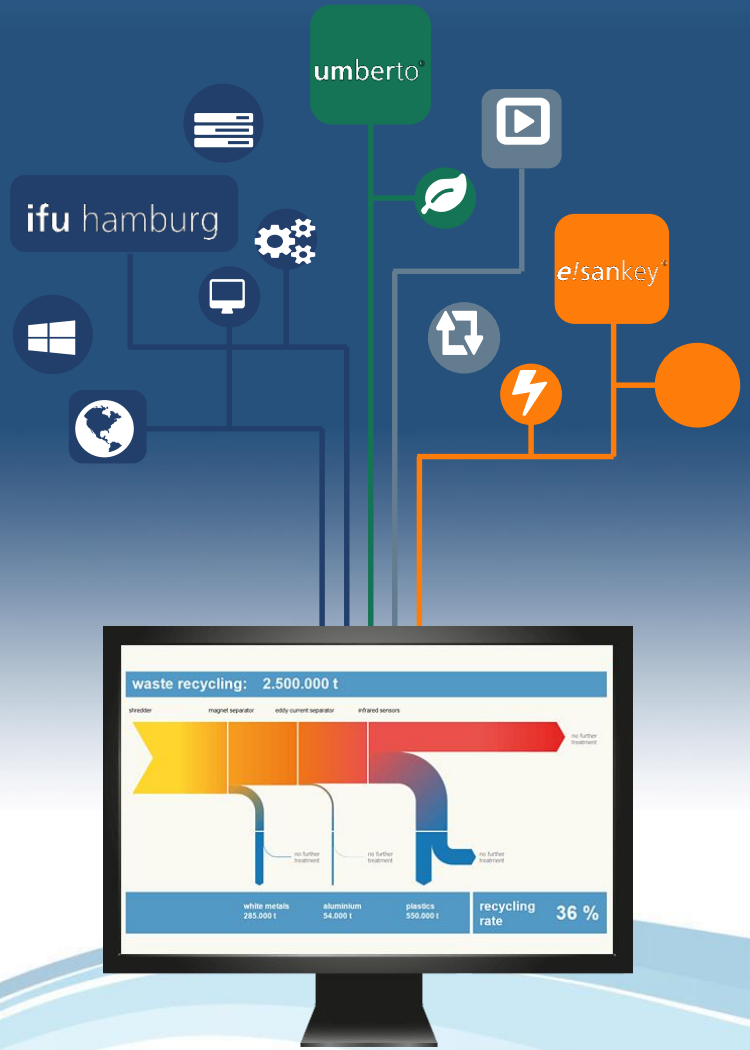

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Productivity meets Sustainability.

LCA in the Textile Industry: Mass is Messing Up Results!

Current LCA Techniques & Main Issue

- Unit datasets are often linearly scaled based on mass (i.e., inputs/outputs per 1kg reference material)
- Overhead expenses are allocated by mass, and yearly production figures are scaled down to obtain specific consumption

Existing pitfall: nuances in production methods are neglected, sometimes producing **grossly inaccurate results**

Example: The Textile Industry

- Focus: woven textile production
- Application
  - Real industry data from a recent LCA used to calculate 4 different approaches to the question:

  How much energy is used and what is the global warming potential (GWP) of the production of 1kg of woven polyester fabric made from 55 dtex yarn using an air jet loom?
  - Constants: location, energy mix

The 4 Approaches

- A. Mass allocation based on yearly production figures
- B. Economic allocation based on yearly turnover figures
- C. Literature-based function based on thread dtex
- D. Detailed modelling of production technology

	kWh/kg woven fabric	GWP per kg fabric (cradle-to-gate)
A	2	13.8
B	4	15.0
C	12	19.8
D	14	21.0

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Nuances of the Textile Example

“1kg of woven polyester fabric made from 55 dtex yarn on an air jet loom”

Nuances of the Textile Example

"1kg of woven polyester fabric made from 55 dtex yarn on an air jet loom"

- One continuous strand of thread is intertwined with numerous vertical strands at right angles

