

CONCEPTUAL MODELLING IN EDUCATION

WITH THE *bee-up* TOOL

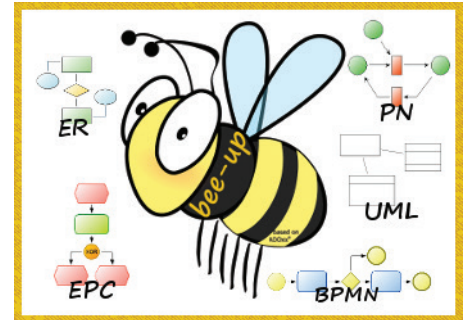
<https://bee-up.omilab.org/>



Modelling Languages with *bee-up*

Bee-Up is a hybrid modelling tool, that incorporates and extends several modelling languages:

- *b*PMN - Business Process Model and Notation
- *e*PC - Event-driven Process Chains
- *e*R - Entity Relationship Diagrams
- *u*ML - Unified Modeling Language
- *p*etri Nets



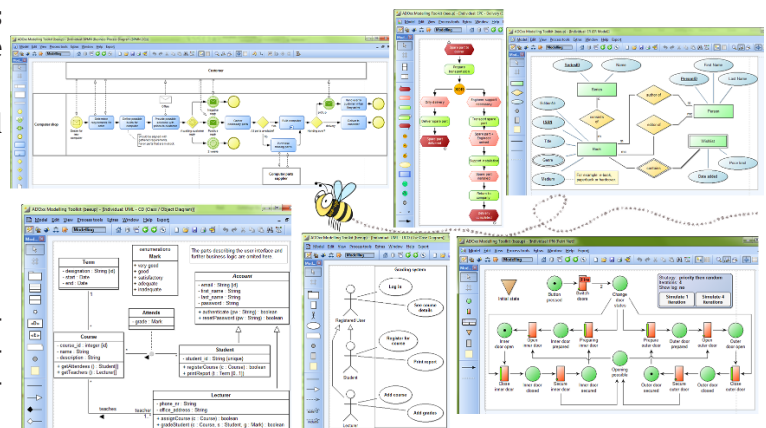
Additional modelling languages are also available in Bee-Up like the Decision Model and Notation (**DMN**) or **Flowcharts**. Bee-Up supports a hybrid approach when solving a problem. It provides a set of different types of models and tools that can be employed according to the requirements of the task at hand.

Model-Design with *bee-up*

With Bee-Up it is possible to represent various systems from diverse domains as conceptual models. Some of the tasks supported by the Bee-Up tool are:

- Creation, modification, and management of conceptual models
- Processing of conceptual models
- Interaction with cyber-physical environments
- Control through voice communication

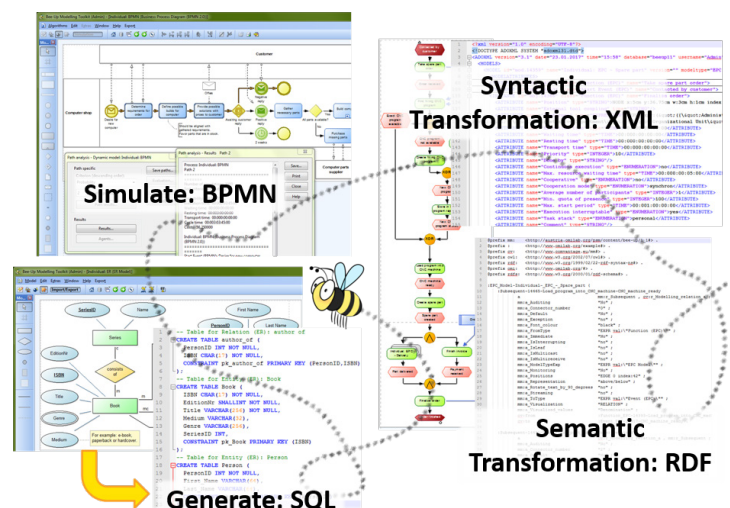
Bee-Up is implemented using the open ADOxx metamodeling platform (www.adoxx.org), whose meta²- and meta-model are applied to provide a tool incorporating the different modelling languages.



Model-Processing with *bee-up*

Bee-Up enables model-driven value creation by extending the processing capabilities of the ADOxx platform with additional mechanisms and algorithms which are made available through the modelling tool, programmed as extensions on top of ADOxx. To name a few of the available capabilities:

- A uniform simulation of process models like path analysis and capacity analysis.
- Analysis of Petri Nets through manual or automatic execution of Transitions.
- Generation of SQL-Create statements from an Entity-Relationship model.
- Inspection of any model using the ADOxx Query Language (AQL) to answer specific questions.
- Export of models in different formats (XML, RDF, ...) and generation of graphics depicting the model (JPG, PNG ...).
- Plug-in mechanism to add own model-processing functionalities.



