Considerations relating to a concept for life cycle assessment from the point of view of a manufacturer of lift door components

UK

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The prime motivation for studying the life cycle assessment of lift doors was to obtain a basic understanding of the subject of life cycle assessment and to learn the significant parameters throughout the service life of lift doors.

In this way it was intended to gather initial experience with the handling and implementation of life cycle assessments, to establish a way of calculating the effort required for this and in the final analysis to identify the relevant means of adjustment.

The lift door manufacturer Meiller sought the assistance of the Landshut University of Applied Sciences, which immediately assigned two master's theses in view of the scope of the work involved.

The first master's thesis was concerned with the manufacturing process for lift doors, starting with the production of the raw materials (upstream), in-house manufacture (core) through to the finished product ("cradle to gate").

The second master's thesis studies the section of the life cycle from the delivery at the factory gate to the disposal of the lift door (downstream process "gate to grave").

Definition of life cycle assessment (ecobalance)

A life cycle assessment is the assessment of the environmental aspects relating to a product and potential, product-specific environmental impacts. A life cycle assessment study examines the environmental aspects and impacts which arise in the service life of a product. The scope starts with the acquisition of the raw products and then covers production and application through to the final disposal of the product (i.e. from the cradle to the grave). [DIN(BS) EN ISO 14 040:1997, 1997]

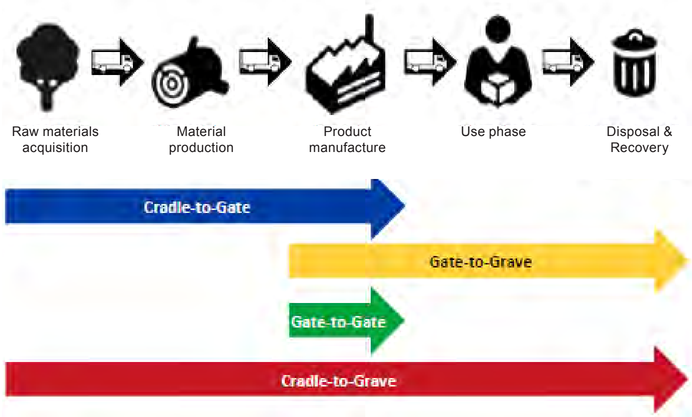

Illustration of the various product life cycle assessments

Environmental Product Declarations & Product Category Rule

In collaboration with a working group of the European Lift Association (ELA) a Product Category Rule (PCR) has been drawn up for lift systems, PCR lift 1.0 UN CPC 4354.

A PCR defines requirements for drawing up Environmental Product Declarations (EPD). An EPD is based on life cycle assessments and is intended to help create transparency and comparability between product systems. An EPD is an independently certified and registered document which contains transparent and comparable environmental information relating to a product.

The results of a life cycle assessment can provide useful indications for a large number of decision-making processes. A life cycle assessment can help in:

- highlighting possibilities for improving the environmental features of a product in the various phases of its service life;
- informing decision-makers in industry and in governmental or non-governmental organisations (e.g. in strategic planning);
- selecting relevant indicators of the environmental features, including the related measuring procedures;
- in marketing (e.g. when implementing ecolabelling).

Relevant standards and Product Category Rules

- DIN (BS) EN ISO 14 040 (Environmental management – Life cycle assessment – Principles and framework) and DIN (BS) EN ISO 14 044 (Environmental management – Life cycle assessment – Requirements and guidelines) lay down how a life cycle assessment is to be organised.

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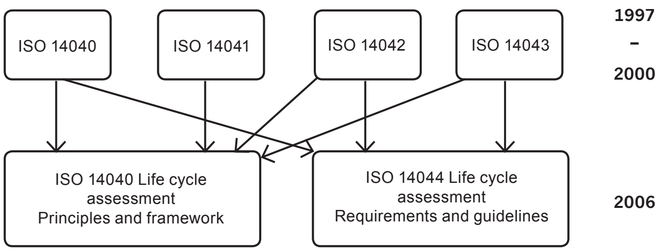
Structure of the previous ISO 14 040-43 standards