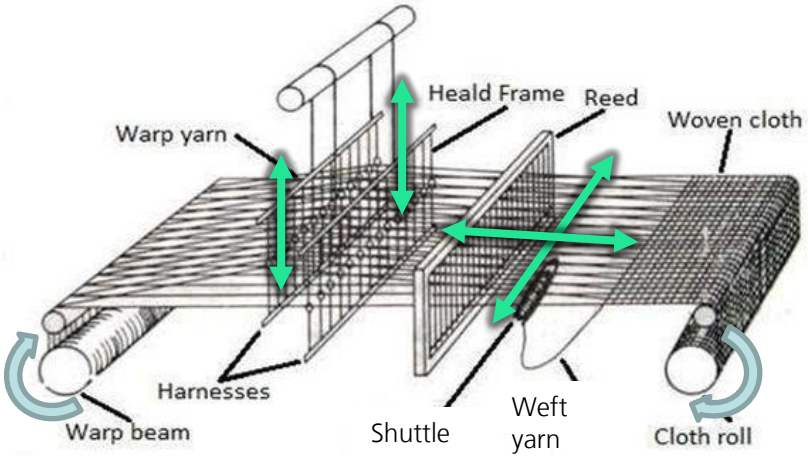

Figure: Basic structure of a loom

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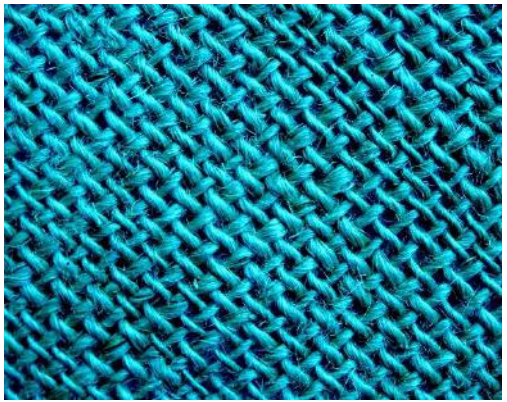

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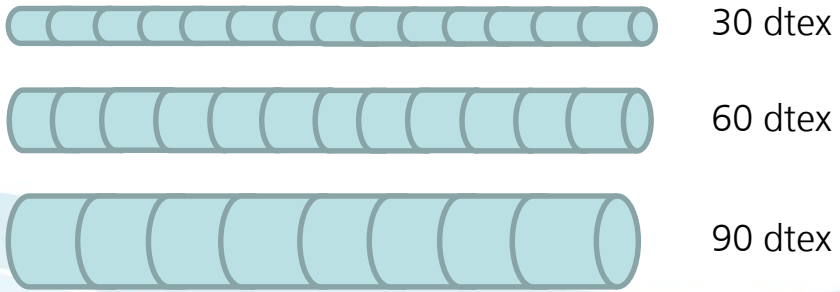
Nuances of the Textile Example

"1kg of woven polyester fabric made from 55 dtex yarn on an air jet loom"

- "tex" is a unit to measure the linear density of yarn/thread
- "dtex" or decitex is a measure of the mass in grams per 10000m of yarn (1 dtex = 1g/10000m)
  - Generally reflects the thickness of the yarn



Nuances of the Textile Example

"1kg of woven polyester fabric made from 55 dtex yarn on an air jet loom"

