impact of a certain product, service or policy – for instance Environmental Impact Assessment (EIA) or Risk Assessment. However, amongst the multiplicity of methods, life cycle assessment (LCA) has become one of the most prominent approaches, since it is considered to be the methodology that encompasses the widest range of possible environmental impacts. Accordingly, the American Environmental Protection Agency defines LCA as a "concept and methodology to evaluate the environmental effects of a product or activity holistically, by analyzing the whole life cycle of a particular product, process or activity" (US EPA, 1993). Originally intended to optimise production processes and inform the industry about potential improvements in energy in- and output, it was not until the early 1990s before LCA was increasingly appropriated as a scientific method and as a basis for the development of criteria to certify eco-labelling schemes around the world. Both state-run, national eco-labelling schemes such as the Blue Angel in Germany, as well as supranational labels such as the EU Eco-label and various independent self-declaratory company schemes claim to rely on LCA for their certification (Wurzel, Bruckner, Jordan, Zito, 2003, p.1).

However, the approach is not entirely unproblematic. Critics argue that its scope of assessment is predominantly limited to environmental considerations, while it lacks a social dimension. Furthermore, despite the fact that institutions such as the International Standardization Organization (ISO) have contributed with the introduction of universal standards (ISO 14040:2006) and regulations for the assessment of eco-labelling schemes relying on LCA, local appropriation of the method as well as conflicting interests have nonetheless led to differences in how it is interpreted and applied. There exists a tension between the 'scientification' of the method and consequentially, the attempt to establish universal, reproducible processes of assessment and the need for contextualisation and local responsiveness (Heiskanen, 1997). As Eva Heiskanen argues, "the attempt to construct a universal, de-contextualised methodology has emptied the technique of much of its local meaning and usefulness in decision-making" (Heiskanen, 1997, p33).

This chapter seeks to shed light on the tension between standardisation and local appropriation, in order to show that a certain degree of local responsiveness is necessary for the effectiveness of the method.

In order to understand why LCA is subject to local appropriation, despite international measures for harmonisation and standardisation, it is necessary to understand its history as a method and the context in which it emerged. Additionally, in order to better understand the theoretical implications of the tension between a formalised, universal science and local practice, it will be necessary to view them within the existing framework of scholarship on the social shaping of science. Thus, I will begin the chapter with establishing a theoretical framework with which to consequentially analyse the development of LCA as well as the empirical findings on current differences in practice, by looking at how a number of eco-labelling schemes apply LCA differently in their certification processes. The comparison of eco-labelling schemes is intended to further illustrate the tension between the universality and locality of LCA and that should not be understood as the primary focal point of this chapter. For my analysis I will draw on theories from the domain of science and technology studies (S&TS), most ostensibly the concept of local universality, developed by Steffan Timmermans and Marc Berg (Timmermans & Berg, 1997).

Finally, in my conclusion I will develop a synthesis of insights from each chapter in order to summarise the findings of my analysis.

The sociology of science:
A theoretical framework

In order to be able to analyse the social dynamics that have shaped and continue to shape life cycle analysis as a methodology, it is necessary to establish a convenient theoretical framework. There exists a vast array of academic literature on the sociology of science; however for the sake of clarity I will limit myself to the use of a few theories and concepts from the field of science and technology studies (S&TS). Accordingly, I will begin with a brief introduction to each concept and theory, their main tenets as well as their relation and usefulness for an analysis of LCA. Firstly, I will introduce the more general idea of social constructivism and the notion of the social construction of scientific facts, knowledge and theories. Secondly, I will introduce Actor Network Theory (ANT) and the concept of translation. Finally, I will introduce the concept of local universality, as developed by Steffan Timmermans and Marc Berg in their article on medical protocols (Timmermans & Berg, 1997).

The term social construction began to gain ground in relation to science and technology studies in the late 1970s. It is however not to be understood as an individual branch of S&TS studies, but rather it encompasses a range of theories within the field itself. The aim of social constructivist theories is to uncover the social construction of facts, knowledge, theories, phenomena, science, technologies etc. (Sismondo, 2004, p.51). According to Sismondo, it provides us with three basic assumptions. Firstly, it presumes that science and technology are necessarily and inherently social, in the sense that there are always social actors and actions involved in their creation. Secondly, they are active, since their construction necessarily involves action. Finally, the results or products of science and technology can never be natural themselves, as they are translated representations of nature. All three of these aspects will be important to bear in mind in the consequent analysis of the social dynamics behind life cycle assessment practices, since all three are inextricably involved in both the development, as well as the execution of the method. Equally it is argued that scientific knowledge itself is thus socially constructed. The 'discovery' of a scientific fact necessarily involves social interaction as well as the communication of results and interpretation of data. According to constructivists, a discovery can never be isolated from its social context:

> For S&TS, knowledge, methods, epistemologies, disciplinary boundaries, and styles of work are all key features of scientists' and engineers' social landscapes. To say these objects are socially constructed is simply to say that they are real social objects, tough contingently real. (Sismondo, 2004, p.53).

Similarly, just as the discovery of a scientific fact or the origin of scientific knowledge cannot be separated from its social context, neither can the models and theories that are based on such knowledge and facts. Scientists thus construct theories and models on the basis of data, or facts, as well as methods that allow them to move from data to representations. However, as is the case with the discovery of facts and the construction of knowledge, this process cannot be entirely methodical, and always remains subject to the social dynamics within the context of its origin. This assumption in particular will be interesting to bear in mind when examining the application of life cycle assessment method in different local and social contexts. One of the main difficulties with the standardisation of LCA practices is precisely due to the methods' heavy reliance on data, which is subject to change depending on the specific context it is derived from, as well as the boundaries and scope determined by the actors that perform the assessment. Once again, all three of the elements mentioned above – the social, the active and the non-natural or constructed – are part of the process.

