SOURCE™

Software Outreach and Redefinition to Collect E-data Through MOTUS

Towards a Modular Online Time Use Survey

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Reader's guide through the document

Start with the **main document** to get a **comprehensive overview** of the entire project or go the **overall summary and recommendations** (hbits.12) for the highlights.

If you would like to know more about the **system documentation of MOTUS**, go to hbits.1 (System documentation of MOTUS).

If you would like to see how you could **map your own NSI's data collection architecture**, you can have a look at Statbel.1 (Data collection architecture Belgium) and Destatis.1 (Data collection architecture Germany), as well as Statbel.3 (Description of e-HBS in Belgium) and Destatis.3 (Description of e-HBS & TUS in Germany). Statbel.3 and Destatis.3 are combined in a separate document. The documentation of Statbel.1 and Destatis.1 are necessary to describe the **conditions for encapsulation of MOTUS** (hbits.3) and to prepare hbits.5 (Inventory of MOTUS towards e-HBS) and hbits.6 (Critical developments of TUS & HBS towards MOTUS).

If you want to know how to **setup a pilot test with MOTUS** in your own country, take a look at hbits.4 (Prototype e-diary TUS), Statbel.4 (New ways of invitation techniques) hbits.8 (Testing of the e-diary TUS), hbits.10 (Pilot test in Belgium) and Statbel.5 (Coordination of pilot test in Belgium). These documents describe the process a country needs to go through when one wants to prepare a pilot test.

After the pilot test, the **results can be distributed** in a number of possible ways, with the most recent development a Rcran package, including an automatic cleaning and dissemination of first results (hbits.11).

The default language of MOTUS was English for the test study but the default language can be defined at the beginning of the construction of a research. So if you only have a study in German it is no problem at all. Before a **pilot test** can take place **in a country's own language**, **translation support** is needed for the following documents:

- Activity Coding List (847218_BE_final report_Activity_List_ENG)
- Household questionnaire (847218_BE_final report_Household_Questionnaire_ENG)
- Individual questionnaire (847218_BE_final report_Individual_Questionnaire_ENG)
- End questionnaire (847218_BE_final report_End_Questionnaire_ENG)

The four documents mentioned above are all based on the HETUS-guidelines.

- Communication flow
  (as a direct consequence of Statbel.4: 847218_BE_final report_Communication_Flow_ENG)

If you want to **evaluate the use of MOTUS within your own country**, additionally the following needs to be translated:

- Evaluation questionnaire (847218_BE_final report_Evaluation_Questionnaire_ENG)

Once all the documents are translated, you can provide a **user guide of MOTUS** (hbits.3), which consists of a user guide **for the respondents** (front-office) and a user guide **for the NSI/researcher** setting up the survey (back-office), where all the possibilities of MOTUS are explained.

Additionally, the possibility of incorporating **speech recognition** (hbits.9) into MOTUS and the **governance of MOTUS** (hbits.7) are delivered is separate documents.

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List of acronyms and definitions

Acronym	Explanation
ACL	Activity Code List (used in TUS)
ACL	Activity Coding List
AP	Administration Program (Software for all administration processes within RSIs and the NSI)
BPMN	Business Process Model and Notations
BSI	Bundesamt für Sicherheit in der Informationstechnik (Federal Office for Information Security)
DAP	Data Acquisition Program (Software that processes survey data of households, paper and mobile app data)
ESS	European Statistical System
Eurostat	European Statistics
EVS	Einkommens- und Verbrauchsstichprobe (German HBS)
GDPR	General Data Protection Regulation
GSIM	Generic Statistical Information Model
GSPBM	Generic Statistical Business Process Model
HBS	Household Budget Survey
IoT	Internet of Things
LFS	Labor Force Survey
LWR	Laufende Wirtschaftsrechnung (yearly conducted study, similar to EVS, smaller sample size)
MOTUS	Modular Online Time Use Survey
NGO	Non-Governmental Organization
NSI	National Statistical Institute
RSI	Regional Statistical Institute (in Germany 14 regional offices)
SOURCETM	Software Outreach and Redefinition to Collect E-data Through MOTUS
Statbel	Statistics Belgium
TOR	Tempus Omnia Revelat (Time reveals everything)
TUD	Time Use Diary
TUS	Time Use Survey
UNSD	United Nations Statistical Division
UUID	Universally Unique Identifier
WP	Work Package
ZVE	Zeitverwendungserhebung (German TUS)

Definition	Explanation
Allgemeine Angaben	Sociodemographic data incl. income
Geld- und Sachvermögen	Monetary and tangible assets

Introduction

The general goal of the SOURCE™-project is to get to know more about MOTUS. The coordinator of this project is Statbel, the Belgian statistical office and the beneficiary is Destatis (Statistisches Bundesamt), the German statistical office. The project specified the appointment of a subcontractor. As a subcontractor the company hbits CV[1] as a Spin-Off of the Vrije Universiteit Brussel (Belgium) was appointed after a tender procedure.

The MOTUS software platform is since 2012 in continuous development by the Research Group TOR (Tempus Omnia Revelat)[2] in response to a general trend in which the combination of high processing costs and on-going cuts in research funding jeopardizes the future of time-use research and other dairy-based surveys. With MOTUS, not only the costs should be lowered, other aspects that need to be tackled are lower response burden and more quality, flexibility, modularity, usability and shareability.

In doing so, MOTUS supports the respondents to provide highly qualitative input, but also enforces the researchers to setup innovative studies and to reuse acquainted knowledge. It is particularly powerful in the collection of people's behaviour within a temporal, spatial and social context. To arrive to this state, MOTUS in continuously in development. Over this development trajectory developments will shift away from an active participation-focus to a more passive participation-focus in which less effort is needed from the respondent and more accurate information in gained without losing the essential interaction with the respondent.

The goal of this consortiums project is to retrieve detailed knowledge on how MOTUS could fit into the data-collection environment of Statbel and Destatis, and so (/later) maybe can be shared and reused in multiple countries in a flexible and qualitative way.

In a nutshell, the more specific goals of the SOURCE™-proposal are:

(1) Software Outreach
(2) Redefinition of flows and
(3) Collect
(4) E-data

through MOTUS.

The MOTUS-software is now fully documented using the CSPA recommendations and related templates, and the feasibility of its approach is evaluated against the context of Statbel and Destatis, including a directive pilot test in several European countries, consisting of the task force and working group members of the time use survey (TUS) and household budget survey (HBS).

The cooperation of Statbel and Destatis in this project and the practical experiences with MOTUS as a collection tool will generalize the knowledge over how MOTUS can be used by other countries as well, and so could become ESS-shareable in the future.

[1] https://www.hbits.io/en/
[2] https://www.vub.be/TOR/

Collaboration between Research Group TOR, Statbel & Destatis

In 1982 the Research Group TOR (or Tempus Omnia Revelat; Time Reveals Everything) was established. TOR is a research group of the Vrije Universiteit Brussel, Belgium. The vision of the research group was to study the use of time within small and large scale populations. In doing so, the Research Group TOR designed his own paper-and-pencil time diary. Two small scale time use studies were executed in 1984 and 1988, followed by two population representative studies in 1999 and 2004.

At that same time Statistics Belgium adopted the HETUS-guidelines to collect time use data. Belgium was in 1999 one of the first European countries to collect time diary information following the HETUS-guidelines. The study was repeated in 2005 and 2013. At every collection round the research group TOR was an advising partner in the collection and valorization of the data. Together with Statistics Belgium the Research Group TOR also valorizes the collected time-use data.

The Research Group TOR and Statistics Belgium continue their partnership by sharing their knowledge on innovative tools to collect time use data. The Research Group TOR developed, and continually keeps on developing, the MOTUS-software platform to collect time use data via online connected devices. TOR and Statistics Belgium had a partnership in a HERCULES-funding to establish and test the MOTUS-software platform. Comparisons were made based on a mixed mode data collection online/web-based study in 2013 with two different ad random selected samples.

The MOTUS-software has been through more development cycles afterwards. The Research Group TOR used the MOTUS-software extensively to collect data within small, medium and large scale sized studies. An example of a large data collection is the 7-day time diary for nearly 10.000 teachers in Flanders on behalf of the Ministry of Education. In 2019 the first data collection using passive data input via sensors was realized. Other studies can be found online[1].Today, MOTUS finished its fifth development cycle, the sixth is on the design table.

Information exchange between TOR and Statistics Belgium takes place on regular basis, and TOR also presents its work together with Statistics Belgium in the Work Group and Task Force meetings TUS in Eurostat. In 2021 MOTUS is also going to be used to collect time use data on the national level.

As is the case in most European countries, also Germany is confronted with a decline in the willingness of households to participate in diary-supported household surveys. Considering the ever greater lack of willingness to participate on extremely time-consuming diary-based surveys, and in conjunction with the increasing digitalisation, the further development of IT-tools for diary-supported surveys (such as HBS (household budget survey) and TUS (time use survey)) is absolutely imperative.

At present, the data collection tools for diary-supported household surveys in Germany still exclusively or mainly comprise paper-based records. That means, that in Germany there is an urgent need for a modern IT-tool, in order to be able to fulfil the mandate to deliver highly qualitative data regarding HBS and TUS in future.

The initial starting point of contact to VUB and the MOTUS-software was the TF TUS at Eurostat, where the software was presented. Seeming to be a highly developed tool for TUS, that already showed a high degree of maturity and was tried and tested in field - Destatis expressed in July 2018 its interest for cooperation in order to prove if the MOTUS software could be an option for a modern IT-tool in the context of Germans HBS and TUS. The SOURCE™-project was the promising possibility for Destatis to get to know the MOTUS-software in a more detailed level and to check, whether German's requirements (e.g. functionalities TUS/HBS, encapsulation into Destatis' IT-architecture ...) could be fulfilled by the software.

[1] www.hbits.io

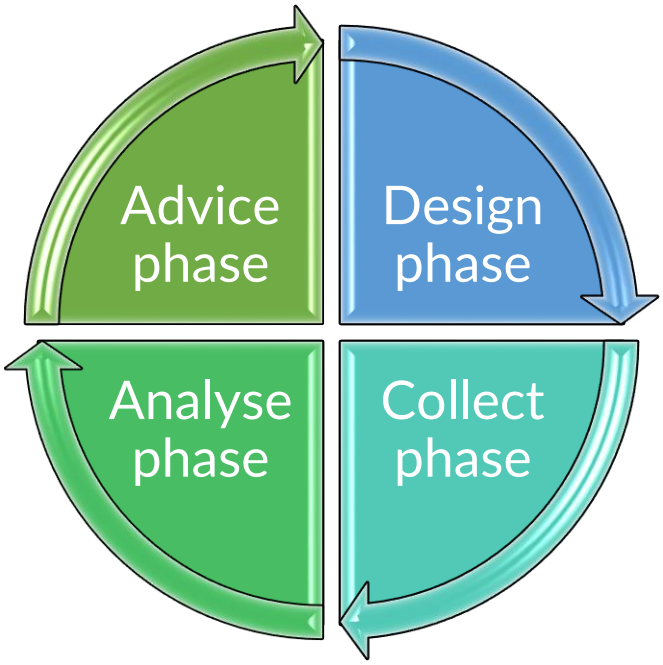
MOTUS – Modular Online Time Use Survey

MOTUS is a software platform developed by the Research Group TOR of the Vrije Universiteit Brussel (Belgium). Its primary aim is the online collection of diary based information. At its origin lies the collection of Time Use Survey (TUS) data. Time diary research tries to capture the actual behaviour (What people do) of people within its context (Why people do it).

MOTUS combines a back-office and a front-office. The back-office supports the researcher to collect and disseminate data. The front-office is available to the respondent to take part in the studies.

The back-office of MOTUS incorporates four phases.

Figure 1: DCAA-model



Each phase includes a number of builders available to the researcher to run a data collection. The use of builders supports MOTUS in its most powerful asset: modularity. It is the composition of the builders, and the choices being made within these builders that define the actual set up of a particular research. As such, MOTUS makes it possible to define multiple researches, that can run at the same time, even within the same respondent (for panel research purposes).

The respondent can make use of a web application that runs in a broad range of web browsers and a mobile application available for Android and iOS (see hbits.3: User Guide of MOTUS). All information is shared and synchronized. Information on respondents can also be attained from other data sources and from sensors that are connected with MOTUS. To support the data collection and the interaction between devices specific server capacities are implemented.

A first data collection took place in 2013. Since then MOTUS was further expanded, and more studies were executed through MOTUS. In 2019 the first data collection using passive data input via sensors was realized.

Due to the functional and technical setup of MOTUS other diary based surveys, like the Household Budget Survey (HBS) can also highly benefit from the business processes available in MOTUS.

Overview of work packages and deliverables

The aim of the project is to get detailed knowledge about MOTUS. This project started beginning of March 2019 and ended April 2020. The consortium partners defined a total of 5 work packages and 24 subtasks. The knowledge of each subtask is essential for both NSIs. Also, as both Statbel and Destatis are facing a change in the mode of data collection, the collaboration regarding to the possibilities of MOTUS makes it possible to have an in-depth discussion that will be helpful to other countries as well.

Table 1: Overview of work packages and subtasks

Number	Work package	Performer	Subtask
WP1	Software Outreach	hbits.1	System documentation MOTUS
		Statbel.1	Data collection architecture Belgium
		Destatis.1	Data collection architecture Germany
		hbits.2	Conditions for encapsulation MOTUS
		hbits.3	User Guide MOTUS
WP2	Redefinition	Statbel.2	Translation support Belgium
		Destatis.2	Translation support Germany
		hbits.4	Prototype e-diary TUS
		Statbel.3	Description e-HBS Belgium
		Destatis.3	Description e-HBS & TUS Germany
		hbits.5	Inventory MOTUS towards e-HBS
		hbits.6	Critical developments TUS & HBS MOTUS
WP3	Collect	Statbel.4	New ways of invitation techniques
		Destatis.4	User identifiers and sample design
		hbits.7	Governance model MOTUS
		hbits.8	Testing of the e-diary TUS
		hbits.9	Speech recognition as a new mode
WP4	E-data	hbits.10	Pilot test in Belgium
		Statbel.5	Coordination pilot test Belgium
		hbits.11	Dissemination of database and results
WP5	Overall management	Statbel.6	Overall IT Belgium
		Statbel.7	Follow-up Belgium
		Destatis.5	Follow-up Germany
		hbits.12	Overall summary and recommendations

In the further report, the deliverable from every subtask is described in detail. To make the report more comprehensive to read, some deliverables are described in the annexes, as their main goal was providing supporting documentation for the subcontractor (SC documents):

- Statbel.1: Data collection architecture Belgium
- Destatis.1: Data collection architecture Germany
- Statbel.2: Translation support Belgium
- Destatis.2: Translation support Germany
- Statbel.6: Overall IT Belgium
- Statbel.7: Follow-up Belgium
- Destatis.5: Follow-up Germany

Some deliverables are provided is separate reports, as they are more comprehensive as stand-alone documents:

- hbits.3: User Guide MOTUS
- Statbel.2 & Destatis.2: Translated documents Belgium & Germany
- Statbel.3 & Destatis.3: Description e-HBS & TUS Belgium & Germany
- hbits.7: Governance model MOTUS
- hbits.9: Speech recognition as a new mode

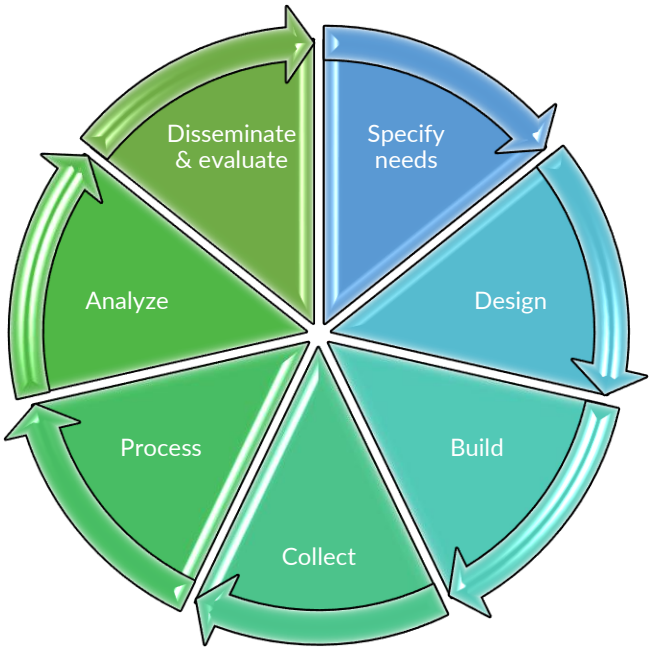
WP1 – Software Outreach

Overall goal	Sharing knowledge about MOTUS via CSPA compliant documentation and options to implement in other software architectures. This will support shareability of MOTUS in the ESS.