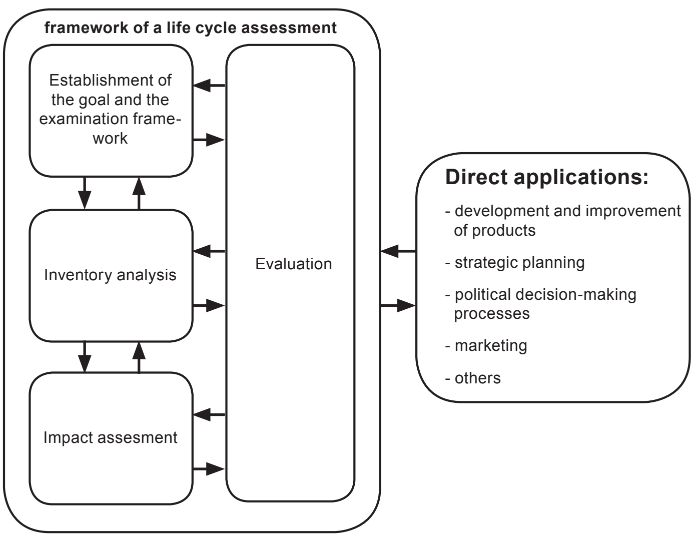


Structure of the new standards ISO 14 040/14 044

- The Product Category Rule PCR lift creates uniform calculation rules for drawing up an EPD.
- The PCR refers to DIN (BS) EN ISO 25 745-2 for the calculation of energy consumption. This standard also gives use categories for lifts.

Sequence for a life cycle assessment

This figure shows that the life cycle assessment according to ISO 14 040 is an iterative method. In the individual phases of a life cycle assessment the results of the other phases are used. This approach within and between the phases helps ensure the holistic character and consistency of the study and of the results given in the report.



Phases of a life cycle assessment [EN ISO 14 040:2006, 2006, S. 16]

Table A.1 - Number of journeys per day (and operating days on the year)

Use category	1	2	3	4	5	6
Use intensity/Frequency	Very low	Low	Moderate	High	Very High	Extremliy high
Number of journeys per day (n_d) Typical range	50 (<75)	125 (75 to <200)	300 (200 to <500)	750 (500 to <1000)	1500 (1000 to <2000)	2500 > 2000
Typical building and use (operating days per year)	– residential building with up to 6 dwelling units (360 d) – care facility (360 d) – small office or administrative building with little activity (260 d) – underground stations (360 d)	– residential building with up to 20 dwelling units (360 d) – small office or administrative building with 2 to 5 storeys (260 d) – small hotels (360 d) – car parks of office buildings (260 d) – general car parks (360 d) – railway stations (360 d) - library (312 d) - entertainment centres (360 d) - stadiums (occasional)	– residential building with up to 50 dwelling units (360 d) – medium-sized office or administrative building with up to 10 storeys (260 d) – medium-sized hotel (360 d) – airports (360 d) – university (260 d) – small hospital (360 d) – shopping mall (360 d)	– residential building with up to 50 dwelling units (360 d) – large office or administrative building with more than 10 storeys (260 d) – large hotel (360 d)	– very large office or administrative building a height of more than 100 m (260 d)	– very large office or administrative building a height of more than 100 m (260 d)
Typical rated speed	0.63 m/s	1.0 m/s	1.60 m/s	2.50 m/s	5.00 m/s	5.00 m/s

Life cycle assessments are a relative approach built up around a functional unit. This functional unit establishes what is to be studied. All subsequent analyses then relate to this functional unit.

All inputs and outputs in the inventory analysis and consequently also the impact estimation profile are based on this and make it possible to compare life cycle assessments.

