

## BACKGROUND

The purpose of the RWTH centralized Biomaterial Bank (RWTH cBMB) is the cryopreservation of biomaterial samples and association of medically relevant data to them. Providing this information for researchers is a crucial task of a biobank. Consequently, the demand for a flexible tool facilitating the interaction of biomaterial requesters with biobank is high.

## AIM

A software tool assisting all participants of a biomaterial request and replacing former paper based workflows needs to fulfill some requirements:

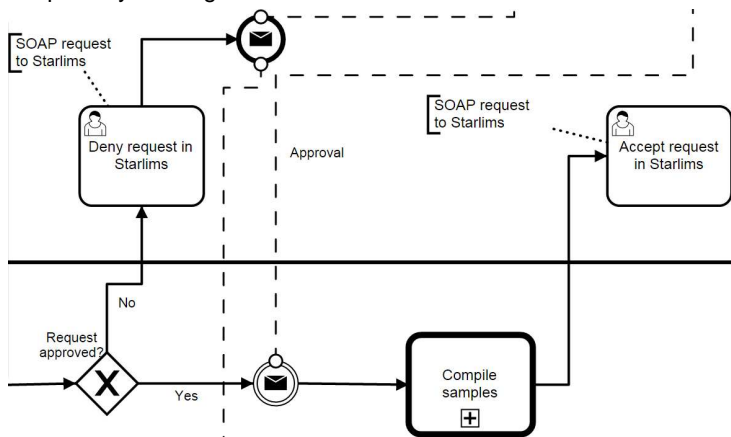
Since the material request process may become complex and is subject to change, the material request software tool must be flexible and easily maintainable.

Another requirement is the reliable communication between request tool and the LIMS (Laboratory Information Management System). Requested samples must be locked in the LIMS to prevent accidental disposal or release to another client. If a request is denied, corresponding locked samples need to be unlocked for future use.

The interface for this interaction between request tool and LIMS must be extendible, proven and tested.

## METHODS

In order to automate sample requests processing at RWTH cBMB, a web-based portal has been developed. It provides a flexible interface enabling researchers to submit requests for specific biomaterials. The portal then helps to process requests at different organizational levels at RWTH cBMB, thus passing all stages of assessment and approval. For this, workflows for sample requests and approval at all biobank levels have been formalized and modeled using BPMN (Business Process Model and Notation). BPMN is a state-machine-like modeling language, with the states being tasks to be performed either by humans or by machines. A dedicated process engine tracks the progress of each request according to the formalized model. The engine validates each state transition against the business model to prevent deviation from the intended workflow. A process ID is assigned to each biomaterial request by the engine.



**Fig. 1: Extract from the request tool's BPMN-diagram.** In this extract there are two tasks, which trigger communication with the LIMS. If the biomaterial request is denied, the locked samples are made available again. If it is approved, the locked samples are marked for delivery.

The communication itself is not modeled in BPMN, since technical implementations are not covered by the modeling language.

## RESULTS

One of the central tasks in sample request processing includes search for suitable samples and check of their availability and status in biobank. Our laboratory staff traditionally performs this task in the laboratory information management system Starlims. Additional sample query is performed using different data sources such as the data warehouse returning Excel tables of sample candidates, which can be imported into the RWTH cBMB request portal. Both ways of data retrieval need to be synchronized.

Therefore a SOAP (Simple Object Access Protocol) based interface between the request portal and Starlims has been developed. SOAP is a widely used XML-based network protocol allowing a standardized way to exchange data over the network. The information on the XML format can be obtained from the Starlims instance via WSDL (Web Services Description Language).

The interface provides authorized users with access to information on biomaterials such as sample availability, material and status in the request portal. Information on running requests has also been made available in Starlims by a dedicated interface. It presents an overview of the requests and provides transactions to manage samples within request before its completion. The laboratory users are thus informed about the demanded biomaterials.

The communication is always initiated from the request tool. Starlims remains passive and receives SOAP requests on demand.

The most important implemented operations are the following:

**AddRequest (processID, requesterName, requesterMail, [...]):** Adds a new biomaterial request from the process engine to the database of Starlims. The process ID represents a single material request process and is needed to re-identify it on subsequent queries. The following parameters contain information on the request itself and are just for informational purposes for the Starlims user.

**StoreSamples (processID, sampleIDs, deletePreviousSamples):** Adds a list of samples (sampleIDs) to a request (processID). "deletePreviousSamples" can be "true" or "false" and determines, whether the sample list of this request is to be replaced or appended.

**SetRequestStatus (processID, status):** Alters the state of a biomaterial request. If for example the status is set to "approved" the lab staff can actively search for approved requests and start to collect the samples from the biobank.

**GetSamplesForRequest (processID):** This operation delivers a list of samples for a specific biomaterial request. This is important for the request tool, since it does only memorize, that a request exists, but not, what samples have been picked for it.

**DeleteSamplesFromOtherRequests (processID):** This operation is triggered when a request is accepted (see fig. 1). All samples from the request belonging to the process ID are removed from other requests to prevent double assignment.

## CONCLUSIONS

The described solution offers sample query interface in the currently developed RWTH cBMB portal. It helps to retrieve organizational data on biomaterials from the LIMS, thus facilitating search for the requested samples in the portal. Process automation using Business Process Modeling helps to increase process transparency, reduce costs and improve quality through elimination of manual tasks and possible errors.