

# Twenty Years in the Making: a Review the 20<sup>th</sup> Umberto User Workshop



A 20<sup>th</sup> anniversary is often a marked event, so it was fitting that this year's Umberto User Workshop was held in Heidelberg, the same venue as the first user meeting back in 1996; same room, same company, but with more developed perspectives.

More than forty participants gathered in the city's idyllic hilltops, overlooking the Neckar river valley, for the two-day workshop event. It provided a prime opportunity to share experience and expertise on the diverse applications of the Umberto software tools across industry, research and consulting projects alike.

With four people still present from the event's first meeting two decades ago, it was a unique opportunity to reflect on the software's beginnings and development over the past twenty years. The Umberto tool was founded as the extension of a research project thesis and launched as a first version in 1994, with the intended application to perform corporate eco balances. By the first workshop in 1996, an improved Umberto 2.0 version had been created. It's interesting to reflect on what has changed, as well as what's remained the same since then. The Umberto tool functionalities, features and interface have undergone considerable developments with the launch of each new version. Despite the progression of Umberto's capabilities, it was interesting to discover that the software's first clients were equally as diverse as they are today; a varied user base of institutes, academia, consultants and industry has defined the development challenge of catering to such diverse requirements.

Challenge does, however, present the opportunity to design something unique—a platform from which the possible applications are boundless. The diversity of presented uses at this year's Umberto User Workshop was a testament to that. With a nearly equal split in attendees from institutes, academia, consultancy and industrial backgrounds, the presentations and discussions provided the opportunity for all to gain an insight into the work being done in areas they're often not exposed to in their day-to-day work.



Industry representatives ranged from large to small, and covered a host of sectors:

- The workshop kicked off with a presentation on the application of Umberto for **Miele**, one of the leading manufacturers for washing machines, vacuum cleaners and kitchen appliances. Miele received the award for “best company brand” in the best brand ranking 2015 for German brands. The company uses life-cycle analysis (LCA) models to assess the efficiency of its processes and products and the environmental benefits of making durable products, as well as analysing the most sustainable material mixes to use in its appliances.
- **Charoen Pokphand Foods (CPF)**, Thailand’s largest food-based company (who make almost entirely animal-based products) have been applying Umberto life-cycle analysis models to their production systems to assess their supply chain efficiencies and corporate footprint. With a growing number of environmental reporting and assessment standards to consider, the company has been looking to distil their analysis to a single metric basis.
- With a slogan of “creating chemistry for a sustainable future”, it’s not hard to see how the Umberto analysis tools could be a major asset to **BASF**, one of the world’s largest chemical producers. A representative from the company discussed how BASF have been applying Umberto models and emissions visualisation to assess the most efficient

methods of hydrogen production from methane conversion. Analysis work with the Umberto tools revealed how cost-competitive hydrogen could be produced with a 50% emissions reduction on current leading methods of methane pyrolysis.

- **Volkswagen** has been applying material and energy flow accounting tools to their automotive coating factory processes in order to enhance their resource efficiency. Umberto tools have allowed the company to assess the emissions as well as water efficiency of competing process options through their full coating production chains. The team has also developed an add-on user-friendly interface to allow the appropriate staff members to alter the dynamics of the underlying model without an intricate understanding of the Umberto packages.
- It's a staggering statistic that 90-95% of German companies are unaware of their main energy and material flows. **Energy Consulting Allgäu**, a local German consulting firm, presented their results on how it has been applying Umberto tools to help companies evaluate their energy and material streams, and identify priority efficiency potentials.

The workshop also provided an eclectic mix of how Umberto has been applied by institutes and academics for the analysis of new systems, processes and products on the horizon:

- The transition from liquid fuel to electric vehicles represents one of the most defining developments in the transport sector. With approximately 50% of an electric car's emissions coming from its battery, assessing **the LCA impacts and costs of its battery cells** is a crucial task in modelling energy and material flows. The interdependencies of cell material changes on process steps far up and downstream makes LCA modelling a complex and intricate task; the **Battery Lab Factory Braunschweig** has been working within industrial collaboration projects with Umberto modelling tools to capture such complexity.
- As the market for electric vehicles grows in the coming decades, the issue of battery waste disposal represents an important issue. Globally, we will end up with an enormous stock of end-of-life waste on replacement vehicles. **Lithium ion battery** electrolyte material represents a key hazard in recycling due to its flammability and high voltage. Despite the energy intensity of the recycling process, however, it does represent a significant opportunity for material recovery. So is it better to recycle with or without electrolyte extraction? The Umberto LCA tools were applied to answer this question—results showed that CO<sub>2</sub> emissions were reduced in recycling versus conventional end-of-life processes, and optimised extraction methods resulted in an even greater saving.
- For anyone with experience in product LCA, the importance of supply chain interdependencies is obvious; most production chains are influenced by processes both up and downstream. A key question is how to collaboratively manage impacts with other companies in the supply chain. **MEMAN**, an EU-wide project consisting of 13 official (and additional associate partners) collaborators has been working to develop new business models for management of impacts over the full value chain in the metal mechanic sector. The project has been applying the Umberto analysis tools to measure material flow across all clusters in the production process, identifying improvement measures, then re-assessing the effects after optimisation. Applying such analysis on an EU-wide scale is a logistical challenge, but highlights the need for a more holistic, collaborative approach to LCA if substantial gains in resource efficiency are to be realised.