What distinguishes Actor Network Theory from the social constructivist approach and the reason why Callon, Latour and other proponents of ANT reject the notion of purely social construction, is the fact that it considers not only human, but also non-human actors (or actants, since ANT seeks to not define an actor's properties a priori but to follow and learn from its movement in a network) to play an essential role in the creation, stabilisation and maintenance of a (scientific) network (Latour, 1987). ANT claims that technology and society are inextricably interwoven, without however trying to make an argument for technological determinism. It can thus be described as a theory of ‘technoscience’, comprising heterogeneous, human and non-human actants with no important distinction between them (Bijker, Callon, Hughes, Pinch, 1987). It comprises actants as diverse as machines, scientists, entrepreneurs, consumers or engineers, that all have interests that need to be accommodated, managed and used. In order to create a stable, well-functioning network it is crucial that the interests of all actants are aligned in such a way that they all work towards the same goal (Law, 1999). In this chapter I will however not specifically concern myself with the *non-human* actors involved in the process of conducting a life cycle assessment. Nonetheless, my analysis shares a common concern with ANT with regards to:

> how actors and organisations mobilise, juxtapose and hold together the bits and pieces out of which they are composed; how they are sometimes able to prevent those bits and pieces from following their own inclinations and making off; and how they manage [to] turn a network from a heterogeneous set of bits and pieces each with its own inclinations, into something that passes as a punctualised actor. (Law, 1992, p.6)

If we apply these preconditions for a successful network to the practice of life cycle assessment, it becomes apparent how difficult it is to reconcile the interests of all the possible actors involved in the creation, application and interpretation of the assessment. Particularly since LCA, despite efforts at scientification, still also needs to accommodate industry practices, possible governmental directives as well as the particularities of the technical components involved in the assessment procedure.

A further interesting concept from Actor Network Theory is translation. Michel Callon understands translation as the process through which the interests of single actors are aligned with the rationale of the overall network, in order for them to participate successfully in the operation of the latter. The process of translation thus seeks to enrol actors in a network by translating their particularities and interest in order to work in harmony with the whole. Callon further defines four distinct moments in the process of translation, namely problematisation, interessement, enrolment, and mobilisation (Callon, 1987, pp.83-103). Not all of these moments necessarily need to occur and when they do, they do not need to occur in a specific order. By problematisation Callon refers to the moment when the ‘network builder’ convinces the different actors within a network that it is necessary for them to work towards the overall goal of the network itself, in order to fulfil their individual interests or goals. Interessment essentially refers to building an interest in the network, while enrolment is the moment when the roles of individual actors are specified and accepted by them. Finally, mobilisation finally denotes moving the new actors to be part of the network (Callon, 1987). The process of translation thus implies changing or aligning the interests of all actors to work towards the same end. In the words of Sismondo, "Translation in ANT's sense is not neutral, but changes interests." (Sismondo, 2004, p.69). In terms of the standardisation process within LCA, the network builder would be the standardising institutions (ISO and SETAC) that attempt to align the interest of all actors involved in an LCA network – from scientists, industry representatives, consumers and the technological components involved – in order to convince them that working towards the same goal (the creation and application of universal standards) is necessary for them to fulfil their own individual goals.

Drawing on ideas from ANT, Stefan Timmermans and Marc Berg seek to resolve the tension between locality and universality with their concept of local universality. Following ANT, the authors see universality not as an intrinsic aspect of scientific knowledge, but rather as a result of the successful establishment of a network. Yet they do not suggest that such universality does not simply erase the specific role of the local context. Their concept of local universality highlights the tension between standards and their relationship with existing infrastructures, procedures and practices and argues that universality is always 'local' in a sense. They observe that the problem with creating universality through the introduction of standards is that they aim to replace already existing practices. Instead, they argue, standards should retain some flexibility and incorporate and extend upon these practices and infrastructures (Timmerman & Berg, 1997, p.275). Standards, according to Timmerman and Berg, should thus have a certain looseness in order to be locally responsive and give some leeway to the trajectories of all actants already involved in the existing practice. Hence, "local universality emphasises that universality always rests on real-time work, and emerges from localised processes of negotiations and pre-existing institutional, infrastructural, and material relations. (Timmerman & Berg, 1997, p.275)". Additionally, they argue that standardisation is not brought about through a single authority within a network. Hence, "standardization efforts do not require a central actor – in fact, they often do without it. Achieving universality should be seen as a distributed activity" (Timmerman & Berg, 1997, p.275). Their concept neatly sums up the underlying tension in the standardisation process of LCA, as it shows that universality is indeed compatible and can actually complement rather than contradict.

From the cradle to adulthood:
The development of LCA

The history and development of LCA as a method is beset on all sides by struggles of conflicting interests and aims as well as opposing conceptions of the proper scope and application of the method. Taking a closer look at the origins of the method will reveal that the direction it ultimately took was by no means a self-evident. During the course of its development, life cycle assessment has been appropriated for a wide range of different purposes in equally different contexts and has been criticised for its deficiencies as much as it has been applauded for its advantages. The tension between a conception of LCA as a purely scientific, universal methodology and its understanding as flexible methodology that is able to adapt to the different circumstances of varying contexts is a consequence of these differences in perception as well as conflicting interests amongst the actants that were engaged with its development. In the consequent attempt to standardise the method, the criticism as well as the opposing conceptions of the form and purpose of the method needed to be accommodated and aligned in a way that would allow the creation of a functional 'standardisation network'. However, the alignment of all actants has not always been possible and is still the cause of differences in application. In the following analysis I will thus take a look at how the conceptions of different stakeholders about what LCA should be in terms of scope and application as well as the criticism directed at it at different times influenced the development of the method. In the course of this analysis it will become apparent that the social dynamics that have significantly shaped the development of LCA are the cause of the tension between the locality and universality of the method and that a certain degree of flexibility may indeed be preferable, if not necessary in order for it to remain a useful assessment tool.