- Uses jets of compressed air to guide the thread through the shed

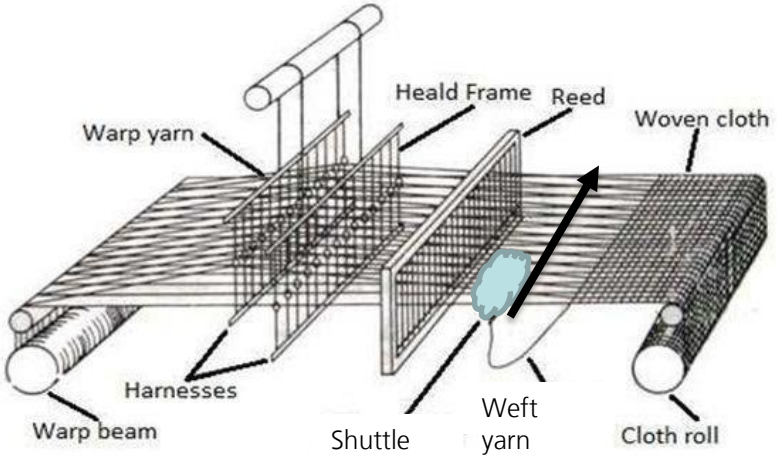


Figure: Basic structure of a loom

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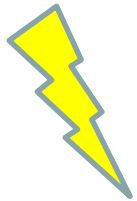
Nuances of the Textile Example: Bringing them Together

- So what actually influences the GWP results?



- required to compress air needed to guide/push thread
- required to operate reed, held frames, etc.
- required to operate AC units to cool machinery

- requirements controlled by <u>machine operating time</u>

Nuances of the Textile Example: Bringing them Together

- What controls machine operating time?

Kg fabric produced OR thread dtex?

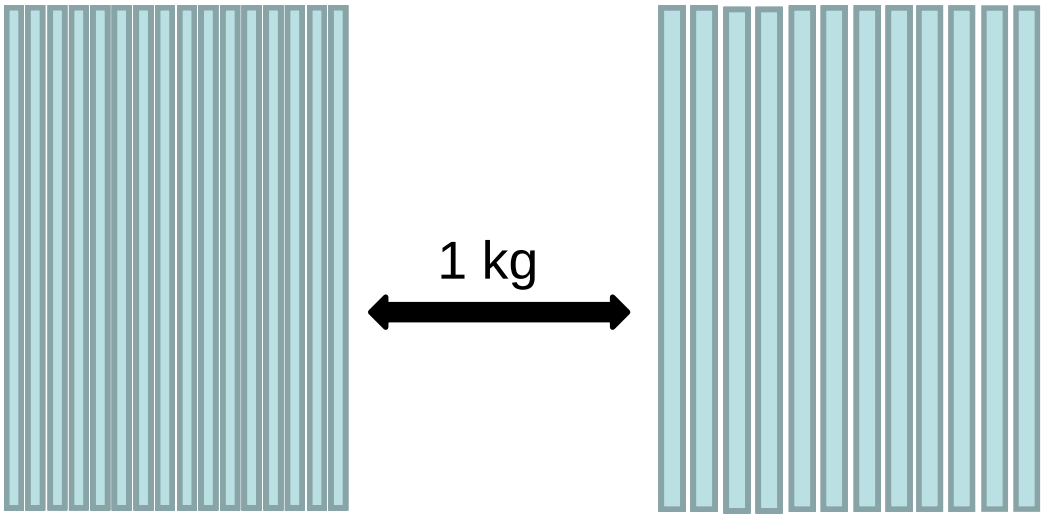
1 kg of fabric made with a thread of a high dtex requires far fewer passes of the thread than 1 kg of fabric made with a thread of a low dtex

Nuances of the Textile Example: Bringing them Together

Example:

Low dtex: 16 passes

High dtex: 12 passes



The number of passes required to produce 1kg fabric is controlled by the dtex of the thread; therefore, the machine operating time is directly related to the dtex of the thread

Other Important Nuances of the Textile Example

- Different types of looms have different energy requirements
  - Water jet, shuttle loom, rapier loom

- Recycled vs primary threads
  - Recycled threads are “hairier,” thus requiring less compressed air to guide them through the shed
  - Similar difference for filament thread vs spun thread

Lack of Data can Hinder Accurate Results

- Only three studies were found that address (or even mention!) dtex in weaving processes
- Nearly all studies before 2014 neglect dtex
  - Studies that do include dtex have very few datapoints
- Knowledge of processes is not very useful without data

Takeaways

- Many processes may seem linearly scaled at first, even if they aren’t
- Production processes should always be examined to determine scaling/allocation procedure
- Previous LCAs might overlook important nuances of production processes, requiring analysis of previous techniques
- Small changes in approaches to modelling can have big effects on results

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Thank You