Download *bee-up* at: <https://bee-up.omilab.org/>



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The “IMKER” Case Study

Use *bee-up* for Modelling

The “IMKER” case study uses the domain of beekeeping to provide a setting for the design of different systems using Bee-Up. Among these are the following:

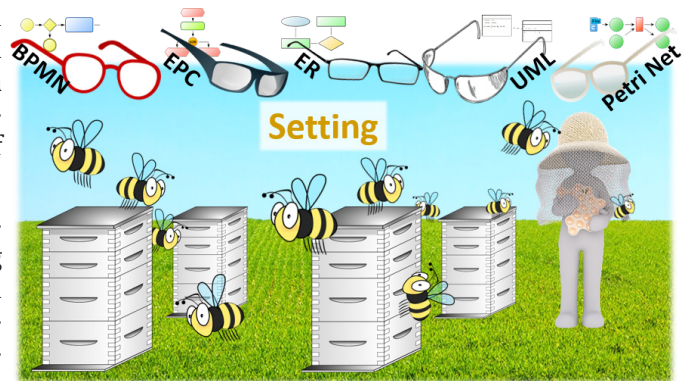
A commercial beekeeper thinks to revise their business model by describing and analyzing it as business processes. These can be modelled using the **Business Process Model and Notation** (BPMN), which allows describing individual or collaborative processes. BPMN adds domain-specificity through its richness of types and visualizations of different concepts.

A company employing several beekeepers aims to better manage its resources by introducing an Enterprise Resource Planning (ERP) system. One approach for customizing an ERP system can use **Event-driven Process Chains** (EPC) for process management, where also parts from the enterprise context (e.g. organizational units) can be depicted.

A beekeeper, currently selling their goods in local shops, wants to reach a wider range of customers through an e-shop. To offer a maintainable solution a proper data structure is required. These can be designed using **Entity Relationship** models (ER), which also allows describing data structures other than relational databases.

A new start-up enterprise wants to introduce “smart factory” practices into beekeeping, like automated harvesting and maintenance of beehives. To describe and design specific scenarios with their different aspects a modelling language like the **Unified Modeling Language** (UML) with its multitude of diagram types can be used.

An enterprise focusing on the production of different bee-related products wants to examine their production processes according to the idea of “Green Production”. In this setting **Petri Nets** can be used for modelling and analyzing the processes using its minimal but powerful semantics based on mathematical foundations.

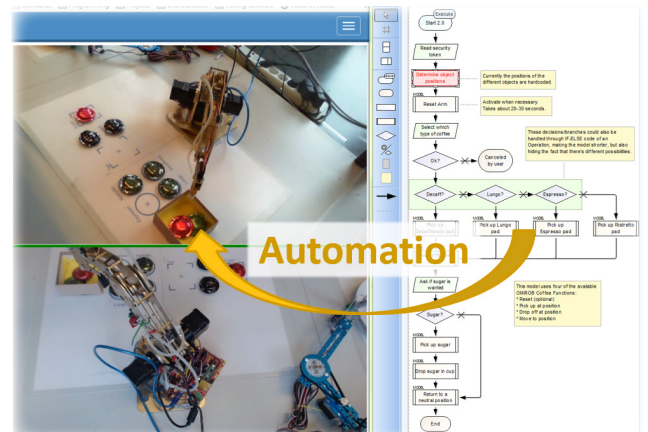


Apply *bee-up* in Scenarios

The “IMKER” case study also provides a scenario for the application of models together with **cyber-physical environments**. One such application would be the automated packaging of honey jars during the shipping process.

The Bee-Up tool provides means to access and manipulate systems outside of itself. Based on the designed models, it supports HTTP calls to systems that embed physically-aware cyber parts from the cloud into the physical world. Likewise, the visual expressiveness of models can be combined with the automated processing of data, information, and formal knowledge of physical devices, networks, services, and so on.

This feature is demonstrated by scenarios in which the Bee-Up tool is used to interact with systems in cyber-physical environments. The scenario of controlling a robot arm to place honey jars in a package can be modelled in Bee-Up using Petri Nets or flowcharts, with code deposited in the transitions / operations. The relevant functionalities can also be described and assembled through several layers of abstraction.



A robotic arm is available as part of the OMiLAB Digital Innovation Environment (DiEn) and its functionalities can be accessed through RESTful services.

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