With the dawning of the oil crisis in the early 1970s, industrialists all over the world felt the urgent need to look for more cost efficient and less energy-consuming ways to make use of their resources and to manufacture their products. Those and similar concerns over the limited availability of raw materials as well as energy resources eventually spawned a new field of research in energy and production efficiency (US EPA, 1993). The first traces of what later would become life cycle assessment are thus not to be found in laboratories or the classrooms of universities, but in the management rooms of large industrial companies, eager to optimise their energy consumption and production processes. Accordingly, LCA was thought of primarily as a managerial tool and only secondarily as a scientific methodology. So-called fuel-cycle studies and energy consumption analyses were conducted in order to estimate and evaluate the entire energy consumption of a finished product. By analysing the amount of energy used at each stage in its development – from the extraction of raw materials to the production and consequentially consumption of goods – each stage was analysed and evaluated individually (Heiskanen, 1997, p.28). A study conducted by the Midwest Research Institute for the Coca Cola Company in 1969 laid the foundation for the current methods of life cycle inventory assessment and simultaneously served as a model for other companies around the world to assess the energy efficiency of their production processes (SAIC, 2006). The aim of the study was to find out what kind of drinking container would be more efficient in its production and less complicated to dispose of. More importantly however, it was the first study of its kind to also incorporate an analysis of possible environmental impacts of the production and post-consumption processes. In order to establish a resource and emissions profile for the companies' drinking containers, a quantitative estimation was made of both the amount of energy used during the manufacturing process as well as the environmental impact during production and after disposal. The study showed that, despite previous assumptions that glass containers would be less harmful to the environment since they could be recycled and reused, the overall environmental impact and energy consumption was higher than that of cans and plastic bottles. However, despite the fact that the study considered the environmental impact of the production process, the company's primary interest was still cost-efficiency (Jensen et al., p.13). Accordingly, critics argued that, "life-cycle analysis (LCA) criteria [were] often based on technical and financial feasibility and not necessarily on environmentally based goals. Therefore solutions developed are to problems that are readily solvable. It may ignore more pressing environmental aspects of production for which there is either no known technical solution or no cost-favorable alternative to existing methods." (Williams, 2004, p.119) The study's surprising results prompted further companies, both in the United States and in Europe, to adopt the method for their own evaluation purposes. However, it is important to note at this point that so far no specific set of guidelines and proceedings had been established, that would ensure that the method would be applied similarly in different contexts. Most material on how to conduct energy- and environmental impact studies was available from public sources, such as government documents or technical papers for instance. More particular scientific material or industry specific papers were however not available (SAIC, 2006). As a result of this lack of a unanimous understanding of what such a method should encompass, a different understanding of its scope and aim developed in the various contexts in which it was adopted. Accordingly, critics bemoaned the limited scope of the assessment, the sometimes arbitrary models for the interpretation of data as well as the difficulty of communicating results in a way that is both simple and at the same time credible to stakeholders (Hutchins & Sutherland, 2006). While the 'prototype' of LCA was labelled Resource and Environmental Profile Analysis (REPA) by the Environmental Protection Agency in the United States, the European Commission named its equivalent Eco-balance, possibly suggesting a rather different take on what the aim and scope of such an analysis should be (Jensen et al, 1997).

Towards the end of the oil crisis in the late 70s in the US, a standardised protocol and a standardised research methodology for REPA's were developed and scrutinised by the American Environmental Protection Agency (EPA), as well as industry representatives. Industry interests specific to the US market and thus not applicable in other contexts however still largely shaped the resulting methodology. Consequentially, the communication of results, as well as the exchange of practices between the US and Europe remained problematic. Comparisons on the basis of input-output data, as was still the basis for environmental profiles, remained difficult since different material flows varied in environmental relevance, depending on the specific local circumstances (Heiskanen, 1997, pp.30-32). Already at this point then, the tension between a locally applicable and specific methodology and a methodology that is apt to be implemented universally became apparent.

Throughout the 1980s, when the oil crisis had subsided, energy use was no longer a higher priority than waste and outputs. Instead, a growing interest in the environmental impact of production and the overall environmental performance of companies as well as an interest in eco-balances developed primarily in Northern America, Europe and particularly Germany (Virtanen, 1994). With the establishment of the first European eco-label, the Blue Angel, in Germany in 1978, as well as growing legislative pressure on packaging processes and rising popular interest in environmental issues and environmentalist pressure, interest in LCA experienced a significant surge (Heiskanen, 1997 & Jensen et al., 1997). Criticism directed at environmental claims made by industry actors and criticism of industry actors directed at claims made by regulators as well as weaknesses in individual LCA studies and consequentially the lack of a transparent, systematic and most importantly reproducible methodology urged governments in the US and Europe to invest in the development of proper standards for life cycle assessments (Christiansen, 1991).