1.1 (hbits.1) System documentation of the MOTUS software

Deliverable	In order to make the software shareable, an unified description by means of the CSPA compliant documentation is necessary.

Figure 2: Rubrics of the system documentation of the MOTUS Software (description of the actions)

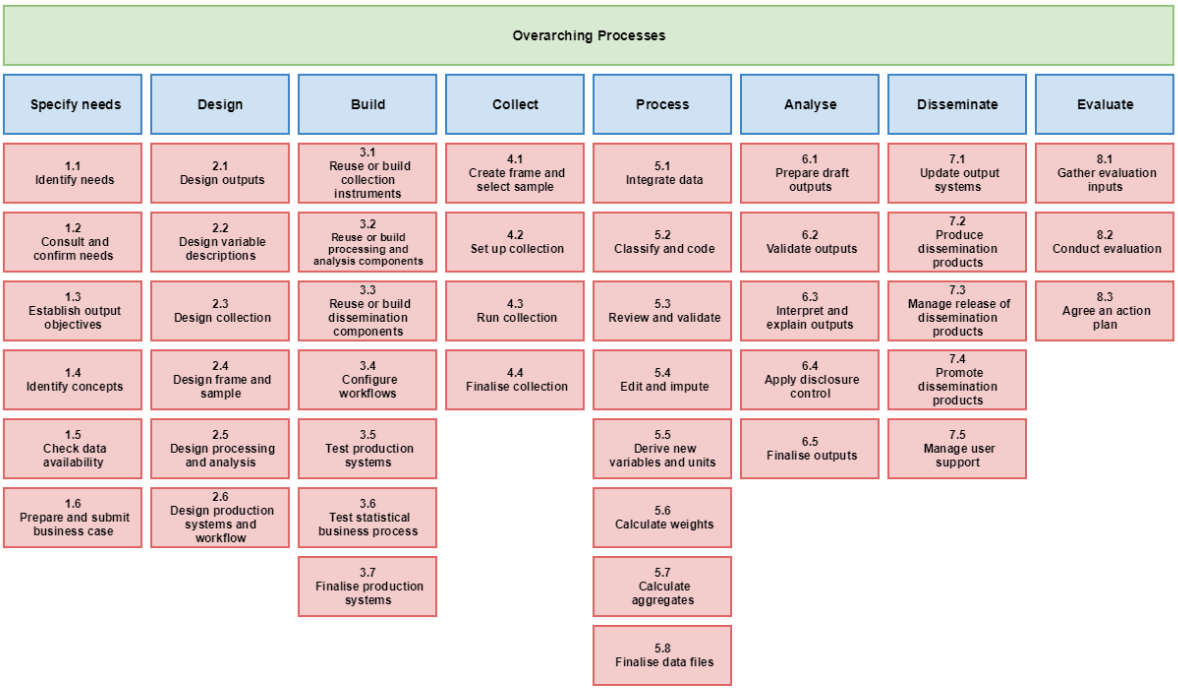


1.1.1 Short introduction to CSPA & GSBPM

CSPA, or the Common Statistical Production Architecture, is developed to be a reference architecture for the statistical industry. The goal is to share knowledge about the services and products that were developed within an organization. The CSPA covers the statistical production across the processes defined by the GSBPM.

The GSBPM stands for Generic Statistical Business Process Model and describes the statistics production in a general and process-oriented way. In this way it provides a standard framework using a harmonized terminology to outline the statistical processes and to define the services/products that provides a solution within one or more of the phases that are defined within the model.

Figure 3: Overview of the GSBPM process on levels 1 and 2



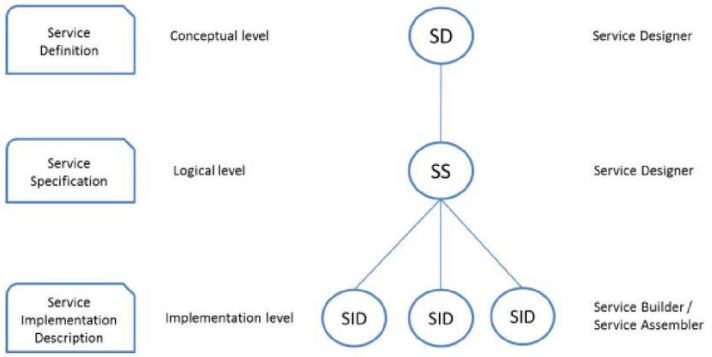
More information can be found online[1].

A statistical business process that is provided by a service or product is a collection of related and structured activities and tasks to convert input data into statistical information. To give a full description, a CSPA-specification holds three layers to the description of the service:

1. Service Definition – conceptual level overview of what the service is and what it does, understandable by users
2. Service Specification (SS) – logical level description of service capabilities, inputs and outputs
3. Service Implementation Description (SID) – physical level description of how to implement the service

Figure 4 puts the three layers in a graphical presentation:

Figure 4: Layers of CSPA-description



[1] https://statswiki.unece.org/display/GSBPM/GSBPM+v5.1

Within the scope of this document we describe the MOTUS-software platform. The goal is to arrive to a common infrastructure and services for Time Use Surveys. This document will describe the MOTUS software platform at his 'Definition' and 'Specification' level. No information is given on the physical implementation of the MOTUS-software platform (3rd level). However hbits.7 describes in total 4 possible architecture scenarios to let the MOTUS-software platform transcendent to an ESS-platform.

Also important to the reader of this document: the MOTUS platform is continuously in development. New functions are added, other functions improved. The status of this document is April, 2020. Also, due to the functional and technical setup of MOTUS also other diary based surveys, like the Household Budget Survey (HBS) can benefit from the business processes available in MOTUS. This evaluation is being documented in hbits.5.

1.1.2 MOTUS – Service Definition

In the phase of Service definition there are described the capabilities of a Statistical Service in terms of the GSBPM sub processes to which it relates to, the business function that it performs and the GSIM information objects which are the inputs and the outputs. To get a grip on the state-of-the-art in Europe, in relation to TUS and HBS, Eurostat organized a survey between the NSIs that collect Time Use Surveys and Household Budget Surveys.

Part of the survey was to define the expertise level of NSIs with these two types of surveys. Another part was to inventory practical information about the methodologies used to collect the time-use and consumption data. Particular attention went to the (possible) innovative tools and sources that were used to collect time and consumption relevant data. When An NSI has a relationship to another organization developing this kind of technology also that organization was invited to fill in the survey. Accordingly, the Vrije Universiteit Brussel was invited to fill in the survey as the developer of the MOTUS-software platform due to the cooperation with Statbel.

Based on the answers to the survey Eurostat developed an online inventory of tools and sources. As and end product every tool and source was mapped according to the Service Definition Template[1].

In the following table the MOTUS-CSPA description is presented. It can also be consulted online[2]: Developers are asked to keep the CSPA documentation up-to-date.

[1] Inventory 4.0, released on April the 8th 2020:
https://webgate.ec.europa.eu/fpfis/wikis/display/ISTLCS/INVENTORY

[2] https://webgate.ec.europa.eu/fpfis/wikis/display/ISTLCS/MOTUS

Table 2: MOTUS Service Definition

1	**Service name**	MOTUS (Modular Online Time Use Survey)	
2	**Ownership**	Vrije Universiteit Brussel - Research Group TOR	
3	**Business Function**		
3.1	**Service version**	v4.0.0	
3.2	**Business process – GSBPM**	Building phase	3.1 Reuse or build collection instrument 3.2 Reuse or build process and analysis components 3.3 Reuse or build dissemination components 3.5 Test production systems 3.7 Finalize production systems
		Collection phase	4.1 Create frame and select sample 4.2 Set up collection 4.3 Run collection 4.4 Finalize collection
		Process phase	5.1 Integrate data 5.2 Classify and code 5.3 Review and validate 5.4 Edit and impute 5.5 Derive new variables and units 5.7 Calculate aggregates 5.8. Finalize data files
3.3	**Description**	The aim of the tool: Doing research using online questionnaires and diary surveys through an online tool in combination with an application. The domains are survey research and time diary research, both cross-sectional and longitudinal. The tool's main functions are: - A back office in which research components (questionnaires, diary, context, communication) are defined, a fieldwork flow is designed for automated operations and data management is programmed and organized - A front office (web and mobile application) for data collection. The tool focuses on: - General population research - Integration broader statistical network (through R packages & libraries) - Government policy research - Multi-disciplinary research – Target specific research - Experimental research – Test environment	
3.4	**Business goals**	- In-house data collection - Scalability-governance tool - Product to others - Service to others (SaaS)	
4	Outcomes		
- Data collection • MOTUS exists of 11 builders; all of these builders are designed to support the fieldwork and to guide the respondent through his/her participation. It improves the response rate (reliability) and the quality of input (validity). It will also support the data handling afterwards so that the researchers-error is lowered as well. The builders are: ○ device builder: use of device of interest; offline/online/; passive data integration ○ survey builder: questionnaire settings, question types, partial completion, data validation ○ diary builder: activity list, standard to all context, context to specific activity, parameters like number of levels, detail, length of observation, data validation, quality control, … ○ event builder: use of sensor data		

<table>
<tr><td colspan="4">

communication builder: e-mail, message, push, text, letter – invitation, reminder, supportive, progression, etc.
language builder: support to the different language in a research
research builder: research flow – sequential based flow & event based flow to handle passive data; organizes the input from survey, diary and communication builder
invitation builder: inclusion of respondents
dashboard builder: overview fieldwork, close communication centre
data builder: data validation, data output, METADATA
quality builder: quality criteria

- Exchange of data - API: dedicated API-keys
- Research: role management
</td></tr>
<tr><td>5</td><td colspan="3">Restrictions and policies</td></tr>
<tr><td colspan="4">
- Architecture

can be plugged in into another data-architecture with or without many extra IT-interference
Input to MOTUS is handled via an API, or read-in file; data extension is preferable .csv, .xlsx, .sav, other formats can be added
Output from MOTUS is handled via an API, or download file; data extension is preferable .csv, .xlsx, .sav, other formats can be added

- Shareability: Multiple researches can run on the same time
- Reusability: Users can redefine content on their interest
- Data capacity: 2 VPS data servers, back-up server, and back-up to the back-up server
- Dissemination: Restricted and open-archive policy
- Privacy: High level of privacy regulation (see GDPR)
</td></tr>
<tr><td>6</td><td colspan="3">Service input(s)/output(s)</td></tr>
<tr><td rowspan="3">6.1</td><td rowspan="3">GSIM Inputs</td><td>Data structure (Content setup)</td><td>• Questionnaires
• Activity list
• Context questions
• Communication
• Parameters to fieldwork
• Parameters settings to download</td></tr>
<tr><td>Dataset (Data file)</td><td>• Administrative validation
• Communication validation
• Input validation-questionnaire
• Input validation-diary
• Process validation
• Database validation
• Security validation
• Back-up validation
• Performance validation</td></tr>
<tr><td>Dashboard (Live)</td><td>• Respondent control
• Researchers control</td></tr>
<tr><td>6.2</td><td>GSIM Outputs</td><td>Different Datasets</td><td>• Progress report; in various levels of detail
• Response report; in various levels of detail
• Metadata report; in various levels of detail
• Database; in various levels of detail
• API-linked output to other sources and databases</td></tr>
<tr><td>7</td><td colspan="3">Service dependencies</td></tr>
<tr><td colspan="4">
– The tool is able to request and receive electronic data from other data sources (administrative data, Smartphone data) via file upload and using predefined fields; via API
– The tool receives data from other existing sources through an API with an administrative data base, and API of connected devices (Smartphone, Raspberry pie, Netatmo)
– The results of the tool create a new data source used for further processing
</td></tr>
<tr><td>8</td><td colspan="3">Exposure</td></tr>
<tr><td colspan="4">MOTUS is used extensively in many projects. A test version can be made available to Eurostat and Task Force TUS. Latter versions planned to be made available at ESS level.</td></tr>
</table>

1.1.3 MOTUS – Service Specification

The CSPA Service Specification discusses the service at a logical level. In this layer, the capabilities of MOTUS are subdivided into business functions that have GSIM implementation level objects as inputs and outputs.

1.1.3.1 Context

Since 2000 EUROSTAT promotes time-use surveys in its member states and associated countries. The HETUS-guidelines have resulted in highly comparable and highly valuable international data employed for a wide range of study domains (paid work, unpaid work, gender equality, leisure, ...). Today comparable datasets of more than 20 countries are available.

Nonetheless, these benefits come at a high cost that directly relate to conducting time-use surveys. Time use surveys have an intensive preparation phase (comprising the different elements like instructions for respondents, questionnaire(s) and the diary, the construction of the sample selection, and the training of interviewers), a yearlong fieldwork period (face-to-face interviews, explanation of the diary procedure, collecting completed diaries), and include an extensive punching and cleaning of the paper-and-pencil diaries to arrive to a digital database ready to be studied by researchers.

The combination of high processing costs and on-going cuts in research funding has two main consequences. Firstly, it hinders the continuity of conducting time-use surveys and of studying the changes of human behavior for the wide range of study domains mentioned above. Secondly, and related to the former, it forces researchers to come up with cheaper methods that still produce comparable, valid and reliable socio-economic estimates, though the latter is by far an easy challenge to undertake.

1.1.3.2 Scope

The primary aim of MOTUS is the online collection of diary based information and - at the same time - reduce the problems that are related to the high respondent burden and the intensive fieldwork being showed in terms of time investment, infrastructure and personnel cost.

Time diary research tries to capture the actual behavior (What people do) of people within its context (Why people do it). In doing so MOTUS makes use of a back-office and a front-office.

Through means of the front-office the goal is to support the respondents in their registration task(s). The respondent can make use of a web application that runs in a broad range of web browsers and a mobile application available for Android and iOS. All information is shared and synchronized. Information on respondents can also be attained from other data sources and from sensors that are connected with MOTUS. To support the data collection and the interaction between devices, specific server capacities are implemented. Conceptually the front-office of MOTUS is defined as 'MOTUSresearch'.

The true engine of MOTUS is the modular back-office of MOTUS. By means of the back-office the researcher is supported to run a time use data collection. Therefore four different phases are developed within MOTUS - called the DCAA-mode (see figure 1).

Each phase includes a number of builders available to the researcher to run a data collection. The use of builders supports MOTUS in its most powerful asset: modularity. It is the composition of the builders, and the choices being made within these builders that define the actual set up of a particular research. As such, MOTUS makes it possible to define multiple researches, than can run at the same time, even within the same respondent (for panel research purposes). Conceptually the back-office of MOTUS is defined as 'MOTUSbuilder'.

The future goal is to modernize the Time Use Data Collection in EU Members States through MOTUS so that collected data are comparable on an ESS-level. See additional information for the posters and leaflet for the SOURCE^{TM} project.

Within this MOTUS-service specification part of the document, the business functions of MOTUS will be structured. Business functions are the activities or processes that are being carried out by a (in this case) CSPA Service. These process will be documented in detail, as well as the inputs and the outputs.

1.1.3.3 MOTUSbuilder

The MOTUSbuilder is a web application[1].

The back-office is a management system that helps researchers to build up a research and to execute the fieldwork. The entrance to the back-office is protected by a two-step-procedure. Users need a username and a password for the first step. In a second step also a number has to be typed in that is generated through a secure authenticator application connected to the smart device of the user. The number remains only valid for 30 seconds. The user can also make back-up codes in case the Smart device is lost.