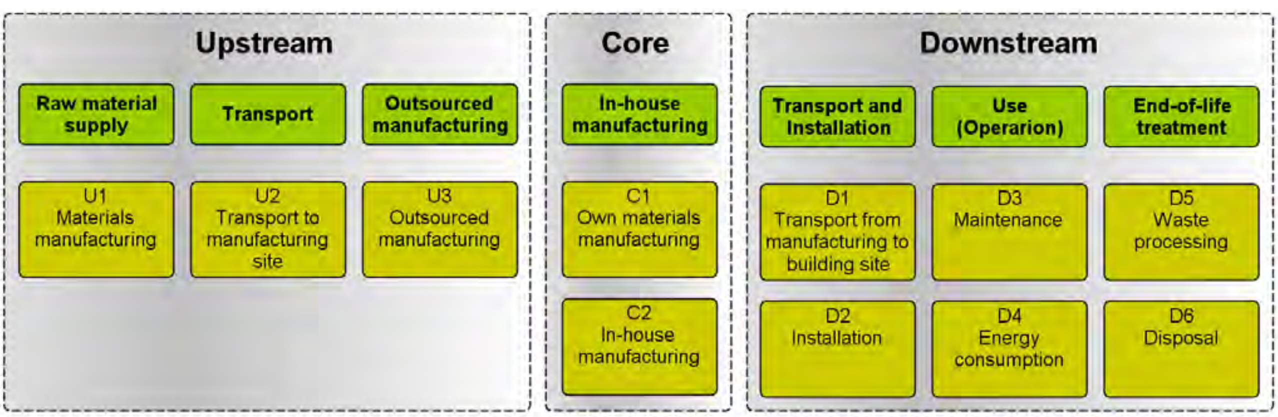
Functional unit

The following is defined as a functional unit:

"quantified usefulness of a product system for use as a comparative unit"

The function of a lift door is to close off or separate the room to the lift shaft and to that of the cabin. This safeguards the passengers from falling into the shaft and protects them during transport.

Table B



The functional unit for these studies was therefore established as an opening and closing cycle of the lift doors. But UN CPC 4354 refers to the whole lift system:

The function of a lift is to transport persons, loads or both => Functional unit: Transport of a load over a distance in [tkm]

Taking the use categories and assumptions concerning the frequency of opening and closing operations of doors in relation to the number of journeys of the whole lift, as defined in DIN (BS) EN ISO 25 745-2, it is ultimately possible to create a relationship between the two functional units:

Examination framework for these studies

To simplify the examinations these studies were limited merely to standard shaft and cabin doors (TTS/K 25) in the relevant door leaf variants of steel, glass (VSG V16) and framed glass (MGT 01). The range of dimensions was defined with TH (door height) 2100 and TB (door width) 900.

System limits

The general system limits are specified by the PCR: See table B page before.

This division into upstream, core and downstream processes is also taken into account in determining the data.

Assumptions

There are extensive databases for the downstream process and so in principle it is not necessary to make any assumptions here. The core process is dominated by extensive, laborious measurements in in-house manufacturing. Once again it is hardly necessary to generate additional assumptions.

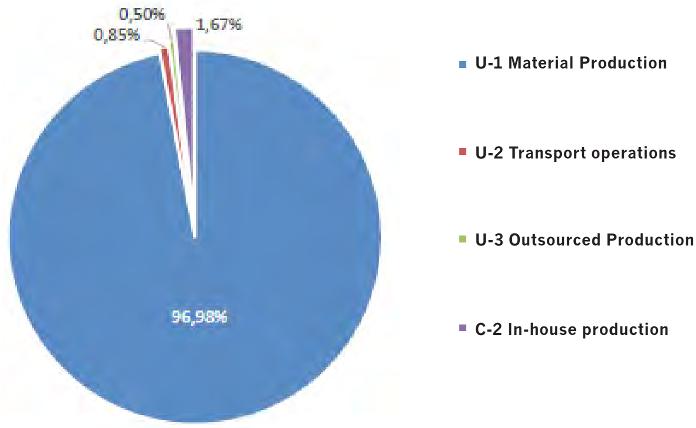
The situation is quite different with the downstream process since here the product leaves the manufacturer's sphere of control and is installed in a different overall system, namely the lift. Environmental impacts in the use phase depend on the customers' specific and individual forms of behaviour. According to how frequently the doors are operated, the speed profiles with which they are operated and the lift system in which the door is installed there are different forms of impact on the energy consumption during operation and on the necessary maintenance measures to be expected. The assumption of the service life of the product alone is a crucial factor for the result of the life cycle assessment. In addition assumptions regarding the means of transport used, the distance to the installation and maintenance location, as well as the recycling routes are of crucial importance.