What we have seen is that already in the first years of its development LCA has been subject to the influence of a variety of actors and dynamics, both social and technical, that have shaped its form and content as a method. Political incentives, such as the focus on environmental issues and the early establishment of an environmental label in Germany, increasing consumer interest in environmentally benign products as well as criticism towards the industry and by the industry against loosely formulated directives all contributed to the shape and form of life cycle assessment. The combination of all these different actors and the diverse trajectories they pursued in the development of the method consequentially led to calls for further standardisation measures.

Eco-labelling and attempts at standardisation

Thus, in the beginning of the 1990s, the US Society of Environmental Toxicology and Chemistry (SETAC) was commissioned to develop a set of guidelines for LCA practices, in order to defend the methodology against criticism that had been raised against it and to align the individual particularities of all actants involved. The SETAC thus recognised the need to harmonise the interests of different actors in order to make a stable methodology possible, or in the words of Timmerman and Berg to create universality through standardisation (Timmerman & Berg, 1997, p.273). In 1993, the SETAC released a report called LCA: A code of Practice, containing the first official guidelines for LCA, delineating the four stages that needed to be included in each assessment as well as their proper execution. In order to establish an ordered and formal procedure, each LCA would have to comprise a definition of the goal and scope of the study, a life cycle inventory analysis, a life cycle impact assessment, as well as an interpretation phase (Hutchins & Sutherland, 2006). The definition of goal and scope are intended to define the purpose and audience of the study as well as to define the boundaries, i.e. the depth and detail of the study. During the inventory analysis, the relevant in- and outputs, i.e. resources and emissions are estimated in order to be able to identify the possible categories of environmental impacts in the impact assessment phase. This phase is especially interesting, since it is up to each institution to independently determine the in- and outputs they find most relevant. The process of determination can thus be subject to local particularities, preferences and interests. Finally, the interpretation phase combines the outcomes of all the preceding phases in order to identify significant impacts, evaluate the completeness and sensitivity of the study as well as to draw conclusions and give recommendations, which again leaves space for different interpretations (Hutchins & Sutherland, 2006). The formal procedure outlined by the SETAC significantly influenced and substantiated the consequent standards that were established by the International Standardization Organization (ISO) – an international standard-setting body engaged with the creation of world-wide standards – in 1994. The call for an international standard was largely justified by the growing number of eco-labelling schemes that demanded that the award of a label should be based on the life cycle approach (Finkbeiner, M., Inaba, A., Tan, R., Christiansen, K., Kluppel, H.J. ,2006).

Accordingly, the practical definition of an eco-label, according to Wendy Williams, is "a label which identifies the overall environmental preference of a product or service within a specific product/service category based on life cycle considerations." (Williams, 2004, p.27). While the nature of and criteria for private labelling schemes remained obscure, the increasing number of official eco-labelling schemes around the world, such as the Blue Angel in Germany, the Green Seal in the United States or The Swan in Scandinavia, insisted on the application of a LCA for the awarding of a label (Neitzel, 1997 & Jensen et al, 1997, p.44). Furthermore, the methodology needed to be guided by an international standard to ensure its credibility within the scientific community as well as in the broader community of the stakeholders involved with it. Nonetheless, the relationship between LCA and eco-labelling was not immediately an obvious one, despite the methodologies' apparent merits in assessing environmental impacts. Accordingly, Jensen et al. argue that, "some industries have pointed out that LCA cannot be used as a scientific methodology to integrate the inherently diverse and complex trade-offs of environmental product issues; or the often conflicting judgements of criteria-setting stakeholders" (Jensen et al, 1997, p.44). The call for structure and standardisation has thus in a paradoxical way coexisted with the acknowledgement of the inherent limitations and disadvantages of standardisation. This has led some critics to suggest that LCA might even be moving out of the domain of scientific methodologies. As Eva Heiskanen argues:

> LCA is a curious standardization item, as it is certainly not a test method, and unequivocal procedures or interpretation rules can simply not be set out. It is part of a new trend in standards, system standards, that set out general guidelines for the development of systems to 'build-in' and maintain the quality of the system. Thus the standardization procedure is moving LCA out of the domain of scientific methods, and into the world of environmental management tools. (Heiskanen, 1997, p.31)

A further aspect that substantiated opposing views on whether LCA should maintain a certain degree of flexibility in its structure were economic concerns, which certainly also had an influence on the process of standard creation. While producers acknowledged the value of having an eco-label on their products they also bemoaned the difficulty inherent in the process of applying for certification. Wendy Williams observes that, "if criteria for certification are considered excessive by producers, or if costs are prohibitive, they will not apply for licensing. Furthermore, when the stringency of criteria is increased, typically every three years, the programmeme may lose licensees who drop out of the programme rather than continue upgrading environmental performance in production" (Williams, 2006, p.119).

Moreover, eco-labels function as a kind of seal of approval for environmentally benign products, which makes them attractive in terms of marketing purposes. Producers announce their environmental stewardship and responsibility via eco-labels, while consumers in turn demonstrate their commitment to environmental issues by purchasing certified products (Williams, 2006). Therefore private companies and corporations often choose to classify their products with self-made eco-labels, for which the criteria have been established on the basis of a LCA that does not necessarily conform to the official ISO standards. Such schemes belong to the category of unverified ISO type II self-declaratory schemes (Wurzel et al., 2003, p.1). Therefore, self-declaratory schemes will be excluded from the analysis of differences in LCA practices in this chapter, because they by virtue of being self-declaratory do not need to comply with the prevailing standards set out by the ISO. Official type I eco-labelling schemes on the other hand, need to comply with the official standards set out by the ISO on a regular basis and therefore remain relevant for the analysis.