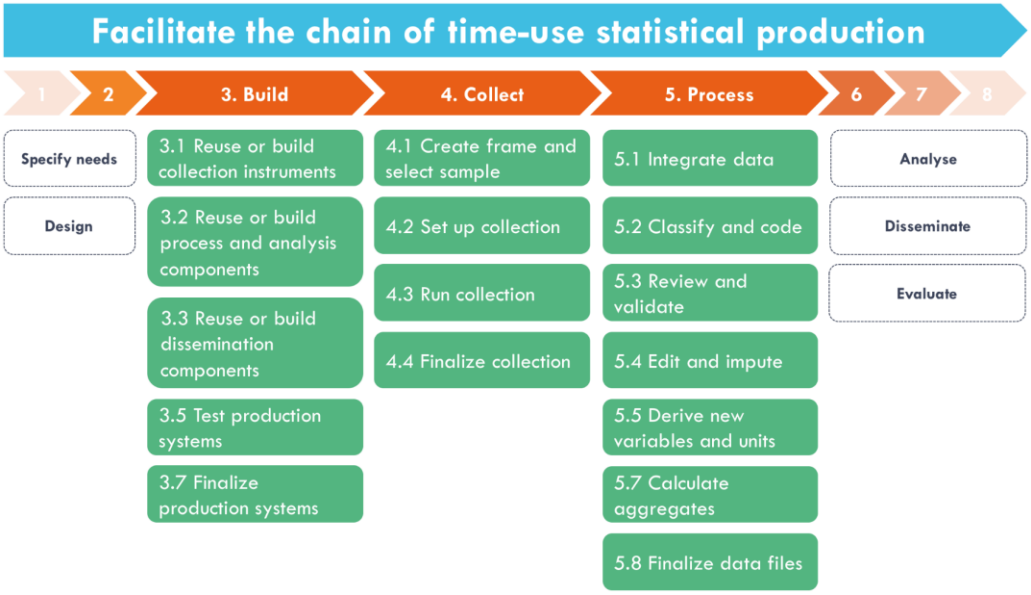
The MOTUSbuilder-environment is managed by an Administrator, who can approve the entry of users and who can define different roles. Multiple MOTUSbuilder-environments can be created on the same domain, on different sub domains or on different domains.

The business functions that are being documented below are all reachable through the MOTUSbuilder.

1.1.3.4 Business functions

The business functions of a CSPA-Service are linked to the GSBPM business process model. The figure below maps the business processes that are available in MOTUS onto the GSBPM-overview.

Figure 5: Service function MOTUS



The Software Service function of MOTUS is to facilitate the chain of (time use) statistical production. MOTUS has important internal processes and produces output. In order to get started MOTUS needs input. So in general there are 3 processes that are linked to MOTUS:

(1) provide input to MOTUS
(2) create internal output to be used within MOTUS
(3) create external output made available by MOTUS

[1] www.motusbuilder.io

The orange arrows show the phases that are included in MOTUS: the Build Phase, the Collect Phase and the Process Phase. These are the (core) business functions of MOTUS. The green boxes are the GSBPM-sub phases below these core functions.

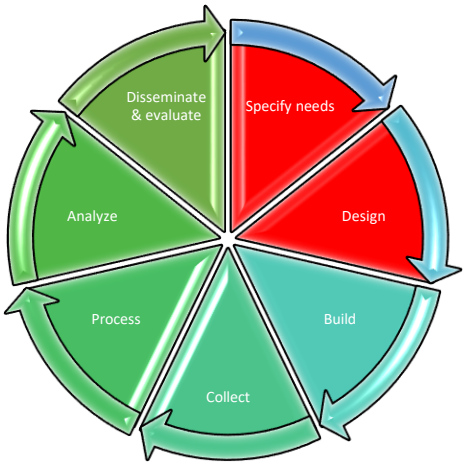
As stated, the input & output phases also have an essential relation with the MOTUS-software platform. Of critical importance is the Design Phase, which incorporates the research interests defined in the Specify needs Phase. MOTUS can be useful to the Design Phase and therefore is colored less orange. To the output side the same is true. MOTUS has a direct impact to the Analyze Phase, and more moderate to the Disseminate Phase. The Evaluate Phase is only a modest part of MOTUS.

For the future development of MOTUS, the developers believe Phases Design, Analyze and Disseminate can become part of MOTUS software platform. These phases are in preparation and will be developed more throughout the years 2020 and 2021.

For the core business function, listed sub phases can become more developed, or even sub phases can be added.

This document starts with which information is needed to be able to start with the Build Phase. This information is considered to be the input (1). This part will be followed by describing the core phases (2), and the output of these phases (3).

Input: Specify needs and Design phase



MOTUS is a software tool that is able to collect data in an automated way. Via MOTUS, the research components are programmed (Build Phase), and subsequently the data is collected (Collect Phase).

MOTUS supports online time use surveys via a mobile (iOS and Android) and/web application (via browser; www.motusresearch.io). Respondents need a smart device as a collection instrument, which can be:

- a computer: web app
- a laptop: web app
- a tablet: mobile and web app
- a smartphone: mobile app and web app

To participate via a browser an internet connection is needed. Combined online-offline registration is possible via the mobile application. Respondents can use any preferred device as the design for both applications is similar and the information collected by the devices is shared and synchronized between the devices. The web app is responsive to function on different screen sizes. Behavioral information can also be captured via sensors in the smart devices.

After the data collection is done, the data is processed and databases are setup taking into account quality assessments (Process Phase). The build, collect and process phase belong to the core process. The output of the first phase serves as the input for the next. After the process phase, the output is available as input for the Analyze and Dissemination Phases.

However, the statistical chain starts with specifying the needs (Specify needs Phase) and with the design of the research instruments (Design Phase).

To this day, time diary data is collected all around Europe following the HETUS-guidelines[1]. The data is collected through the active participation of respondents keeping a paper-and-pencil time diary designed as an easy to carry booklet. This methodological approach is under pressure due to increased data collection costs, and the high impact on the willingness of respondents to participate. This means

[1] https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-19-003

that a transformation to an online data collection is needed. But also that the collection set up and strategy are open for debate, as well as the basic components of time use research can be reoriented. In doing so, the current collection approach can be redefined and new information requests can be met. These requests can also take into account the inclusion of sensor data and other external data when discussing new research possibilities with stakeholders.

Internal stakeholders are the various departments of NSIs that can profit from the generated data, but also supra national organizations like EUROSTAT and the UNSD are involved. External stakeholders are other national bodies like the Federal Planning Bureau, NGOs, civil society organizations or academic research groups. Commercial partners can also find benefits from the aggregated data, for instance to benchmark their market position/proposition against population data.

It is clear that the NSI has a central role. AN NSI is responsible for:

- the setup of the research tools
- the data collection
- the data preparation
- the data documentation
- the support

and functions during the entire process as the point of contact.

In any scenario the statistical chain starts with the setup of the tools, in relation to the capacity of the research methodology. In the most simple usage, time diary output shows how much time individuals and households spend to an activity. Due to the detailed data collection also an insight can be gained in the temporal, spatial and social organization of a society as a whole, but also on topics taking into account the physical and mental health of people. When time-use data are collected within fixed time spans, trends over time can be studied. When time-use data are collected by different countries, cultural differences in time patterns between countries and regions can be studied.

Within this broad array of possibilities, the strong modular setup of MOTUS to introduce new concepts and research components is especially interesting. Based on this quality MOTUS is able to fortify even more the already strong elements of the traditional time use setup, and to open-up the methodology to more research disciplines.

Time diary data has two levels: an activity database and an aggregated database. The activity database is the raw overview of all the activities and their contexts. An aggregated database usually gives an overview of 3 time-use indicators:

- Time spent: mean time spent on the activities by all individuals
- Participation rate: the proportion of the individuals that spent some time doing the activities
- Participation time: mean time spent in the activities by those individuals who took part in the activity

The activities are determined on the basis of an agreed Activity Code List, or ACL, which can be found in the HETUS-guidelines. The context Is the extra questions that are asked to the respondents as they refer to the different time-use dimensions:

- Timing – when
- Location – where
- Social – with whom
- Psychological – why

With the inclusion of passive data, also objective data like hart rate, CO_2-level, etc. via sensors could be part of the research setup.

Then, research questions can, not only be linked to the traditional questions but can also be derived from the interaction between the activity (see the ACL in the HETUS guidelines) and the contextual

questions. Based on this interaction behavioral indicators can be developed, such as (but not limited to) sleep time, social time, gender equality, time poor/time rich, pressured time, transportation mode, …

It is also possible to develop for example SDGs – Sustainable Development Goals[1].

Next, the time diary information can be linked to the questionnaires that are part of a time use survey. Both the time diary and the survey have the HETUS-guidelines[2] and ESS survey standards[3] as documentation to describe the variables and the collection instruments.

MOTUS is also supportive to include administrative data sources. More technically MOTUS produces micro data frames with the following types:

- data frame with personal information + merge fields and UUID-key
- data frame with survey information + UUID-key
- data frame with time diary information + UUID-key
- data frame with log data + UUID-key

These datafiles are Comma Separated Value (.csv) files and can be convert to R and SAS files (see hbits.11).

It is up to the NSIs, internal and external stakeholders to define and construct these behavioral indicators.

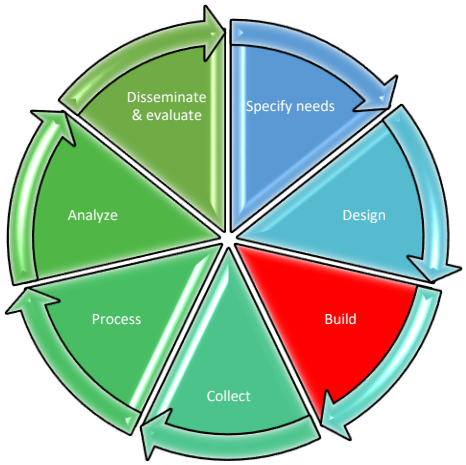
This (suggested list of) input is the starting point of the Build Phase:

- Documentation of interests in new variables/concepts/statistics by internal/external stakeholders
- Up-to-date HETUS-guidelines: offline to online
- Documented individual questionnaire(s)
- Documented household questionnaire(s)
- Documented additional questions
- Documented ACL
- Documented sensor data/external data
- Documentation on the variable descriptions
- Documentation on input from sensors (algorithm, variables, indicators, …)
- Documentation on administrative data sources for pre/post-merging
- Documentation on behavioral indicators [Concept, definition, …]
- Documentation on invitation procedure
- Documentation on GDPR
- Documentation on META-data

[1] https://worldtop20.org/
[2] https://ec.europa.eu/eurostat/documents/3859598/9710775/KS-GQ-19-003-EN-N.pdf/ee48c0bd-7287-411a-86b6-fb0f6d5068cc
[3] https://www.europeansocialsurvey.org/docs/round10/methods/ESS10_project_specification.pdf

Core: Build Phase

MOTUS consists of a front-office and a back-office. The front-office is the mobile and web application necessary for respondents to take part to studies. The front-office is partly defined by the design of the application and the operational logic defined in the source code, and partly by the content of the application.



It is the content definition that prepares (i.e. builds) the application to be able to collect the requested information (defined in the Design Phase). This is done via the back-office of MOTUS, called the MOTUSbuilder.

The MOTUS builder counts in total 11 builders.

Table 3: Components and instruments of the MOTUS builder

Number	Builder	Components	Instruments
1	Device builder	Web app Mobile app API	
2	Survey builder	Create surveys Multiple question types Library of surveys	• Individual questionnaire • Household questionnaire • [Country specific questionnaires] • Context questionnaire – non travel • Context questionnaire – travel • [Specific context questionnaire that focuses on (and/or) the temporal, spatial, social, psychological dimensions

3	Diary builder	Create diaries
		Multiple time diary parameters
		Library of ACL
			• Activity Classification List (ACL)
			  ○ Number of levels
			  ○ Coding
			  ○ Selection and/or search functionality
			  ○ Tags
			• Time diary parameters
			  ○ Diary length
			  ○ Grain of precision
			  ○ Cycle
			  ○ Focus
			  ○ Learning period
			• Quality criteria
			  ○ Undefined time
			  ○ Number of activity
			  ○ Number of different activities
			  ○ Rounded hour activities
			  ○ Sleeping time
			  ○ Occurrence of eating, drinking

			○ Occurrence of travelling ○ …
4	Event builder	ESM Sensors Plugin or Microservice	• Input from geolocation plugin • ESM – Experience Sampling Method
5	Communication builder	E-mail SMS Notification Page	• Page • Email • Text • Notifications
6	Language builder	Default language Additional languages	• Languages • Translation of system buttons • Translation of research components • Translation of communications
7	Research builder	Customize respondent tasks Customize respondent events Customize communication	
8	Invitation builder	E-mail invitation Postal invitation Automatic registration Anonymous registration	
9	Dashboard builder	Response rate Completion rate Infographics	• Progress fieldwork • First results via an interface
10	Data builder	Download .csv R, SAV	• Download database • META-data
11	Quality builder	Quality controls META-data	• Para data/metrics • Status - progress • Logs • Communication overview • Quality determination •
To be developed			
12	Computation builder		• Data availability via RStudio • MOTUS-Library with variables and statistical methods syntaxes
13	Visualization builder		• Data availability via RStudio • MOTUS-Library with visualization techniques • Possible programs are R Markdown and R Shiney

The builders above will be further developed in the future, in particular the Event, Dashboard and Quality builder, but also new builders will be created (12 and 13).

Below we pass along the different subphases of Phase 3 'Build' that are included in MOTUS.

Reuse or build collection instruments (3.1)

Collection instruments are programmed in the survey, diary, event and communication builder. All components are stored in a library to support reusability and shareability. Existing components can be copied (and new components can be added) or linked (an existing component is reused from another study).

The HETUS-guidelines define a set of specific components. Below these components are placed within the setup of an online TUS, supplemented with some new innovative approaches.

These components are:

- Defined within the survey builder
  - Individual questionnaire
  - Household questionnaire
  - [Country specific questionnaires]
  - Context questionnaire – non travel
  - Context questionnaire – travel
  - [Specific context questionnaire that focuses on (and/or) the temporal, spatial, social, psychological dimension]
- Defined within the diary builder
  - Activity Classification List (ACL)
    - Number of levels
    - Coding
    - Selection and/or search functionality
    - Tags
  - Time diary parameters
    - Diary length
    - Grain of precision
    - Cycle
    - Focus
    - Learning period
  - Quality criteria
    - Undefined time
    - Number of activity
    - Number of different activities
    - Rounded hour activities
    - Sleeping time
    - Occurrence of eating, drinking
    - Occurrence of travelling
    - …
- Defined within the event builder
  - Input from geolocation plugin
  - ESM – Experience Sampling Method
- Defined within the communication builder
  - Page
  - Email
  - Text
  - Notifications
  - Letter (to be printed with personalized credentials)
- Defined within the language builder
  - Languages
    - Translation of system buttons

        - Translation of research components
        - Translation of communications
- Defined within the quality builder
    - Para data/metrics
        - Status - progress
        - Logs
        - Communication overview

Reuse or build process and analysis components (3.2)

Process and analysis components are prepared in the dashboard, database and quality builder. These components will also benefit the future computation builder.

All captured data is stored on an MariaDB database server. Via an integrated MOTUS R-package the data becomes available for further usages. This package is helpful to the:

- Dashboard builder
    - Progress fieldwork
    - First results via an interface
- Database builder
    - Download database
    - META-data
- Quality builder
    - Quality determination
- Computation builder
    - Data availability via RStudio
    - MOTUS-Library with variables and statistical methods syntaxes

Reuse or build dissemination components (3.3)

Dissemination components are prepared in the visualization builder:

- Visualization builder
    - Data availability via RStudio
    - MOTUS-Library with visualization techniques
    - Possible programs are R Markdown and R Shiney

Test production systems (3.5)

The questionnaire, diary, events and communication components can be tested via www.motusresearch.io in development mode. This also includes the research flow, where the research tasks the respondent have to go through in order to complete the research. Every component can be translated (see Statbel.2 and Destatis.2). This also includes the connection with other data sources via API's or other processes in connection to the fieldwork process designed in MOTUS.

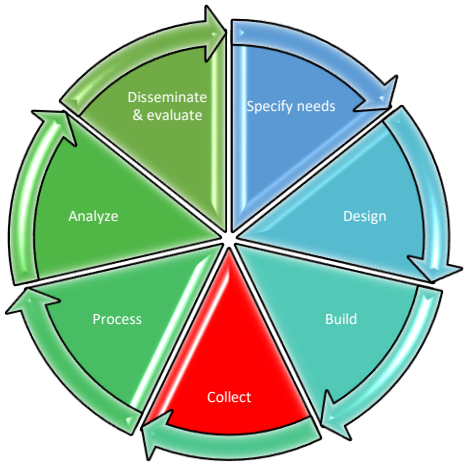
Finalize production systems (3.7)

The MOTUS-tool will provide two user manuals and technical documentation:

- Guideline for respondents
- Guideline for researchers
- Technical documentation

The output of the Build Phase is the input of the Collect Phase.

Core: Collect Phase



In time-use research respondents take part in a number of consecutive tasks in order to fully complete their participation.