Results

1. Results for examination of the upstream and core process only (cradle to gate):

Only the GWP (global warming potential = CO_2-equivalent) is compared here and this is intentional because in industry as well, e.g. the automotive sector, it is the only really relevant comparison parameter of life cycle assessments.

The proportion of in-house manufacturing in the case of the TTS 25 steel door in relation to GWP is only 1.67 % and is



Percentage breakdown of GWP for a shaft door

negligibly small. The greatest percentage of 96.98 % is accounted for by the U-1 domain. The largest originator can also be found in origin of material in each case.

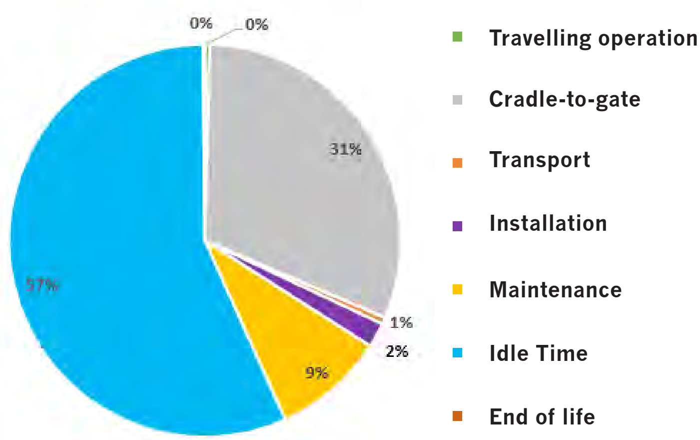
Conclusion

From the very extensive and laborious examination ultimately the sobering result is that material production alone influences the overall result of the life cycle assessment for cradle to gate with a share of 96 to 97%.

Transport, external production and in-house production play as good as no part at all in this.

2. Results summarised over the whole service life:

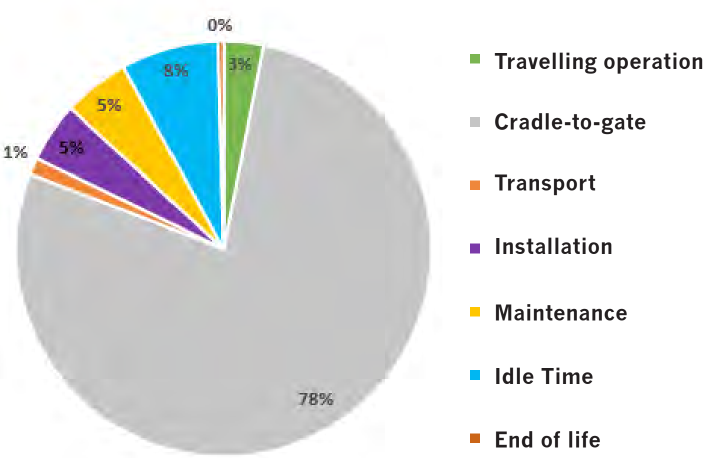
Examination of use category 1:
Proportion of service life segments (all doors)



Reference service life 25 years
2 storeys
Operating days: 360d/a
Operating hours: 24 h/d
Use category: 1
Door leaf variant: steel
Energy saving mode: Eco+ (shut-down < 5 min)

By far the greatest proportion of greenhouse gas emissions (shaft and cabin doors together) in use category 1 is caused by idle consumption (57%). Overall the proportion accounted for by the upstream and core process, called here cradle to gate, is still 31%.

Examination of use category 6:
Proportion of service life segments (all doors)

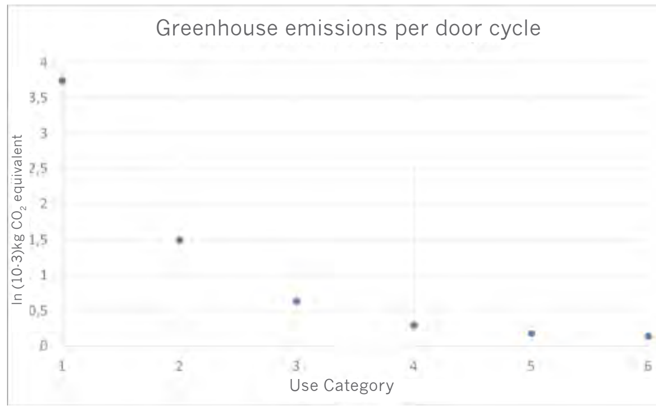


Reference service life 25 years
35 storeys
Operating days: 260 d/a
Operating hours: 16 h/d
Use category: 6
Door leaf variant: steel
Energy saving mode: Eco+ (shut-down < 5 min.)