It became obvious that despite the widely held belief that compliance with official ISO standards was necessary, even those institutions that set the criteria for official type I eco-labelling schemes interpreted the guidelines differently. Pivotal for the differences in how the guidelines are interpreted, besides economic interests, national governmental policies and context specific variations, are the different phases of LCA themselves. Since it is up to each institution that executes a life cycle analysis to set the boundaries and define the scope of the study, the aspects that are brought into consideration vary considerably from study to study. As Harald Neitzel argues, “The extent to which the life cycle is considered may vary depending on the type of environmental label or declaration, the nature of the claim and the product category. The extent of the realisation of this approach therefore depends on each specific product category and on the approach of each environmental labelling scheme.”(Neitzel, 1997, p.241). A certain degree of flexibility in LCA thus not only seems to be inherent to the method itself, but moreover it is prescribed by the very standards that attempt to harmonise and formalise it in order to make it universally applicable. Accordingly, Williams argues:

> Life-cycle analysis [.] is somewhat of a random science. Determining the beginning and end of the life-cycle requires setting boundaries at points that are indeterminate. Some phases of the life-cycle are difficult to control, and depend on producer and consumer behaviour. The packaging, marketing and use phase of the product life-cycle are different for individual producers and consumers. Again there is a compromise between a sound scientific basis and manageability of the programme. (Williams, p.178)

The crucial tension thus arises out of the compromise that has to be made between a manageable method on the one hand and a credible, universal scientific basis on the other. Since the first set of 14000 standards was established by the ISO in the mid 90s, the series has been continually updated and the discussion about how to manage this inherent tension has shaped opinions about the method as much as it has shaped the method itself.

At this point it is necessary to refer back to the theoretical framework established above, in order to support the argument that the tension between locality and universality in LCA is to a significant extent the result of the social dynamics that guided its early development. As we have seen, LCA developed out of a network of different actors – consisting of industry representatives, government officials, scientists, academics, consumers etc. – with various and often-conflicting interests. The fact that it was initially thought of as a managerial tool and designed to suit industry specific needs already suggests that there was no immediate need to standardise the method. Indeed, in its early stage a certain flexibility and local responsiveness was deemed to be crucial for its effectiveness. As a result however, the methodology was too loosely defined and actors with different interests appropriated it for their own purposes. Consequentially, the methodology became vulnerable to criticism due to the varying results obtained and could therefore neither gain much scientific credibility. Eventually it was acknowledged that the interests of all those involved in the network that supported the methodology needed to be translated in a way that would allow the proper functioning of the latter. Thus, in order to make the methodology more generally applicable, and to make the translation of results possible, a set of standards needed to be created that would guarantee some degree of universality, i.e. the development of LCA into a universally applicable methodology. In terms of ANT this would be the moment of problematisation, the recognition that all actants need to be convinced that following a set of standards would enable them all to realise their individual aims. In order to establish a kind of universality from which to judge results in various contexts, a formalised system of guidelines was thus developed by the SETAC and later substantiated by the international standards developed by the ISO. However, even this system of formal procedures remained open to interpretation by the different actors involved, as it was recognised that the rigidity of international standards does not give enough leeway to local particularities. It thus becomes apparent, that the effectiveness of LCA depends on the somewhat paradoxical recognition that the successful standardisation of the method actually requires a certain looseness in its constitution, in order to on the one hand guarantee scientific credibility and on the other hand retain its usefulness in specific local contexts. As Timmermans and Berg argue, "rather than being antagonistic to it, a certain looseness in the network may be the preferred (or only possible) way to achieve standardization" (Timmermans & Berg, 1997, p.275). As a consequence, institutions that determine the criteria for type I eco-labelling schemes still exercise a significant amount of flexibility in the way in which they choose to execute a life cycle analysis. The results of various LCA studies on identical products have thus often led to different results depending on the specific context and the definition of boundaries (Christiansen, Finkbeiner, Heiskanen). Accordingly, critics observe that, "depending on the location, on the boundary and allocation choices and on the valuation of different environmental problems, we get very different results" (Heiskanen, p.39). Paradoxically, it therefore seems as if LCA becomes less manageable as a standardisation tool, the more you extend its scope (eg to social issues or particular local issues).

The development of LCA from an industrial assessment tool to a more standardised scientific methodology involved a large variety of often opposing interests, social actors and interactions and was shaped by them accordingly. As Eva Heiskanen points out, "besides the community of LCA practitioners, the actor-network currently encompasses LCA users, such as third-party systems for environmental labelling, product designers, politicians, and environmental educators" (Heiskanen, 1997, p.43). Since the International Standardisation Organisation established the first ISO-standard for the conduct of LCA studies in the mid 90s, the development of LCA has followed a more focused development than before. The discourse surrounding the method is still vigorous and the debate among stakeholders continues to influence the public conception of LCA as well as the standards that should guide its conduct. Moreover, despite its popularity and continued efforts to optimise LCA methods as well as the continuous development and updating of ISO standards, a fair amount of criticism is still directed towards life cycle assessment as a scientific methodology, in particular its relationship to certification processes in eco-labelling.

In recent years critics have increasingly called attention to the lack of a social dimension in life cycle assessment, especially in relation to eco-labelling schemes. While LCA considers the environmental and economic pillars of a product or services life cycle, the social pillar, i.e. the impact the production of a product or the implementation of a service or policy has on its social environment, has been widely ignored. Accordingly, Hutchins and Sutherland argue that, "clearly, there is a need to incorporate the social dimension into life cycle assessment (LCA) to recognise its importance with respect to sustainability" (Hutchins & Sutherland, 2006, p.55). On the other hand, others argue that the inclusion of social factors in the assessment process might overextend the scope of the assessment and put it out of reach for standardising measures. Moreover, the existence of different types of eco-labels with varying methods of certification behind them are often confusing to customers and cause damage to the credibility of labels that have been officially certified by third party institutions using LCA's. According to Williams, "the typical Type I eco-label does endure competitive knocks from Type II private self-declarations, for example, as well as from single-issue labels (such as the Forest Stewardship Council), even if they are not considered comparable to the life-cycle oriented eco-label" (Williams, p.58). This leads to what Williams has termed label fatigue, i.e. the confusion about different kinds of eco-labels and competing credibility claims causes customers to become suspicious towards the overall credibility of eco-labelling schemes.