In the build phase all the components are prepared in MOTUS. In the collect phase the focus lies with the research setup and organization of the data collection itself. To support this process, MOTUS uses the research builder. The research builder of MOTUS incorporates and puts into relation all preparations made in the previous phase. Subsequent, in the collect phase the respondents are assigned to a research and their contact information is stored to be used. A dashboard is helpful to follow-up on the fieldwork. Para data on the collection progress is kept in the background (see hbits.3).

MOTUS can be used for several studies that can even run at the same time (see also hbits.6 and hbits.7). At the moment of login the web app stores the research information to the used browser. If the respondent uses the mobile app the framework of MOTUS is stored on the smart device at the moment the MOTUS-app is downloaded from the app store. At the moment the respondent logs in, research specific content is also stored on the smart device.

Below we pass along the different subphases of Phase 4 'Collect' that are included in MOTUS.

Create frame and select sample (4.1)

The sample for a research is defined within the Invitation builder of MOTUS. MOTUS foresees a number of ways to include respondents to a research:

- Defined sample
  - .csv-file
  - External database connected via an API
- Voluntary participation
  - Webpage
  - Profile questionnaire
- Anonymous link

The input can hold contact information (first name, last name, address, e-mail address, telephone number, preferred language …), as well as auxiliary information (employment status, family situation, …).

For researches that request the participation over a longer period of time, a username and password are essential. MOTUS makes it possible to define usernames and passwords:

- Username
  - Read-in
  - Generated Username based on a combination of a name (list) and/or number (range)
- Password
  - Password difficulty
- Two-factor authentication
  - Credentials
  - Code authenticator

Set up collection (4.2)

In the device, survey, diary, communication and event builder all research elements are prepared. In the research builder the collection strategy is set up. There are two options: the linear flow and the event flow. Both flows can interact.

In the linear flow all the research elements are put together. A linear flow exists out of one or more tasks, and one or more actions per task. Depending on the study goals the research set up can contain multiple states, stretching over a period of time.

A state can be a:

- Questionnaire
- Time diary
- Communication page
- Pause

An action can be:

- Communication
  - Page
  - Emails
  - Text
  - Notification
- Dispersion
  - Wait
  - Pool
  - Length
- Event
  - Login
  - Complete
  - Timed event
  - Event trigger (see below)
- End
  - Complete
  - Timed event

Within the event flow, research tasks are triggered on the basis of a defined event.

- Event trigger in combination with a notification
  - Time based
    - ESM: Experience Sampling Method
  - Connected device – plugin
    - Geolocation plugin
    - Other plugin including a smart tool or sensor (temperature, CO2-level, …)

The geolocation of the respondent is a good example. When respondents enter a geofence (defined by a location – longitude and latitude – and a radius) a notification is sent to the respondent notifying the respondent about an extra task. Answering a question about the reason why the person is at that place could be an extra question. The same principle can be used with sensors sensing the temperature, the CO_2 level, … "Do you find the temperature comfortable?" or "Did you experience problems breathing?" In the event based flow the interaction with the sensors are programmed. In the linear flow the triggered events are allocated to a task. As long as the task is not complete, the time window for the triggered event remains valid.

In their participation respondents can use the web and/or the mobile app. Once a respondent entered a study, a personal research page is shown. This research page gives an overview of the research tasks

to be completed and the sequence of the listed tasks. When an extra task based on input from a sensor is triggered, this task is added to the task overview. At the personal research page, the respondent can also find information about the research. Depending on the provided languages respondents can switch from language to language.

A guideline for the researcher and for the respondent is provided (see hbits.3). A training/workshop can be organized.

Run collection (4.3)

MOTUS aims for a fully automated data collection. Most of the interactions with respondents are prepared, and embedded in the research flow. Every research goes through 4 states:

- Under development
- Active
- Paused
- Archived

At the moment the research is launched, the status changes from 'Under development' to 'Active'. From that point on respondents start to receive their invitation e-mail with their credentials. A research can be 'Paused' and after the data collection be 'Archived'.

Information about the research is provided to the respondents via an informative webpage. This webpage also includes information about the web app, mobile app and connected devices

Once logged in, the respondents see their personal research page with the research tasks listed. Event tasks are added in real life.

A research can be executed in multiple languages. There is a priority setting that defines the language of the research the respondents will see at the start of their participation. This priority is defined by:

- Known language preference (at read in)
- Browser – Device language setting
- Research default language (this is the language when none of the other preferred languages are valid)

Respondents can change the language of the research in their personal settings, or via the web page toggle.

MOTUS produces data frames. These data frames include personal, household, survey, time diary information, sensor data and log data. The log data contain information on when the respondent participates to the study, as well on the communication that has been sent to and consulted by the respondent. The data are raw microdata. The META-data contain information on the collection elements and the research flow. It also holds information on the response and quality assessment.

During the fieldwork, researchers can follow-up on the research progress via the MOTUS-dashboard (in connection to the MOTUS R-package). MOTUS can also call-up the responses given by the respondent during the data collection. This means that the answers in a questionnaire can be displayed but also the time diary input of the respondent can be followed in real time.

To support further automatization the quality of the registration is also monitored. Feedback is given to the respondents:

- During the study
  - Warnings
  - Errors
  - Quality issues
  - Gaps
- End of the study

- Overall quality assessment with the possibility to return to the timeline
  - Undefined time
  - Number of activity
  - Number of different activities
  - Rounded hour activities
  - Sleeping time
  - Occurrence of eating, drinking
  - Occurrence of travelling
  - [...]

Finalize collection (4.4)

All collected information by MOTUS is stored in the MariaDB-database.

The MOTUS data builder provides:

- Data frames per stage
- Para data
- META-data

Via the MOTUS R-cran package, and corresponding library

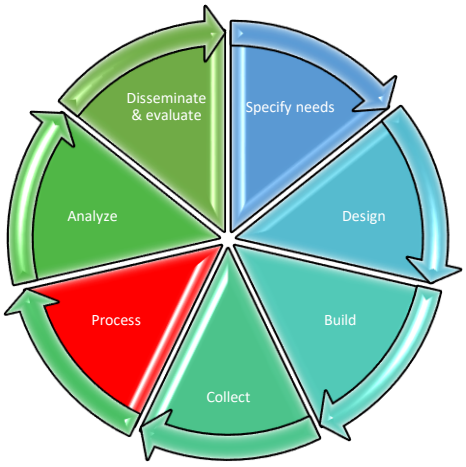
- Cleaning and quality control data files
- Transformation variables
- New variables
- Analysis
- Conversion to other data formats
- API to send data

The output of the Build Phase is the input of the Process Phase.

Core: Process Phase

In the process phase the raw micro data are prepared for analysis. Part of the sub processes are incorporated in MOTUS, another part is being done in relation to the server integrated MOTUS-R-cran package.

Below we pass along the different subphases of Phase 5 'Process' that are included in MOTUS.



Integrate data (5.1)

There are two ways to integrate data:

- At the moment respondents are read in to the research (Invitation builder)
- After the data collection data files can be merged based on a UUID-key using the MOTUS R-cran package

When data is integrated before the start of the study, the information can be used during the field work as well. An example are personal data: gender, age, etc. This information does not have to be asked again

to the respondent, or can be displayed to the respondent in order to be corrected and confirmed. These are called 'Merge fields' in MOTUS.

When the data merging after the data collection is recurrent, a library can be developed that automizes the integration of multiple data sources.

Classify and code (5.2)

MOTUS works with coded response categories, this is the case for:

- Survey questions
- Activity code list
- Context questions

Open text questions or actions described in own wordings are stored as text variables in the database.

Sensor data are used in correspondence with an algorithm to reduce the amount of data inflow and to add extra information. At the moment this is the case for geolocation.

Via the MOTUS R-cran package and in combination with other packages these information can be further classified and coded. New efforts will be documented in the library.

Review and validate (5.3)

MOTUS makes use of the MOTUS R-Cran-package to examine the microdata. The MOTUS-package checks upon:

- Missing data
- Time diary data are controlled upon the following criteria:
    - Length of unreported time
    - Number of reported activities
    - Number of days reported
    - Check on reports on rounded time
    - Occasion of eating
    - Occasion of sleeping
    - Disclosure of activity sequences
    - Imputation of sleep
    - …

Edit and impute (5.4)

The MOTUS R-Cran package includes procedures to flag time diaries based upon the quality criteria in 3 groups:

- Green
- Grey
- Red

Green responses pass the quality criteria, red responses will not be part of the final dataset. Grey responses are flagged to be evaluated manually.

Derive new variables and units (5.5)

The MOTUS R-Cran package automatically derives a set of new variables based upon variables available in the database (see hbits.11):

- Time related variables
- New variables – R library

Calculate aggregates (5.7)

The MOTUS-R-Cran package automatically derives aggregates based upon the microdata in the database (see hbits.11):

- Reorientation of time activity data file
- Aggregation of time activity data file

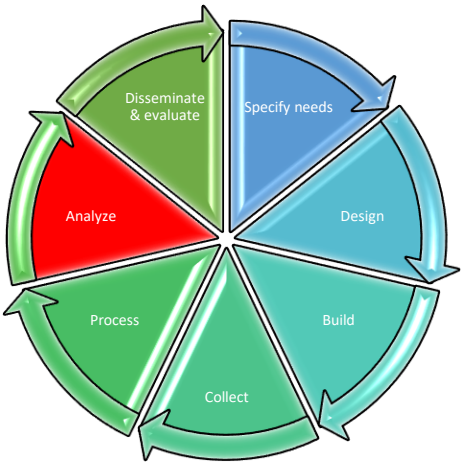
For the time diary databases the activity file is aggregated to a respondent file. This respondent file can be merged with the data files that contain personal and household information.

Finalize data files (5.8)

Using the MOTUS R-Cran package R-databases are converted to a .csv and .sav. The .sav and .Rdata file can be imported in SAS (see hbits.11). The databases and META-data are available through the MOTUS-data builder.

The output of the Process Phase is the input of the Analyze and Disseminate Phase.

Output: Analyze and Disseminate Phase

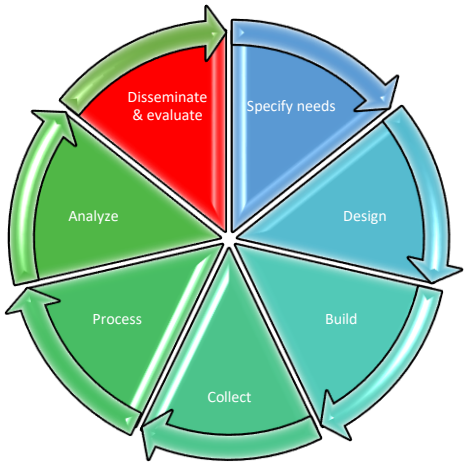


In a nutshell, via MOTUS research components are prepared (built), respondents are invited and participate via the web/mobile app and connected devices (collect), the collected data is stored in a datafile (process) to support the analysis of the data (analyze). As an output MOTUS provides data files/data frames and supportive documents that are ready to be analyzed in the Analyze Phase by internal and external stakeholders. Further on these databases can be used for the Dissemination Phase.

MOTUS can become helpful in the future to the Analyze and Disseminate Phases through the further inclusion of R. R is also interesting to visualize the output, which are otherwise difficult to understand.

Throughout time it is the goal to further improve the MOTUS R-package and library to support the time-use community with statistical methods and visualization techniques that start from time use data. Data users are asked to archive their syntaxes within the package and library. The Research Group TOR and the spin-off hbits are developing a TUD (Time Use Diary) handbook that is helpful to analyze time-use data (see hbits.11).

Output: Evaluate Phase



In relation to the Evaluate Phase it is important to stress that from the early development stages onwards modularity and flexibility were the key assets for to develop MOTUS. This means no third party components are part of MOTUS, and that new developments stories depart from the basic setup of MOTUS. This short cycle approach has as an effect that the time between an idea or a new interest and (even) the implementation of a new development is therefore much shorter.

MOTUS is the research output of the Research Group TOR of the Vrije Universiteit Brussel, and so an academic environment.

To gather evaluation inputs, conduct evaluation and to agree to an action plan for MOTUS the Atlassian software package Jira is used. Multiple workflows are used to retain a structured and iterative approach to further develop MOTUS, and projects linked to MOTUS. Jira uses the approaches:

- Scrum
- Kanban
- Backlog

Now, all phases of the GSBPM have been discussed in a logical manner. This document ends with a conclusion.

1.2 (hbits.2) Defining the conditions for encapsulation of MOTUS

Deliverable	Data collection architecture of Statbel and Destatis compared to MOTUS

1.2.1 Setup of the approach

This goal brings together the reports of Statbel.1 and Destatis.1 on their data collection architectures. There were two kinds of input. At first, Statbel and Destatis completed a template in order to get a general overview on their approach and strategy to collect TUS- and HBS-data. In a second step this information is used to build a BPMN-model (Business Process Model and Notation) to visualize the subsequent activities performed to collect this data in an understandable way. This process included multiple iterations of the model showing already the complexity of the organisation of a fieldwork. Besides, on a first level, mapping the activities, this graphical representation also has the meaning to disentangle the different roles within the organisation, as a second level, that come in touch with the data collection. Also, the external roles are taken into account (e.g. interviewers, households, …). A third level holds information on the relation between tasks and the IT-infrastructure. Having this insightful information from two NSIs will learn us on how fieldworks and especially linked activities are executed in order to realize their goal, namely to collect TUS and HBS data.

The completed templates are available as an attachment. For the graphical representation of the workflow the web-based tool CAWEMO for BPMN-modelling was used, specifically the Camunda Modeler (https://bpmn.io). An explanatory document can be found here: https://camunda.com/bpmn/, a summary poster with all the basic concepts can be found here: http://www.bpmb.de/images/BPMN2_0_Poster_EN.pdf

After the deduction of the input, this knowledge will therefore support the technical implementation of other IT-services, like the MOTUS-software platform. On another level, this knowledge supports the shareability and reusability strategy of software tools on the ESS-level. Member States will have questions about new tools and the functionalities of these tools. The assessment of the workflows of Member States is an important input in the concretization of a Governance Guide which is in development by ESTAT. The other way around, the Guide will describe how Member States can explore the tools, test them or ask for new functionalities (see hbits.7). The future outcome is a more agile execution of coming business processes within the collection of TUS and HBS data (Chinosi & Trombetta, 2012). The ultimate goal would be to have a software solution and business architecture that embeds most of the activities in an automated flow.

1.2.2 Technical description & architecture MOTUS

The MOTUS software consists of a number of software components, and will be technically outlined in the subsections below.

A first component is the MOTUS-front office. This is the component that respondents use in order to participate to the studies. Respondent can use the web based and the mobile version to contribute to the study. The input between devices is synchronised in order to switch depending on the preferences of the respondent.

A second component is the MOTUS-back office. The back office has two main functionalities. This environment is being used by the researcher who designs studies, runs the fieldwork and downloads the data. More information is to be found in the CSPA-description of MOTUS (see hbits.1). The back office consists of a number of servers. To date, MOTUS consists of 2 clustered VPS servers to collect data and to prepare the databases and one back-up server. The databases are configured so that they can be replicated and clustered easily.

A third component are the APIs or Application Programming Interfaces. Internal APIs function between the MOTUS-front and -back office and are essential for the performances of MOTUS. The input and

output APIs handle requests from external services and prepare data inflow (input) and data outflow (output). An example of data inflow could be administrative data or the input of sensor data, an example of data outflow could be a continuous update of the average time spend doing housework by gender published on a government owned website.

A last component deals with the Graphical User Interface of the MOTUS-front and -back office.

Table 4: Developer details of MOTUS

Version	MOTUS v4.0
Owner	Vrije Universiteit Brussel – Research Group TOR
Licensee	hbits CV (Spin-Off Vrije Universiteit Brussel – Research Group TOR)
Contact	Joeri.Minnen@hbits.io
Source code	Not public, own developments, no third party components (e.g. Google components)

1.2.2.1 Plug & Research principle

MOTUS is designed as a Plug & Research principle, so that everyone with an entrance to MOTUS can setup a time use studies themselves. Studies can be web- and/or mobile-based. Via the highly configurable software platform all research elements can be combined into an automated flow in order to save time and money in an otherwise costly project. Once configured, the research flow runs automatically, including communication with respondents. The fieldwork can be followed upon and the collected data are processed in a user-friendly way.

By doing so, projects of any scale and for any given fieldwork period can be designed and the best response strategy can be selected. The platform assures comparability, reliability and quality of the data.