Lifts with high use intensity (use category 6) are typically located, according to the standard EN ISO 25 745-2, in very high buildings. In these buildings the ratio of shaft to cabin doors is very large (in this example 35:1)

This means that, in the examination of the environmental impacts over the service life of all doors of a lift in this use category, the proportion accounted for by the cradle to gate area continues to increase and now causes more than 2/3 of all greenhouse gas emissions.

The proportion accounted for by other important service life segments, such as that of energy consumption and that of maintenance in the use phase, therefore decreases paradoxically with more intensive use (and a related increase in absolute amounts).



Influence of the use categories

(Greenhouse gas emissions in kg CO_2-equivalents in relation to functional unit)

More intensive use leads to lower greenhouse gas emissions per door cycle.

Lift doors with very high use intensity (use categories 5 and 6) yield figures which are lower by a factor of 10 than doors operated in the use category 1.

That is why doors from different use categories cannot be compared with one another

Overall conclusion on the life cycle assessment of lift doors

In the first part, the master's thesis on "cradle to gate", considerable efforts were made to measure energy consumption rates in in-house production and complicated system flowcharts were developed to establish ultimately that in-house production plays no part in the life cycle assessment, but only the acquisition of resources for the material used.

These figures for raw materials acquisition can be retrieved from appropriate databases and so overall hardly any assumptions have to be made in the upstream and core process, and consequently a high degree of comparability is achieved.

The situation is quite different in the second part, the downstream process. Many different assumptions have to be made here since the lift door product is installed in a total system, "lift", and so it leaves the manufacturer's sphere of control. Numerous influencing factors come into play, such as the consumer's use behaviour, the assumed service life of the product, the transport routes to installation and maintenance, the means of transport used, the distance, the recycling routes and much more.

Here is an extract from a practical example to give a picture of the assumptions to be made:

- **Lift doors:**
  – framed glass door leaf
  – 25 years reference service life
- **Building/lift:**
  – medium-sized hotel (360 d and 24 h/day operation)
  – 8 storeys (3m storey height)

	– use category 3 (300 journeys/day)
▶ **Transport**	– small truck (rated load 12.3t/ EURO5/85% loading rate) – 500km
▶ **Installation**	– proportionately 123.7 km of the delivery journey for the cabin door – proportionately 61.9 km of the delivery journey for each shaft door – diesel vehicle EURO 4 – fastening of the shaft doors with galv. heavy-duty bolts – use of energy-driven tools
▶ **Maintenance**	– 30 km average delivery journey (diesel EURO 4) – 4 preventive maintenance services/year – all wearing parts are replaced during the preventive maintenance (despatch 500km/small truck/85% loading rate/EURO5)
▶ **Energy consumption**	– no energy-saving mode – no light grid emergency shutdown
▶ **End-of-Life**	– recycled-content – plate glass is dumped after the end of the life phase

In view of the many necessary assumptions it is questionable whether the original aim of the EPD system, namely to create transparency and comparability, can be met at all on the component level.

In the final analysis only a whole system, in other words a complete lift, and be meaningfully subjected to a life cycle assessment meaningfully according to the existing PCR.

Either lift manufacturers would have to specify to component manufacturers the assumptions to enable the latter to draw up an appropriate EPD which stands up to comparison, or it would be necessary to restrict oneself to the second possibility described in sentence 7.1.1. of the PCR. This would involve the component manufacturer supplying only the necessary information, such as the nature of the materials, the useful life of the component, maintenance measures and information relating to the demolition measures.

On the basis of these details the lift manufacturer can then draw up an overall life cycle assessment.

In view of the possibilities already highlighted for exerting influence through the establishment of assumptions this would appear to be the more appropriate approach.