Flexible standards?
The appropriation of LCA in different labelling-schemes

As we have seen, LCA has been shaped by a variety of social, political and economic dynamics in the course of its development. In order to accommodate the interests of all stakeholders effectively, a set of international standards has been established by the ISO that are supposed to ensure that the methodology is universally applicable and its practices transferrable from one context to another. However, paradoxically attempts at standardising the methodology have shown that making the system too rigid means that the methodology loses its attractiveness and efficiency, as it becomes less responsive to local differences and less able to accommodate more specific considerations, such as the assessment of possible social impacts. In order to shed light on how these developments manifest themselves in the actual certification processes behind eco-labels and how different schemes interpret and appropriate the method, let us now take a look at a small number of eco-labelling schemes and their appropriation of LCA.

Already in the early 1990s, the German Federal Ministry developed a very straight-forward condition for the awarding of eco-labels in Germany and the Blue Angel in particular (for more information on the Blue Angel and its history, see the chapter by R. Savadkouhi). Accordingly, a statement from an environmental labelling conference held in Berlin in 1990 reads as follows:

> Objective environment-related product labelling demands that the products and/or product groups be looked at in a comprehensive and technically sound way. The products to be labelled are therefore to undergo a thorough assessment taking the form, for example, of an ecological balance sheet, where possible comprising the

entire life-cycle of a product and the relevant environmental aspects which apply, and depending on the nature of the product, the suitability for use and safety“ (German Federal Ministry, 1990)

The decision making process that seeks to establish the criteria for environmental labelling is the outcome of a co-operation between the German Federal Ministry of the Environment (UBA), the German Institute for Quality Control and Labelling (RAL) as well as a representative Environmental Labelling Jury (US EPA, 1993, p.17). So far, the Blue Angel has established around 75 sets of labelling criteria that are based on a qualitative matrix of environmental impacts at each of the stages in a products life-cycle and follows the official ISO 14000 standard series (currently 14040:2006) for type I labelling schemes, (US EPA, 1993, p.18). The Blue Angel considers three stages in its assessment, namely those of production, use and disposal and differentiates between seven possible impact categories (hazardous substances, emissions, noise, waste minimisation, resource conservation, fitness for use and safety) (German Federal Ministry of the Environment, 1990). Although government bodies are involved in the process of criteria establishment, it is primarily the RAL and the Environmental Labelling Jury, which are both non-governmental, that oversee the process. It is important to note at this point that the Environmental Labelling Jury is composed of a variety of actors, e.g. representatives from environmental organisations as well as members from industry, consumer associations, trade unions and federal states (Neitzel, 1992). The jury is also the final decision making apparatus for the criteria on product categories. The initial scientific review of a specific product category as well as a first draft of criteria is provided by the UBA and the passed on to the Institute for Quality and Control and Labelling, which organises expert hearings to discuss the proposed criteria before they are finally passed on to the jury. The Blue Angel model relies on a network of actors that ultimately determines the boundaries and scope of LCA criteria for each individual product group is constituted of a diversity of interest groups that all have their say in the process of defining just what aspects should be considered and prioritised in the assessment.

Besides the range of actors that are involved in the creation of its criteria, the German Blue Angel scheme also differs from other national eco-labelling schemes because it does not require producers to demonstrate that they meet national environmental standards in the actual production process (US EPA,1993, p.18). According to the German UBA this has two reasons. Firstly, it argues that most analytical methods fail to differentiate sufficiently between the environmental impact of the product under consideration and the whole manufacturing facility’s performance. Secondly, it points out that if such manufacturing standards were to be a requirement for the assessment of a products performance, this would discriminate against countries that have less stringent manufacturing standards and may therefore constitute an unlawful trade barrier (Neitzel, 1992). What becomes apparent when examining the example of the Blue Angel then is that no direct, unmediated connection between LCA and the criteria for product labelling exists. Instead, there exists a process of mediation and delegation by a variety of actors and experts that discuss the proper application and scope of the assessment, before actually recommending it as a basis for the certification of products. LCA in the German programme is therefore not seen as a purely objective scientific method for assessment, but rather as a tool to support delegation by assessing the relative environmental impact of a product.