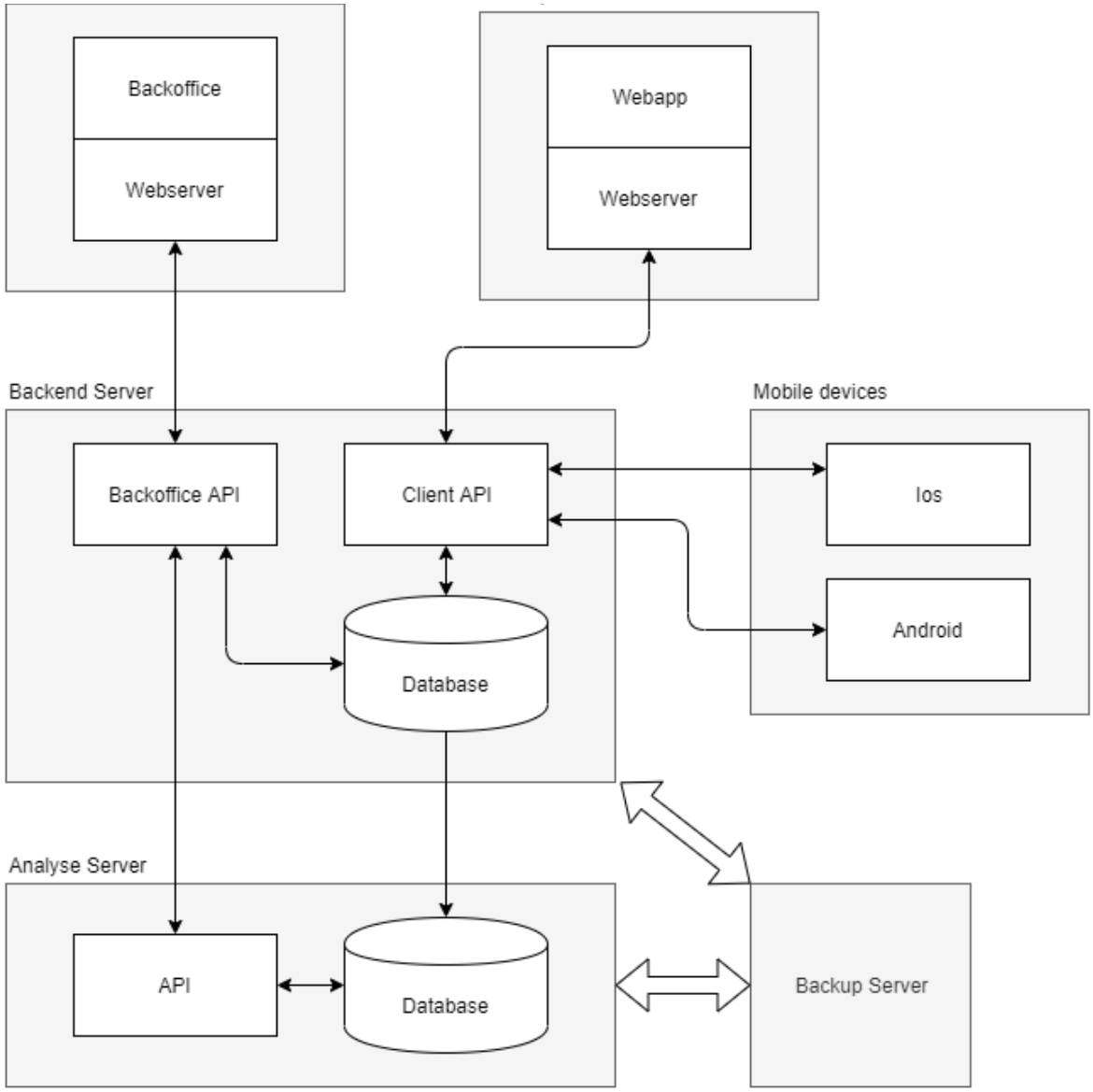
MOTUS foresees in all essential hard and software components, as presented in figure 6.

The picture describes the CORE architecture of MOTUS. Taken into account the components and modules, MOTUS can be encapsulated into the data collection architecture of an organisation like An NSI. Data streams both internal and external can be included when defined by specifically designed APIs.

The components and modules are composed as follows:

1. Backend server: the backend server stands central in the MOTUS-software platform. It holds the database, the back-office API and the client API.
2. Back-office: the back-office serves as the research environment where the researcher sets up a research and the fieldwork can be followed. The back-office runs in a browser.
3. Analyse server: the analyse server holds a replicate of the database of the backend server and prepares the reports for the backend server, which at its part can be called by the back-office.
4. Back-up server: the back-up server is a replicate for secure storing from the backend server and the analyse server.
5. Client portal: the client portal holds the MOTUS-web application and an underlying webserver.
6. Mobile devices: the mobile application is available for Android and iOS

Figure 6: MOTUS software architecture



There are three API's that arrange the entrance to the components:

1. Back-office API: both ways webserver back-office and analyse server
2. Analyse server API: both ways database (to prepare reports) and back-office API to send over reports and other analytics.
3. Client API: Receives the input from the web & mobile app and syncs the data on both applications. It could also function as a data harmonization tool.

Based on this setup 4 different data architectures can be proposed. These data architectures are being described in hbits.7 as part of the Governance model, and more specifically the Technical Governance.

1.2.2.2 Software components

Table 5: Technical description of the front- and back-office, both client and server side

MOTUS front office		
Respondent front-end web app: https://www.motusresearch.io/		
Respondent client side technology	Programming language	Javascript
	Framework	Angular 5
Respondent server side technology	Programming language	PHP 7.x
	Framework	Koseven
	Database	MariaDB – shared hosting
Respondent mobile front-end technology iOS: https://play.google.com/store/apps/details?id=be.byteworks.motus Android app: https://apps.apple.com/be/app/motus-zap-vub/id956934466		
	Programming language	• Javascript • Objective C • Java
	Framework	• Angular 8 • Ionic 6 (5 + beta 6)
Endpoint server technology	Programming language	PHP 7.x
	Framework	Koseven
MOTUS back-office		
Researcher/admin back-office web app		
Client side technology	Programming language	•Javascript
	Framework	• Angular 8 • jQuery
Server side technology:	Programming language	•PHP 7.x
	Framework	Koseven
	Database	MariaDB
	Back-end server	• VPS • Linux: Debian 9 // Updated to CentOS (free version of Redhat) • Ten core CPU • 60GB RAM • Disk storage: 1600GB • Port/bandwidth: 1Gbit/s • DDoS protection
	Analyse server	• VPS • Linux: Debian 9 // Updated to CentOS (free version of Redhat) • Ten core CPU • 60GB RAM • Disk storage: 1600GB • Connection: 1Gbit/s • DDoS protection
	Back-up server	• 2x100GB back-up space • Internal network only

There are 3 sorts of APIs:

1. Internal: handles the communication between internal components of MOTUS
2. Input: handles the input communication with an external source
3. Output: handles the output communication with an external source

1.2.2.3 Security

MOTUS takes into account a number of security measures. Both the respondents and the researchers have to authenticate against either the front- or the back-office to make use of the service. In both instances confidentiality and data integrity are essential.

To meet this criteria, user credentials are issued by MOTUS while these settings can be modified by every organization. Initial credentials are provided to the user by letter or e-mail. Users can change their username/password via the applications. Passwords are encrypted in the database. Each user application has his own unique API-key, as is the same for every respondent. Username and identifier are connected in the database. Connection to the database is strictly ruled. For researchers an extra 2-factor authentication is required and user roles are defined.

Also, the questions and the answers of respondents are linked through UUIDs and stored accordingly in the database without the relationship file which is stored on another place. Although the servers of MOTUS are protected against intrusion, the acquaintance over the data cannot lead to a privacy breach without having the relationship file.

MOTUS only works with own components, no data are leaked via third party components.

Table 6: Overview of the MOTUS components

MOTUS front-office	MOTUS Front/back-office communication	MOTUS back-office
• Login with username and/or email + password • Logins are linked to researches • Oauth 2.0 • Password are encrypted in the database • Initial passwords are auto-generated and can contain numbers, characters and signs	• Connection to the database is only allowed from application or analysis server • No external connections to the database are allowed	• Login for admins with username and/or email + password • Password are encrypted in the database • Requires 2-factor authentication • User role restrictions
MOTUS API communication		
• Each user application (respondent web frontend, web app, registration website, …) has a unique API key; with configurable rights • Each respondent receives a unique API key • Data is transmitted over a https protocol which an SSL/TLS encryption layer. The SSL connection encrypts and decrypts requests and responses. • The JSON encoding standard is used to transmit pieces of data between the MOTUS-components		
User tracking		
• No external tracking tools used • Internal device tracking (model, platform, browser, operating system) to detect usage		

A complete overview of the MOTUS database architecture can be found here:
http://www.hbits.io/wp-content/uploads/20200308-Database-architecture-MOTUS.pdf

1.2.3 Data collection architecture Statbel

The responses to the template (see Statbel.1 and Destatis.1) gave a first input on the business processes and the workflow within Statbel. The document also gave a first insight in the activities that are online, automated, and/or supported by an infrastructure. This information is supplemented with technical descriptions of the IT-infrastructure, and the linkages that exist between data tools and sources.

The Statbel-model discussed below is practicable for both TUS and HBS and is based on in total 6 phases:

1. Sample selection
2. Recruitment
3. Training and selection interviewers
4. Research instruments
5. Data collection
6. Data dissemination

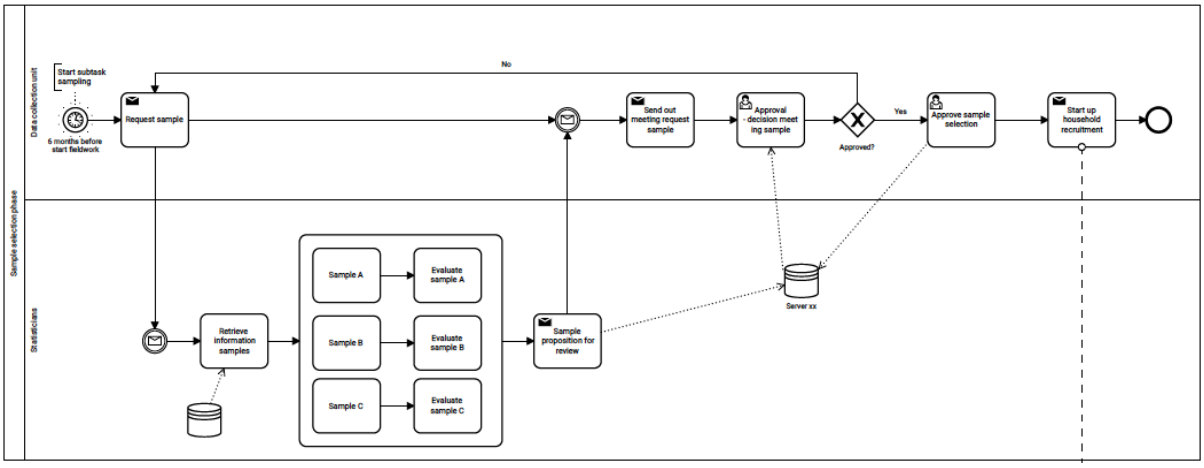
For every phase, we present and discuss the BPMN-sub model. IT-infrastructure is considered to be overarching. Therefore, for every phase the technical details of the IT-element is given.

1.2.3.1 Sample selection

HBS is collected every 2 years, TUS is collected with the range of 5 to 10 years. The fieldwork takes one full calendar year, typically starting on the first day of the year. The business process starts with the preparation of the sample selection and is foreseen 6 months ahead of the start of the fieldwork. In case the fieldwork runs over one entire calendar year, the sample selection phase starts in June.

The sample selection model combines three roles within Statbel: the data collection unit, the methodologists and the statisticians of social statistics. The methodologists are responsible for the preparation of the sampling frame and for designing and selecting the sample. The data collection unit is responsible for sending the invitations to the selected households. The statistician's main task is overseeing the process.

Figure 7: Sample selection strategy within the data collection architecture in Belgium



The methodologists start the preparation of the sample selection after receiving a request from the data collection unit. This request holds information on the number of households that needs to be collected, the periodicity of the sample selection and other relevant points of attention. Statbel does not have a formalized procedure. Last HBS the sample selection was made based on 3 sources: the LFS panel survey from the year before, the previous HBS wave and the National Population Register. The LFS and HBS information was available internally within the DWH, for the drawing on the National Population Register the methodologist ran a request on the DWH server. The methodologists evaluate and combine

these sources to a balanced sample proposition, being put available for review. The constructed database holds information on respondents name, family name and address as contact details.

The sample selection and related information is being discussed by the data collection unit and approved, or subject for resampling. After final approval, the dataset is the start for the recruitment process of the households.

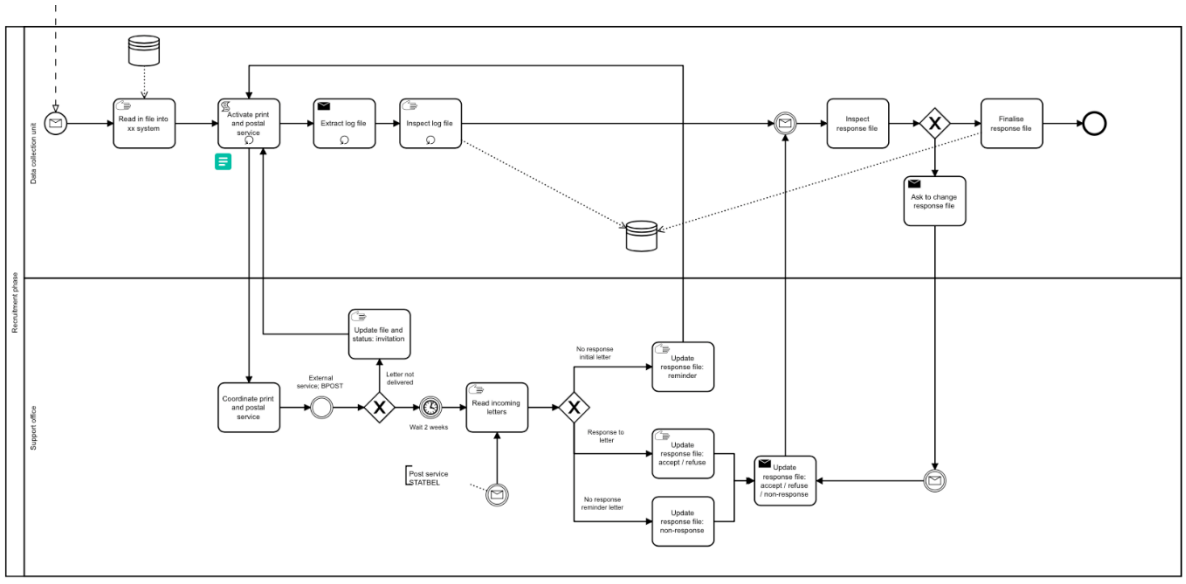
Table 7: Infrastructure of sample selection in Belgium

Server/ infrastructure	Source	Description	Linkage/API
DWH	LFS	Households are invited for participation in HBS at the end of the 4th (=last) wave in LFS	/
DWH	HBS	Households that participated in the previous HBS are invited for participation in the next HBS	/
DWH	National Register	Households are randomly selected in PSU that were selected for the LFS panel survey	/

1.2.3.2 Recruitment

About 3 months before the start of the fieldwork, the recruitment phase starts. In this recruitment phase, the households receive a postal letter in order to invite them to take part in the study. Participation in HBS and TUS is voluntary. The model below shows an interaction between the data collection unit and the support office. The support office is in charge of printing and sending the invitation letters.

Figure 8: Recruitment strategy within the data collection architecture in Belgium



The sample is retained from the DWH and is transferred into an excel-file on the file server. This file and a model letter are sent to the prepress of our Support Office. After a validation by the Collection Department, the Support Office prints the letters. They also coordinate the dispatch of the letters to the post office of BPost who delivers letters in Belgium. Once send out, mail can return (not delivered), households can response by means of a response card, or do not respond, even not after a reminder letter. All incoming letters/cards are read and catalogued in a response file by the Data collection unit. One month before the data collection starts, the invitation phase closes and the response file gets evaluated and finalised.

The final response file is charged into our sample managing system (DBENQCIT). This system will connect the sample with the interviewers.