- Conventional wastewater treatment processes can be energy-intensive due to the need for aeration and circulation. Methanol can act as an effective energy storage medium to aid the balance of intermittent renewable energy production, but traditional production processes are also CO<sub>2</sub> and cost-intensive. The **BioMethanol** research project has attempted to address both of these issues through the sustainable synthesis of methanol from wastewater. Using Umberto material flow tools, the potential for alternative processing methods are being assessed to determine the most optimal solution to maximise efficiency and cost gains.
- It's often assumed (and is promoted by the EU's waste hierarchy treatment scheme) that material and energy recovery from **pre-treatment of landfill waste** is the best way to reduce waste emissions; but is this always the case? Pre-treatment processing and separation is often energy-intensive. Analysis from Umberto material flow modelling has shown that the benefits from pre-treatment are very much dependent on both the waste composition and national energy mix—intensive recycling doesn't always make sense for emissions.
- Material flow analysis doesn't have to be limited to the product, or even company-scale; results from the Rapid Planning Project for **future megacities** was demonstrative of that. The ongoing 12 partner project funded by the European Commission and Federal Ministry for Education and Research has been assessing the application of material flow networks using Umberto tools in order to find optimal transsectoral solutions for better building, energy, waste and water planning in rapidly growing megacities. This research could particularly be valuable given the current and expected rates of urban migration—keeping up with the related infrastructure demand is going to be a pressing challenge.

Beyond the specific applications of the Umberto software packages, the workshop also had much to offer in terms of highlighting the key international developments in resource efficiency, as well as progress in the software tools themselves:

- When did companies start to become interested in **resource efficiency** and how has it been framed as an **international issue**? Dr. Mario Schmidt provided an interesting overview of the relationship of efficiency to raw material price and volatility. Now a key international political issue, its link to economic metrics has led to the omission of non-raw materials from resource efficiency considerations. The ProgRes project has been trying to incorporate resources such as water, land and biodiversity into VDI standards to avoid the burden-shifting from one resource pressure to another.
- ifu Hamburg's Martina Prox delivered an interesting showcase of the **international developments in Material Flow Cost Accounting (MFCA)**. In addition to its largest uptake in Japan, MFCA application and training has been expanding across the rest of Asia in recent years, with serious interest in production hubs such as India, Malaysia, Vietnam, Thailand and the Philippines. The development of a new international standard, ISO 14052, attempts to implement MFCA across the full supply chain with a hope of promoting cooperative improvements between up and downstream companies for shared benefit.



- A common theme throughout the workshop’s presentations was the highlighted issue of data availability; without credible, relevant data any modelling application becomes obsolete. Representatives from **ecoinvent**, the Umberto plug-in LCA database provided an overview of the features available in their current 3.1 database version, and provided information on what to expect from the latest version, 3.2, due for launch later this year.
- ifu Hamburg’s Dr. Nicolas Denz provided an overview of how the Umberto NXT package has been used as part of the InReff collaboration project for application in process engineering. The Umberto package has been core to the development of integrated resource efficiency analysis (with specific process and heat integration plug-ins) for efficiency enhancement in the chemical engineering industry.
- ifu Hamburg’s CEO, Jan Hedemann, rounded off the two-day session with some tips and tricks on how Umberto NXT features could be used to facilitate more efficient and effective applications by users and companies for optimised resource efficiency.

Now in its 10<sup>th</sup> year, the Umberto Student Award is one of the highlights of the annual user workshop. The award offers a great opportunity to showcase how skilled students, in addition to industry professionals, can use the Umberto software tools to undertake valuable studies as part of their university thesis projects. In parallel with the other presentations of the workshop, the different scalability of the Umberto application in the three finalists’ projects highlighted the broad potential of resource efficiency analysis. Third-placed **Christian Kunisch** (Hochschule für Technik und Wirtschaft Berlin) presented his project on how the application of material flow analysis identified key material and cost saving potentials in an SME working in the vehicle painting industry. In the final vote, **Vikrant Bhakar** (Birla Institute of Technology and Science) and **Anne-Sophie Fölster** (Technische Universität Braunschweig) were awarded joint winners of this year’s Student Award. Vikrant presented his full carbon footprint analysis of his university campus, with benchmarking comparison to other Indian as well as international university campuses.

On a much broader scale, Anne-Sophie presented her study on the positive emissions and energy consumption analysis of refrigerator recycling in Brazil, scaled as a national level analysis.



The primary concept and vision for Umberto is largely unchanged from the first user meeting twenty years ago. However, if anything, this year's 20<sup>th</sup> User Workshop was a showcase of how the functionality, scalability and application of the software has evolved beyond recognition since its launch in the 1990's. A 20<sup>th</sup> anniversary is cause to celebrate; Umberto's success in the interim made this year's celebration even more necessary.