The Dutch Stichting Milieukeur has chosen a slightly different approach. The Milieukeur is a non-profit, government independent organisation that has been commissioned with the administration of the Dutch eco-labelling programme, which has gone under the same name since 1992. In contrast to the German Blue Angel, no government bodies are actively involved in the process of defining the labels criteria except for a few representatives in a general committee of stakeholders. Instead, a group of experts consisting of representatives from different segments of society such as environmental groups, consumer groups, manufacturers, retailers and government representatives sets the criteria for the Milieukeur label (US EPA, 1993, p.22). Furthermore, before the criteria put forward by the committee are finalised, there is an opportunity for the public to voice their opinion in a public hearing. In this way the consumer has an opportunity to be directly involved in the process of creating the criteria for products that seek to differentiate themselves on the basis of alleged environmental friendliness. The procedure for researching the proper criteria then is handled by independent consultants who make use of already existing LCA studies that are concerned with the same or similar class of products. Thus, in contrast to the German model, where a special Institute (RAL) is commissioned with the creation of a new study for each new group of products, the Milieukeur draws from an already existing stock of knowledge. Additionally, the programme openly acknowledges the deficiencies of the life cycle approach and attempts to complement them with the knowledge of experts in the council:

> The programme [.] does not depend on the development of the perfect LCA methodology, but uses the available information to develop product criteria with expert judgement. The programme recognizes that an LCA does not automatically make the choices of the greatest opportunities for environmental improvements in product classes that have to ultimately be made by the Board of Experts based on the available information. (Giezman & Verheers, 1997 & US EPA, 1993, p.22)

The Dutch programme thus deems LCA to be more successful if a certain degree of flexibility in the assessment is recognised from the beginning and more room is given to the knowledge and opinions of experts and even the public to some extent. Furthermore, in contrast to the German programme, the Milieukeur considers six life cycle stages in its assessment and a total of twenty-five environmental aspects (Giezman & Verheers, 1997). Hence, the goal and scope of the assessment need to consider a wider range of possible impacts than in e.g. the Blue Angel certification process. If however, insufficient information is available in one of the relevant categories, the development of criteria in that particular category can be postponed or skipped entirely. The Milieukeur argues that some details may be omitted because "the purpose [of a LCA] is not to compare every aspect of two or more actual products, but to select the most important environmental aspects for development of product criteria." (Giezeman & Verheers, 1997, p.22). Moreover – and this is another important difference between the Dutch and the German understanding of what the aim of a LCA should be – the Milieukeur strives to set the environmental requirements that need to be met in order to be awarded with the label need to be higher than those prescribed by national environmental standards (US EPA, 1993, p.23). It becomes apparent that the Dutch and German labelling programmes have a different understanding of how LCA should be applied in their respective schemes, as well as who should be involved in the process of determining the scheme's certification criteria. The German programmeme seeks to include the government in a more direct way and passes legislation on to a single independent institute (the RAL) to give recommendations to a jury that finally decides upon the criteria. In contrast, the Dutch programme pursues a more inclusive process from the beginning, with less governmental involvement and more emphasis on expert recommendations and opinion.

A more extreme example of how life cycle assessment has been appropriated to fit local priorities is the state-run Belgian Social Label (*Belgisch Sociaal Label*). Established in 2003, the label is a government initiative that seeks to earmark products and services that show exceptional consideration for their social impact throughout their production chain in accordance with the internationally recognised conventions of the International Labour Organisation (ILO) (Spillemaeckers, 2007, p.1). Aspects taken into consideration can range from freedom of association and discrimination to forced labour and child labour. An independent verification institution certifies products and services that contribute to the lessening of the social burdens of production and consumption (Sociaal Label: Het Lastenboek, 2011). The Belgian government has consciously chosen to complement the environmental aspect in the establishment of criteria for the label. This helps to include and assess the social dimension of the production chain, from the extraction of raw materials to the final stages of production. The model developed by the Belgian government is based on the official standards for environmental LCA's. However, in order to account for the social dimension it also pays attention to the ramifications of the production process itself, which is often 'black boxed' in environmental LCA's, as we have seen is the case in the Blue Angel scheme (Spillemaekers, 2007, p.4). To account for the distinction between environmental and social impacts in the assessment, the Belgian model makes a distinction between product-related aspects on the one hand and aspects specific to the social actors involved in the production chain on the other. This approach is still comparatively young and not entirely unproblematic. Accordingly, criticism has been raised on both sides of the spectrum: industry representatives have criticised the fact that it is often difficult for them to oversee the entire production process, since third-party producers often do much of the work. Consumers on the other hand put an emphasis on the necessity for companies to actually prove that their production chain is socially just and worthy of the label (Spillemaekers, 2007, Melckmans, 2003). The government has tried to tackle this problem by engaging independent verification organisations with on-site visits to disburden the companies.

To conclude, the Belgisch Sociaal Label shows the advantages as well as the difficulties that arise when extending the scope of LCA to include the social dimension of production. In contrast to both the Milieukeur and the Blue Angel, the Belgisch Sociaal Label is a governmental initiative that has consciously chosen to open the 'black-box' of the production process and to thus extend the scope of the assessment. However, this has also meant that the assessment has become less manageable and the label as a consequence less attractive for producers and less credible for consumers.

Conclusion

In the course of this chapter we have seen how a diversity of actors and dynamics has shaped and continue to shape the methodology of life cycle assessment. The tension between a locally responsive and meaningful methodology on the one hand, and a universally applicable and credible methodology on the other has been the central defining point in this development. It has become apparent however that neither is fully achievable, nor necessarily desirable, for the success and effectiveness of the methodology. The different ways in which LCA has been appropriated in various eco-labelling schemes – ranging from purely environmental assessments to primarily social assessments – further illustrates the value of a certain degree of looseness and flexibility in the application of the method to retain its usefulness in locally specific contexts. The Dutch Milieukeur accepts the limitations of the methodology and seeks to supplement them with the knowledge of experts and also gives the public a chance to participate in the criteria setting process. The German Blue Angel scheme relies more heavily on the scientific soundness of the approach and delegates the establishment of criteria to a mixture of governmental bodies, independent certification institutions and a representative jury. Depending on the local context the methodology is re-shaped by the actors that use it as well as the method itself reshapes the network of actors that choose to apply it. The concept of local universality has helped to highlight the dynamic between the introduction of standards, which aim to create a form of universality within a network and the incorporation of already existing structures and practices to substantiate and secure the usefulness of the standard. Although I did not explicitly include the contribution of non-human actors, the application of ANT to the analysis of the development of the method has helped to shed light on the problematic aspect of translating the particularities and interests of all actants involved. However, the 'LCA network' is not only shaped by a conflict of interests but ultimately also shaped by the methodology itself. As Eva Heiskanen argues, "The process of re-embedding and re-contextualising the disembedded, abstract knowledge produced by LCA is as large a task as the original abstraction and disembedding. 'Think globally, act locally' is not as easy as it sounds." (Heiskanen, 1997, p.46). Ultimately then, the challenge for proponents of life cycle analysis will be to determine its proper domain. LCA as a science on the one hand should strive for universality and a formalised, transferable system of procedures. A life cycle assessment method thought of as a managerial tool or a tool to support policies needs to be able to be re-contextualised and localised, to be flexible and responsive to local needs and particularities in order to retain its usefulness.