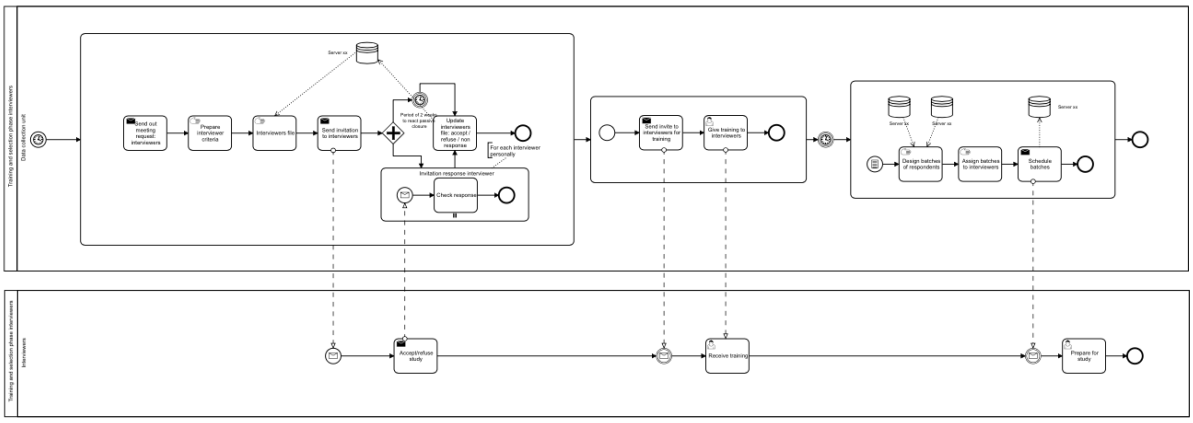
Table 8: infrastructure of sample management in Belgium

Server/ infrastructure	Source	Description	Linkage/API
DWH	CMC	The sample is retained from the DWH and is transferred into an excel-file on the file server	/
File server	DWH	/	/
DB2 JAVA	/	/	/

1.2.3.3 Training and selection interviewers

A third sub process in preparation of the fieldwork is the training and selection of the interviewers. Interviewers are today self-employed, and so no part of the Statbel-organisation. Nevertheless, the job content of an interviewer holds contacting the households a first time to explain the survey, a second time to follow-up on the data entrance and a third and last time to interview the households for individual and household questionnaires as activities.

Figure 9: Training and selection interviewers within the data collection architecture in Belgium



Interviewers are invited to the study about two to three months before the start of the fieldwork. They have a 2-week period to react. After a response check, the data collection unit derives a list of interviewers which are sent an invitation for a 4-hours training. During this meeting they pass and discuss every element of the study: contact procedure, research elements, use of a laptop, assistance, compensation, … .

After the meeting, the responding households are organized in batches and assigned to an interviewer, who also receives a schedule about when the batches need to be activated and completed. In the meantime, the interviewer can prepare him/herself for the study.

Table 9: Infrastructure of interviewer management in Belgium

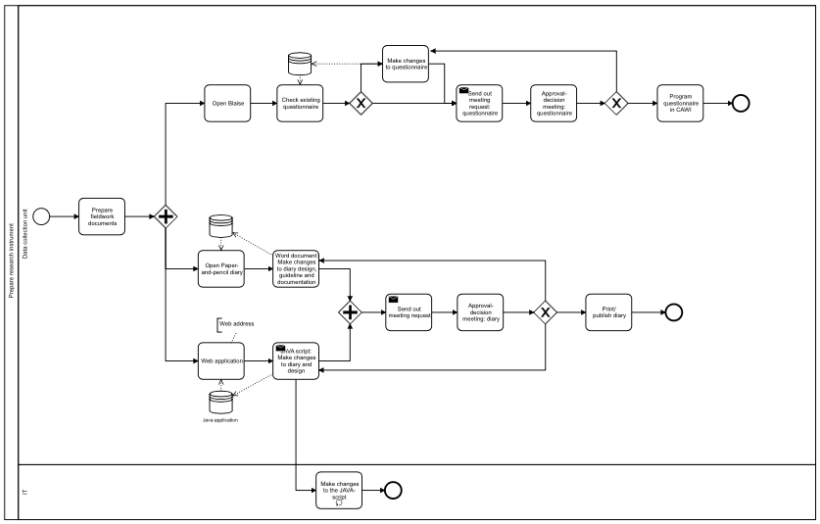
Server/ infrastructure	Source	Description	Linkage/API
DB2 - JAVA	Manual input of interviewers choices	DBENQCIT	/
Blaise server	Automatic charge	Link between sample and interviewers choice	/

1.2.3.4 Research instruments

An important step is the preparation of the research instruments. Central to HBS and TUS are the diaries to be completed by the households. For HBS, households keep track of their expenditures over a period of 15 days (first or second part of the month). For TUS, households keep a record of their activities for 2 days, one weekday and one weekend day. Also different is that for HBS every person can add expenses, but only the reference person is questioned, while in TUS all persons 10 years and older from the household are invited to participate.

The diaries are available both offline[1] and online[2] for HBS. For the offline part the Data collection unit relies on standardized designs. The online diary is designed by the IT-department of Statbel. The IT-department is responsible for the collection of the data, first controls of the price in relation to the quantities and cleaning of these data.

Figure 10: Data collection instruments within the data collection architecture in Belgium

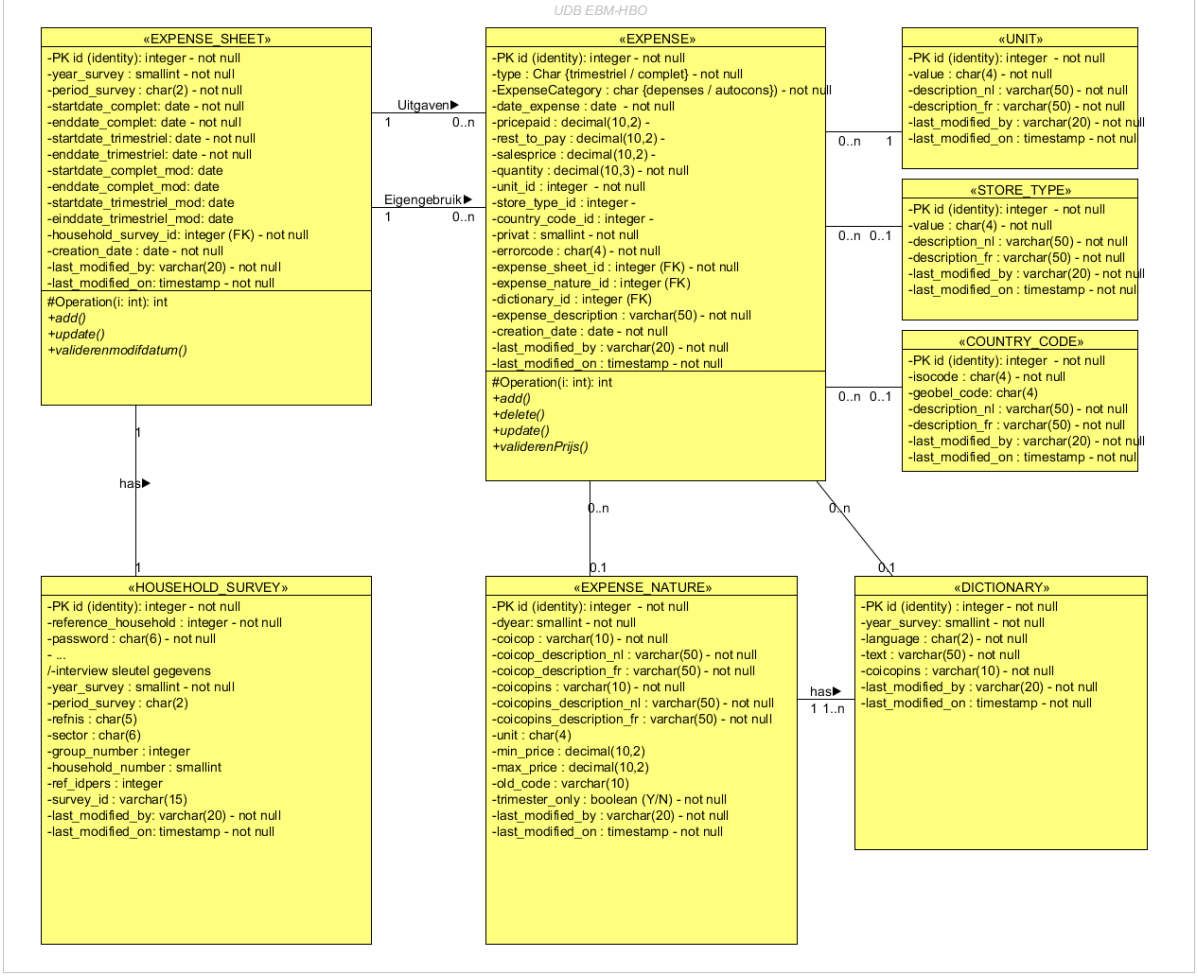


The web diary is an application running in a browser and written in JAVA. Adaptations in the web diary requires changes being made by IT in the JAVA-script. The web diary runs on Tomcat servers and a Linux operating system. The type of database behind is DB2 LUW running on Linux. Below an overview is given of the database characteristics:

1 https://Statbel.fgov.be/sites/default/files/files/documents/Huishoudens/10.1%20Huishoudbudget/INTERIEUR_HBO_carnet_2018_NL.pdf

2 https://hbs.statdata.be/hbs/

Figure 11: Online HBS diary - database characteristics In Belgium



For the offline diary, Statbel lets the coders use the JAVA-application to digitalise the paper diaries.

Besides the diary, the respondents have to complete a survey questionnaire. This completion happens by means of an interview via a computer: a CAWI-survey. The CAWI survey is built via Blaise. Blaise is a computer-assisted interviewing (CAI) system and survey processing tool developed by CBS (Statistics Netherlands) and fits on different devices and screen sizes. Blaise makes use of the .NET framework. The back-end server of the questionnaires is a Microsoft windows server. When defined, the CAWI-survey is made available to the interviewers via an Ultra Mobile Personal Computer, or UMPC. Overall, the duration of the CAWI interview is estimated to be approximately 45 minutes.

The interaction between the user, the application and database are visualized in figures 12 and 13.

Figure 12: The interaction between the user, the application and the database

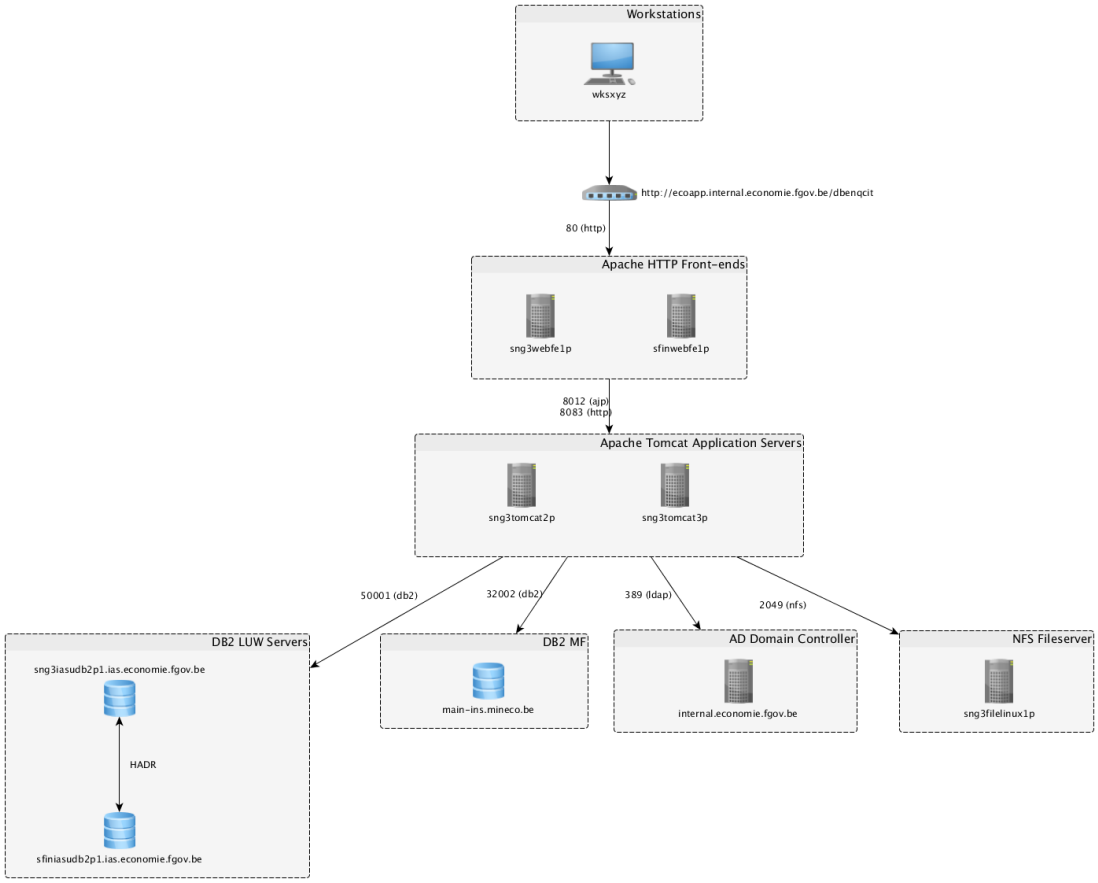
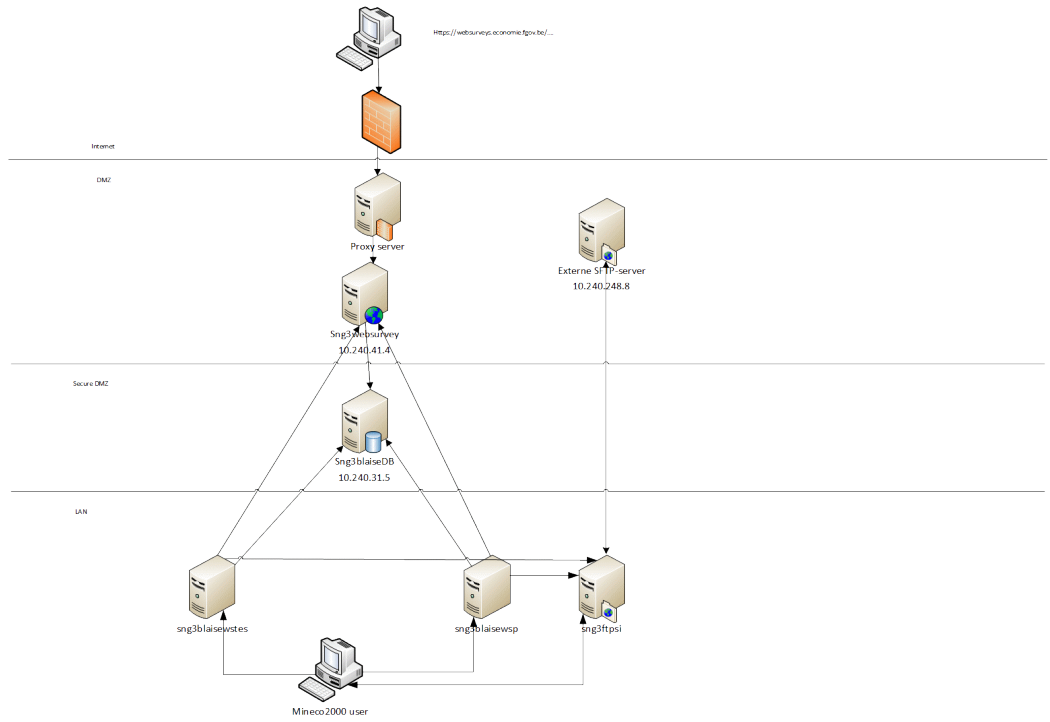


Figure 13: The interaction between the user, the application and the database (2)

