

# Research question decomposition: a way to organise research output

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Food research is performed in multidisciplinary projects, generating a wide variety of data. It appears that often this output is unavailable for reuse in new projects. As a consequence, experimental work and analysis of results are repeated unnecessarily. This not only leads to inefficient use of resources, but even worse hinders the learning cycle that is essential to research activities. For example, sensory panel experiments usually measure sensory attributes other than strictly necessary within a specific project. However, accessing and re-interpreting the raw data is not common.

The aim of this project is to develop an interactive method and tool for sharing and reusing experimental data, models and methods. The ultimate goal is to have a fully transparent knowledge chain, from fundamental to applied research and finally to application in food industry.

## Conceptual design

A number of workshops and meetings with researchers have resulted in a global specification of the envisaged research management system. It appeared that a commercial LIMS (Laboratory Information Management System) or project management system would not comply with these requirements. These systems typically require fixed, static working procedures and focus either on samples or on projects as their primary entities. In the context of scientific food research a much more flexible approach is required.

The crucial breakthrough was the observation that the key concept for organising research data and models is the *research question*, rather than *project* or *sample*. At the start of a project a general research question is formulated to define the goal of the project. This research question is then decomposed into more detailed research questions, based on new hypotheses and assumptions. This process is repeated until research questions are at such a concrete level that either (1) experiments, or (2) models can be defined and executed to answer the respective research question. The answers of all sub-questions will then be combined to answer the higher level question, and so on, ideally until a satisfactory answer is found at the highest level. By associating the experiments and models with research questions they will be tractable, even after the project is closed. In other words, data and models have been enriched with context information.

## Research Management System

We have implemented this approach in RMS, Research Management System. First of all, it allows researchers to access research output from any location, using a standard web browser. Second, it puts data and models in a context, by describing experimental conditions, sample preparation protocols, parameter sets, methods and devices, etc. Finally, RMS employs research question decomposition to organise data and models as described above.

Presently we are gaining experience with the organisational aspects of data sharing, using RMS. At present some hundreds of experiments have been contributed. In this phase, we had additional resources to have researchers enter and annotate the data. This can be a quite cumbersome task, in particular if a project is not well documented and if no publications are available. For new projects, we propose to plan a specific activity (and responsibility) for archiving results in RMS.

## Conclusion

We believe that the way in which RMS has been organised, it will offer unexpected opportunities to increase research efficiency. The framework already stimulates scientists to analyse their research questions and to plan experiments in more detail, also considering already available data. In future, we intend to provide direct access to data analysis methods and reusable (sub) models. Although RMS is all about sharing of information, some kind of authorisation and security policy is required as well. Finally, the next version of RMS will use *ontologies* to define the semantics of the information contained by it.