References

Bijker, W. (1987) *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology.* Cambridge, MA: MIT Press

Callon, Michel (1987), Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay. In *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology,* eds. W.E. Bijker, T.P. Hughes, and T.J. Pinch, pp.83-103, Cambridge, MA:MIT Press.

Christiansen, K. (1991) Possibilities and Limitations to life cycle analysis. In *Packaging and the Environment – Policies, Strategies and Instruments,* University of Lund, Department of Industrial Environmental Economics, Lund

Environmental Protection Agency, US [EPA] (1993) *The Use of Life Cycle Assessment in Environmental Labelling Programmes.* University of Tennessee, Knoxville Tennessee.

Finkbeiner, M., Inaba, A., Tan, R., Christiansen, K., Kluppel, H.J. (2006) The New International Standards for Life Cycle Assessment: ISO 14040 and ISO 14044. *International Journal of Life Cycle Assessment,* 11 (2), pp. 80-85.

German Federal Ministry of the Environment, Nature Conservation, and Nuclear Safety [UBA] (1990), *Documentation, International Conference on Environmental Labelling – State of Affairs and Future Perspective for Environment Related Product Labelling,* July 5th-6th, Berlin, Germany

Giezeman, H.G.M. and G. Verhees (1997), Stichting Milieukeur. Ecolabelling: Practical Use of Cradle to Grave, In Zarrilli, S., Jha, V., Vossenaar, R.(1997) *Eco-labelling and International Trade.* London: Palgrave, Macmillan.

Heiskanen, E. (1997) The Social Shaping of a Technique for Environmental Assessment, *Journal of Science Studies,* 11 (1), pp.27-51

Hutchins, M.J. & Sutherland, J.W. (2006) The Role of the Social Dimension in Life Cycle Engineering, Michigan Technological University, Michigan Jensen, A., Hoffman, L., Moeller, B., Schmidt, A., et al.(1997), *Life Cycle Assessment; A guide to approaches, experiences and information sources,* European Environment Agency (EEA): Copenhagen.

Latour, B. (1987) *Science in Action: How to Follow Scientists and Engineers Through Society.* Milton Keynes: Open University Press

Law, J. (1999), After ANT: Complexity, Naming and Topology (pp.1-14), In Law, J. & Hassard, J. (1999), *Actor Network Theory and After.* Oxford, Blackwell Publishing Law, J.(1992), Notes on the Theory of the Actor-Network: Ordering, Strategy and Heterogeneity, Retrieved June 1st from, *http://www.lancs.ac.uk/fass/sociology/papers/law-notes-on-ant.pdf*

Melckmans, B. (2003) *Strengths and weaknesses of Belgium's social label.* Research Services, Enterprise Dept., General Labour Federation of Belgium NA (2011), Sociaal Label: Het Lastenboek, Retrieved June 7th, 2011 from *http://www.mi-is.be/be-nl/doc/sociale-economie/social-label-lastenboek*.

Neitzel, H. (1992) *Experiences with the Blue Angel Scheme (Environmental Labelling in Germany) Working Methods, Problems, Balance, and Perspectives.* Annual Conference of the Environmental Law Network International, October 9th-10th , Athens, Greece.

Neitzel, H. (1997) *LCA and Ecolabelling; Application of Lice Cycle Assessment in Environmental Labelling, International Journal of Life Cycle Assessment,* 2 (4), pp. 241-249 Scientific Applications International Corporation (SAIC), 2006, Life Cycle Assessment; Principles and Practice, National Risk Management Research Laboratory, Office of Research and Development, US EPA, Cincinatti, Ohio.

Sismondo, S. (2004) *An introduction to Science and Technology Studies*. Oxford: Blackwell

Spillemaekers, S. (2007) *The Belgian Social label: A governmental application of Social LCA,* NA.

Timmermans, S., Berg, M. (1997) Standardisation in Action: Achieving Local Universality through Medical Protocols, *Social Studies of Science,* 27, 2, pp. 273-305.

Virtanen, Y. (1994) *Life cycle assessment; goals, limitations and approved procedures.* Presentation at seminar, Life Cycle Assessment in Product Development 4.-5.5., 1994, Neopolis, Lahti.

Williams, W. (2004) *Eco-labelling. A Socio-economic Analysis.* Doctoral thesis, WU Vienna University of Economics and Business.

Wurzel, W., Bruckner, L., Jordan, A., Zito, A.R., (2003) Consumer responsibility-taking and eco-labeling schemes in Europe. In Micheletti, M., Føllesdal, A., Stolle, D., (2003), *Politics, Products and Markets: Exploring Political Consumerism*. Transaction, Somerset: NJ.