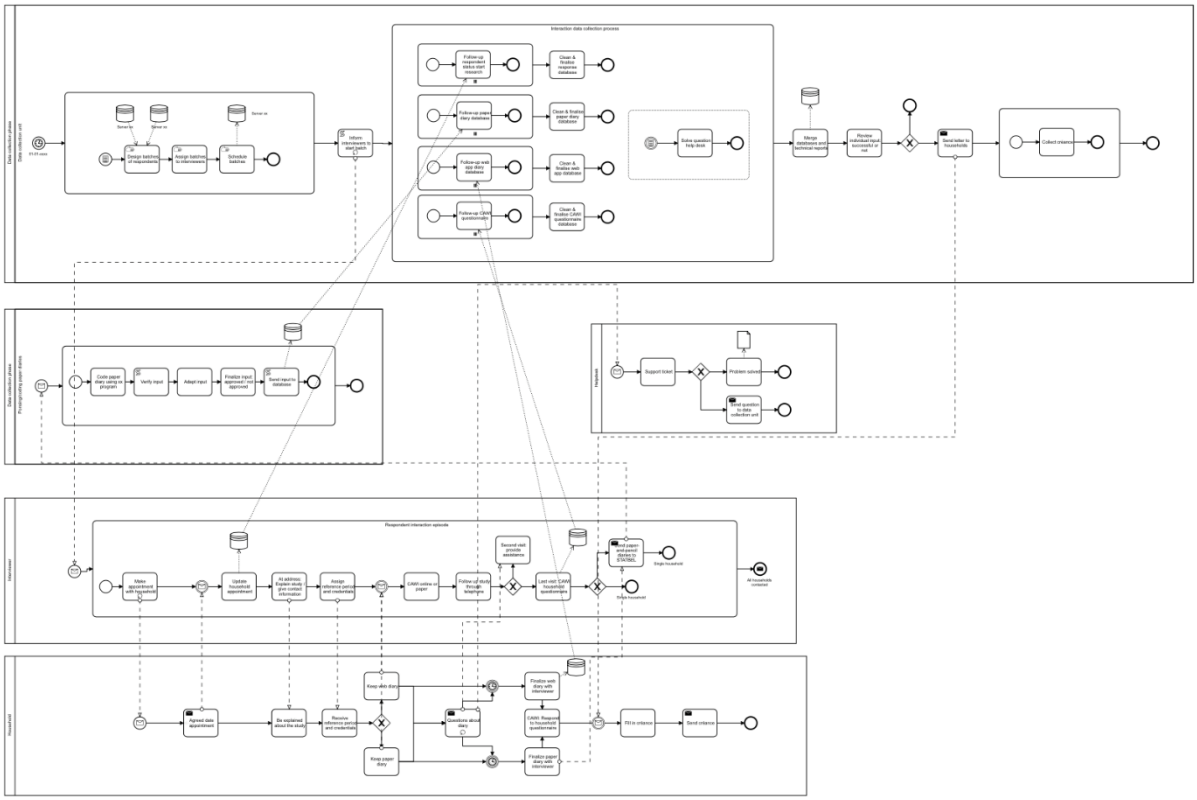


Once all the research elements are prepared and tested they can be approved by the data collection unit.

1.2.3.5 Data collection

After all the preparations, the fieldwork can start. Data collection is most often balanced over the entire duration of one year, including a launch phase running into the previous year and closure phase running into the subsequent year. During the data collection, different roles interfere: the data collection unit, the helpdesk, the interviewers and the households. The helpdesk is responsible for answering the most frequently asked questions. Figure 14 provides insight in the interaction between the various roles.

Figure 14: Data collection architecture within the data collection architecture in Belgium



The factual start of the fieldwork lies within the range of tasks of the data collection unit. They design the batches of the respondents, assign them to the interviewers and schedule them. In what follows, the fieldwork engine continues with parallel running episodes of interviewers contacting households, households participating to the study, interviewers visiting the households in their task of intermediary between the respondents and Statbel, the helpdesk solving and canalizing questions from the respondents and Statbel in their role of supervising the fieldwork and inspecting the quality of the data collection process.

The role of the data collection unit is supported by nightly exports in SAS from out the DB2 LUW database (web diary) and the Blaise databases (via Blaise2DWH programming developed by the E8-DWH team). In order to evaluate the offline response and input, the data collection unit has to rely on the continuous transmission of paper diaries in order to get encoded. As a good practise standard, interviewers have one month after the end of the reference periods batch to return all the documents to Statbel.

Together with the SAS-outputs, Excel files are produced to monitor (by group/mailing lists/payment lists) the fieldwork. The data collection phase ends when all data are collected and have received a first quality check. This quality check is needed to pay out the interviewers and awards the households a compensation.

1.2.3.6 Data dissemination

In this step new variables will be generated like age in groups or status of education. After data entry is completed and the validation is done, the generation of new variables can be started in the DAP. The new variables will be specified in SAS and the same variables will be generated for each household.

To calculate the weights the data will be shared with the methodologists. The weights/extrapolation factors will be calculated using the LFS frame. The weights are getting merged to the final data set.

The validated datasets are exported from SAS to Sharepoint. Further processing of the data is done in SAS. For HBS there are almost 50 different aggregated tables published on our website. For TUS, a separate website was developed by the Vrije Universiteit Brussel for the dissemination, with dynamic tables that can be produced. This website will be reintegrated In the Statbel website.

The finalized data sets can be used for further analysis and a scientific use file/public use file will be provided for researchers.

1.2.4 Data collection architecture Destatis

Also, Destatis gave a first insight in their business processes and the workflow via the completion of the template. Via the template an overview is received over the tasks and activities Destatis need to fulfill in order to complete the data rounds of EVS and ZVE. EVS stands for Einkommens- und Verbrauchsstichprobe, ZVE stands for Zeitverwendungserhebung. They refer respectively to HBS and TUS.

The provided information also includes technical descriptions of the IT-infrastructure, and the existing linkages between data tools and sources.

The Destatis-model is based on in total 5 phases:

1. Sample selection
2. Recruitment
3. Research instruments
4. Data collection
5. Data dissemination

To present and discuss once more the BPMN-model is used and the technicality of the IT-infrastructure is provided.

Note: the following descriptions in this document refer to current as well as future processes. This is due to the fact that processes simply need to be improved (e.g. confirmation receipt after sending in registration), but also need to be adapted according to the new offer of a mobile app (e.g. push notifications in mobile application, additional interfaces due to mobile app, intensification of communication between RSIs and respondents, ...).

1.2.4.1 Sample selection

In Germany, a crucial fact, that has influence on the respondent journey, is that for EVS and ZVE not a probability sample, but quota sampling is used with a disproportionate distribution.

The quota plan for both surveys splits up the population set of the households into groups by combining the following characteristics: federal state, household type, social status of the main income earner, and for EVS additionally household net income (in 5/6 categories).

Also important is that both studies, ZVE and EVS, are organised as decentralised studies, i.e. data collection (incl. recruitment of households) is conducted by the RSIs. Germany has in total 16 federal

states, and 14 Regional Statistical Institutes or RSIs. Data processing and all phases afterwards are centrally executed in the office of Destatis (national statistical office).

The quota plan is compiled centrally by the department of mathematics and statistical procedures at Destatis. Each RSI receives its own quota plan, that gets imported by Destatis to the administration program (AP – Software for all administration processes within RSIs and the NSI).

1.2.4.2 Recruitment

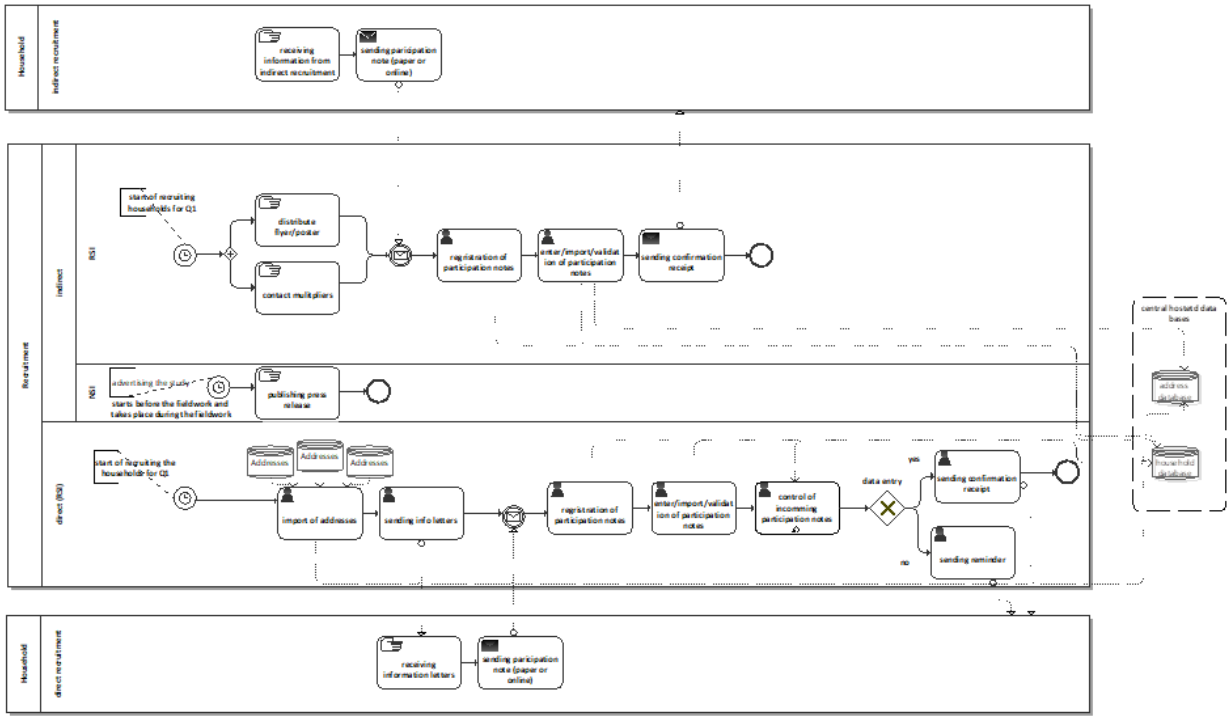
The recruitment step is the first step in the data collection process for an RSI and it starts approx. 5 months before the fieldwork. Within the scope of the recruitment (done by RSIs for each region separately), various measures are undertaken to recruit households for each group until the defined quota target is attained. Participation in ZVE and EVS is voluntary. To create a frame two recruitment strategies are applied: a direct recruitment and an indirect recruitment.

In case of direct recruitment a RSI send letters to known households (import address) and invite them to the study (by sending out info letters). In case of indirect recruitment they distribute flyers and posters at places like supermarkets or kindergarten. Additionally, they contact multipliers in different organisations who distribute the information about the survey to their members.

So, each RSIs uses different data sources for recruiting:

- Addresses of households, that have indicated their consent to take part in studies of official statistics
- Addresses from national register (only in some regions)
- Addresses from organizations, associations, companies (e.g. email list)
- Indirect advertisement: e.g. flyer, social media such as youtube-video, facebook, twitter, ads in newspaper, online ads, press releases, etc.)

Figure 15: Recruitment strategy within the data collection architecture in Germany



Depending on the source RSIs compile address lists with a standard format and import them (manually) into the administration program. In case contacted households - directly or through indirect advertisement - intend to take part in ZVE/EVS, they may register via printed form or online (via IDEV). Data from households that are interested in participation (via paper or online) get recorded in the administration program (AP – Software for all administration processes within RSIs and the NSI), where data get checked towards doublets. Remaining households automatically receive a confirmation of receipt and serve as sampling frame. For direct recruited households it is even possible to remind them if they didn't send their registration.

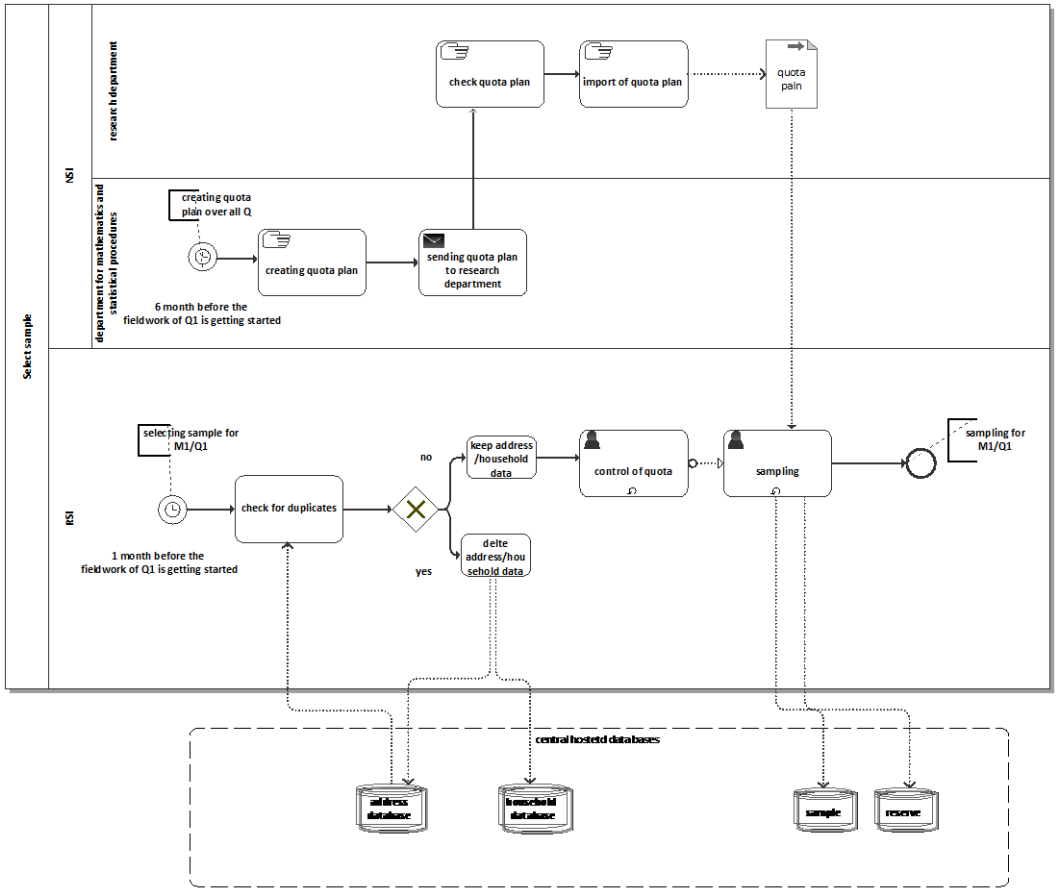
The quota plan is compiled centrally by Destatis for all RSIs and gets imported by Destatis to the administration program. The sample is drawn based on the quota plan.

Before the sampling starts the RSIs control the quota based on the quota plan. The sampling procedure takes place four times (4 quarters).

In EVS for each quarter (of the year: I to IV) based on the sampling source a sample is drawn (regarding the above mentioned criteria). Addresses of households with participation interest, that cannot be considered in the sample of quarter I, get assigned to the next quarter(s).

In ZVE the households selected in quarter I will be randomly distributed to the days in that quarter. For this reason, the first day of the reference period will be selected by random and the second and third day will be selected by using an algorithm.

Figure 16: Sample selection within the data collection architecture in Germany

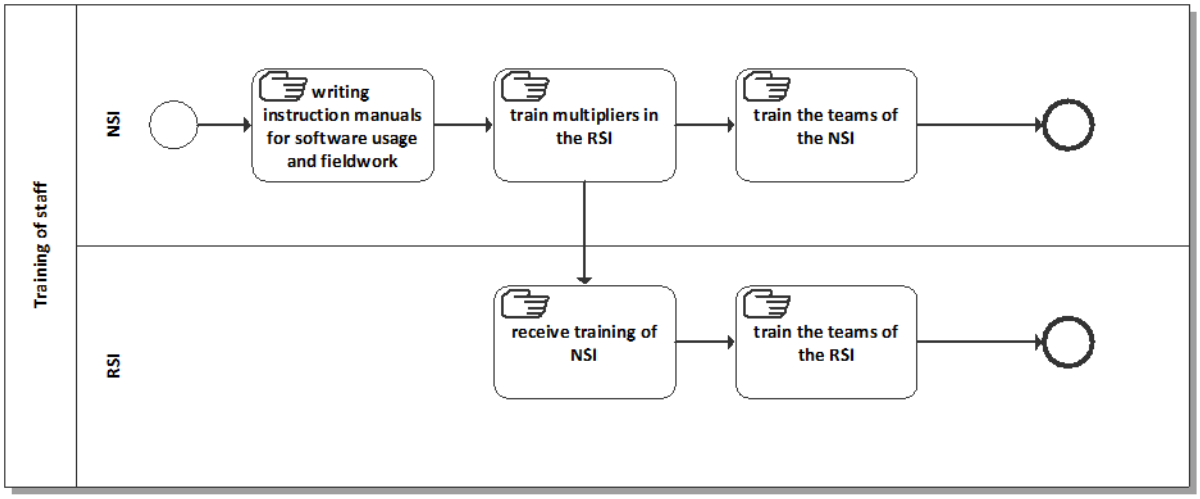


1.2.4.3 Training and selection interviewers

Germany does not make use of interviewers, in contrast to many other countries in the EU. This means, that households/respondents fill in questionnaires by themselves. Certainly, if requested, they get assistance by contact persons in the RSIs.

In preparation of the data collection process the staff will be trained for their tasks by Destatis' central team members. They get to know how the software, i.e. the administration program as well as the mobile app is to use and how they have to support the households during their reference period. Destatis additionally provides instruction manuals for software usage (AP, app) and regarding the assistance towards the households.

Figure 17: Training of RSI contact persons

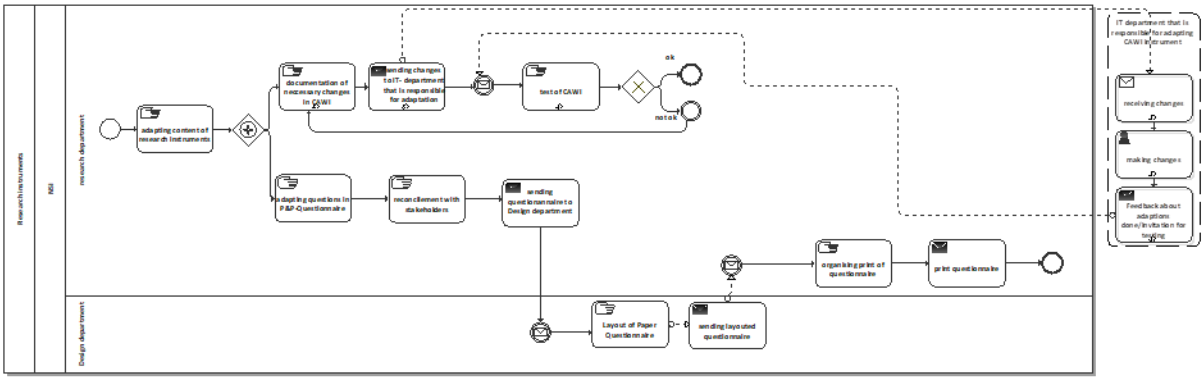


1.2.4.4 Research instrument

Also, for Germany an important step is the preparation of the research instruments. Central to HBS and TUS are the diaries to be completed by the households. In comparison to Belgium, respondents need to fulfill a higher effort: for HBS households track their expenditures for 3 months. For TUS there is the need to fill out the diary for 2 weekdays and 1 weekend day. For HBS one person gathers all information, while in TUS all persons 10 years and older from the household are invited to participate. Survey questionnaires are also part of HBS and TUS.

Most of the research instruments are - at the moment - paper based. Design of the paper questionnaires are made by Destatis and have to follow standardized designs. The same will apply for future IT-based research instruments.

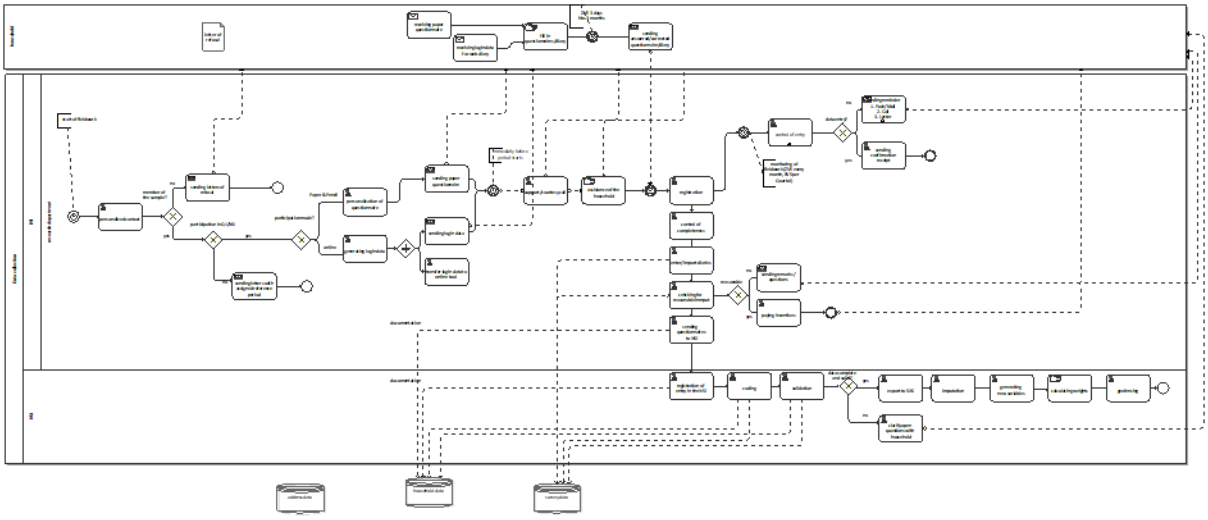
Figure 18: NSI preparing research iInstruments



1.2.4.5 Data collection and dissemination

During this step the RSIs send out either letters of refusal (for households that are not included in the sample(s)) or information letters about assigned reference period, login credentials or paper-questionnaires/diaries. For the selected households in the sample that indicated to use the PAPI-mode the questionnaires will be personalized with an ID, for those who prefer to take part in the study per mobile app, login data will be generated. Close to the assigned reference period households get reminded via email/push-notification and a support/courtesy call will be made within the next 1-2 weeks in order to clarify open questions. For ZVE the reference period will be 3 days and for HBS 3 months.

Figure 19: Data collection architecture within the data collection architecture in Germany



The RSIs offer assistance throughout the survey: for technical questions as well as questions regarding contents of the study. Approx. 1 week after the reference period (depending on mode) households receive a first reminder if mobile app data/paper documents are not sent in (e. g. email/push-notification, 2nd by phone, 3rd by letter). Households using the mobile app additionally should get reminder not only at the end of the reference period, but also shortly after the reference period and no data entry is done. Especially for the 3 months period in EVS, households should have the possibility, to send in data in partial deliveries, e.g. 1 months. The incoming documents will be registered and checked for completeness.

Paper questionnaires will be entered by the RSIs. During the data entry process first validations for extremely high values take place. Households using the app have the possibility to code their activities or expenses to the correct categories with the aid of a search function integrated in the app. For this purpose, the users record the activity or expense in plain text and then, if possible, code it using the suggestions selected by the search algorithm. Activities/Expenses that haven't been coded by the households get coded by the RSIs. For the paper diaries the RSIs code the activities or expenses in this step in the DAP (Data Acquisition Program – software that processes survey data of households, paper and mobile app data).

After data entry is completed the validation of data takes place. In a first step a rough validation will proof if the data is reasonable to pay the incentive. Afterwards a detailed validation is executed. The validation will be done in the DAP. The validation checks are defined in the PL-editor (SteP-tool). Once defined, the code can be exported and imported to the DAP. The households with noticeable implausible entries will be called by RSIs and the data will be corrected in the DAP. In case of EVS, missing or implausible values will be imputed in the DAP and SAS, if possible.

Approx. 6 weeks after the end of reference period RSIs start paying the monetary incentives for households that have delivered reasonable input (questionnaires and diaries). For this reason, the

households send their bank information in a separate letter to the RSIs who enter and validate them in the administration program.

In this step new variables will be generated like age in groups or status of education. After data entry is completed and the validation is done the generation of new variables can be started in the DAP. The new variables will be specified in the DAP and the same variables will be generated for each household. To calculate the weights the data will be exported (csv). The csv will be imported into SAS, where the weights will be calculated. The weights/extrapolation factors will be calculated using the micro census as frame. The weights are getting merged to the final data set, they are not getting imported into the DAP.

The validated datasets are exported from the DAP (csv-format). Further processing of the data is done in SAS. In case of EVS currently three datasets get exported (Allgemeine Angaben, i.e. sociodemographic data and consumer durables, Geld- und Sachvermögen, i.e. monetary and tangible assets, Haushaltsbuch, i.e. diary of expenses). For ZVE there are currently four datasets (Household questionnaire, individual questionnaire, Activities/diary, Dataset where activities are summed up).

1.2.4.6 Data dissemination

The finalized data sets can be used for further analysis and a scientific use file/public use file will be provided. Also finalized data for delivery to Eurostat are prepared.

1.3 (hbits.3) User Guide of MOTUS

Deliverable	To accommodate the use of MOTUS a respondent guide, and a researcher guide will be developed.

This deliverable is provided as a separate document, containing the following items:

- Respondent guide of MOTUS (front-office)
  - Start of the time diary
  - When to start the time diary
  - Primary activity
  - Secondary activity
  - Where and with whom
  - Other context
  - Your timeline
  - Your final activity
  - The app helps you
- Researchers guide of MOTUS (back-office)
  - What is MOTUS?
  - Who is behind MOTUS?
  - Philosophy of the MOTUSbuilder
  - My profile
  - Getting started
  - Design phase
  - Collect phase
  - Analyze phase

2 WP2 – Redefinition

Overall goal	Mapping of the content and the technical requirements for TUS and HBS, to support shareability and reusability

2.1 (hbits.4) Establishment of a prototype e-diary for TUS

Deliverable	Prototype e-diary for TUS

2.1.1 Introduction

The origin of diary research lies in the beginning of the past century and dealt with the legal restriction of working hours and the impact of free time (Bevans, 1913). In the next two decades more studies were done in the UK, Sovjet Union and America. All with a social element in question (Pember, 1914) (Zuzanek, 1980) (Stinson, 1999). The international breakthrough of time-use surveys, however, came with the UNESCO-funded 'Multinational Comparative Time-Budget Research Project', coordinated by Alexander Szalai (Szalai, 1972). Between 1964 and 1966 respondents in twelve countries reported their activities using the same time-diary methodology. From that point on, time-use surveys were never to lose their socio-economic angle of incidence and under impulse of the United Nations the application of time-use surveys for quantifying socio-economic development expanded even more during the 80s, for example, by making visible (the timing of) unpaid work (Juster & Stafford, 1991) (Nations, 2004).

This growing use of time-use data preluded two important global developments in the 90s. Firstly, more and more academics started taking up time-diary methodology to analyse a wide variety of social and economic issues and, secondly, more and more national statistical offices started conducting time-use surveys. The former led to the congregation of scholars in the International Association for Time Use Research (IATUR), the latter to a plea for more international comparative data (Harvey, 1993) either by post-harmonising existing databases or by pre-harmonising the time-diary methodology. The post-harmonisation has largely been realized by the Oxford Centre for Time Use Research (CTUR) and resulted in an open-access database of Multinational Time Use Survey (MTUS), containing both EU- and American data.

The process of pre-harmonisation, which logically was not at issue for the American Time Use Surveys but of major importance for the European Time Use Surveys, was not taken lightly and under the leadership of EUROSTAT resulted in a decade of debates and decision making that ultimately culminated in the guidelines on Harmonized European Time-Use Surveys (HETUS) (Commission, 2008).

2.1.2 Harmonized European Time Use Surveys Guidelines

Since 2000, EUROSTAT promotes time-use surveys in its member states and associated countries. Today comparable datasets of more than 20 countries are gathered, collecting data over in total 2 data rounds. The first version of the guidelines was published in 2000 and revised in 2008 and 2018. The most recent publication can be found online[1]. The Guidelines refer mainly to the following 3 elements:

- Sample design
  - Population delimitation
  - Households: all inhabitants 10 years and over
- Diary days
  - Observation window: one weekday and one weekend day

[1] https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-GQ-19-003

  - Fieldwork period: coverage of one year
- Survey forms
  - Household and individual questionnaire
  - Time diary

Both the survey forms are part of the time diary research setup, but it is the time diary as such that is at the center of the modernization initiative. For every step within the time diary research the intervention of an interviewer is necessary.

2.1.2.1 Household and individual survey

The guidelines discuss the core and voluntary questions and their relation to other European Surveys. The household questionnaire is directed to the reference person within the household and rubrics relate to the household composition, provision of childcare, housing and living conditions, ownership and use of items like a tv and a washing machine, the execution of infrequent/productive activities like building a house or growing plants and breeding pets, the sources and amount of income and the occurrence of help to the family.

The individual questionnaire is presented to every household member 10 years and older and starts with questions on the respondents professional life (first and second jobs). Also, the time devoted to work and the income gained from it is questioned. A part is devoted to people without a gainful employment. Furthermore, this questionnaire collects information on the educational status of the respondent, along the ISCED classification. The questionnaire continues with questions on the health status of the respondent and the feeling of being rushed. The remainder goes about biographic information from the respondent, but also on having a driver license or not.

2.1.2.2 Time diary

The time diary characterizes itself by its design, the variables, the Activity Classification List and the different parameters that furthermore are essential in the time diary data collection.

Design

The guidelines describe a A5-format booklet, capturing 3 hours per page in time slots of 10 minutes, and in total 8 pages to cover an entire day. One day is reported in 144 time slots (24 x 6). Per day an extra page is added to pose questions on e.g. whether or not feeling rushed or the kind of the day. Including an introduction and a guideline for respondents, a time diary for 2 days counts between 20 and 24 pages (recto verso). Countries have shown to be inventive with these standards to be more in line with the materials of their NSI, or to support the registration willingness of the respondent.

Variables

The diary captures information on the primary and secondary activity, on the place or transport mode and the social context of the activity. What people do, and where they are is being reported in the own wordings of the respondent. The with whom question is addressed via a multiple answer question and check boxes.

Recently two more variables were added to the time diary: the use of a computer or internet (check box yes/no), while an indicator for well-being was added to the end of day questionnaire asking whether or not the diary day was pleasant or unpleasant (scale 1 to 5).

In general, the time diary captures the activity being done (primary and secondary) and the context of the activity (spatial, social & temporal dimension). Variables can be filled out independently from each other, and can span more than one time slot usually indicated by dragging a downward line.

Activity Classification List (ACL)

After respondents have written down in their booklet what they have done during 2 days (one weekday and one weekend day) the input in plain text needs to be converted to electronic codes by post-coders. To standardize/harmonize this process the coders rely on the Activity Classification List or ACL. "A statistical classification or nomenclature is an exhaustive and structured set of mutually exclusive and well-described categories, often presented in a hierarchy that is reflected by the numeric or alphabetical codes assigned to them, used to standardize concepts and compile statistical data (European Commission[1])".

The HETUS code list goes up to 3 digits, and so providing a 3-level classification with at the most general level in total 10 activity groups, being:

0. Personal care
1. Employment
2. Study
3. Household and family care
4. Voluntary work and meetings
5. Social life and entertainment
6. Sports and outdoor activities
7. Hobbies and computing
8. Mass media
9. Travel and unspecified time use

On the second level the Activity Classification List holds 34 categories, and the third level 116 categories. Some countries opted for a fourth level, and so 4 digits in case they wanted to add some more detail (e.g. going to the sauna, Finland).

The Activity Classification List also holds information on how to digitalize the context variables: computer/pc, with whom, location and transport mode and the satisfaction with the activity.

Parameters

Parameters are seen as settings that in essence can variate, but due to the decisions been made also characterize the time diary (approach). Above already a number of parameters were mentioned. Nevertheless, the parameters within the HETUS time diary collection are:

- Cluster: individual and household, household members fill in the same days
- Length of the fieldwork: one year
- Observation window: one weekday and one weekend day, so in total 2 diary days that are most likely detached from each other but within the period of one week
- Grain of precision: 10 minutes
- Registration focus: continuous
- Input method: own wordings
- Activity list: post-coding
- Context question: standard to all activities
- Quality: checked by interviewer, and after coding phase

All elements together define the EUROSTAT-HETUS time diary approach. The Guidelines was also a basic ingredient of the Survey on Time Use Survey Innovative Tools and Sources.

[1] https://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Classification#:~:text=A%20statistical%20classification%20or%20nomenclature,concepts%20and%20compile%20statistical%20data.

2.1.3 Survey on Time Use Survey Innovative Tools and Sources

The focus of the survey dates back to 2011 when the Wiesbaden Memorandum[1] called for better information on time use and household budgets. In order to improve the quality and the reliability of the registration, both the participation rate needs to be improved and the registration burden needs to be lowered. A way to support this strategy is to develop/deploy modern tools and to include new sources of information.

With the survey EUROSTAT wished to get an overview of the expertise in the Member States in the field of Time Use Surveys. The survey consisted of 3 parts: past and current expertise, future interest and an inventory of innovative tools and sources developed and used by Member States.

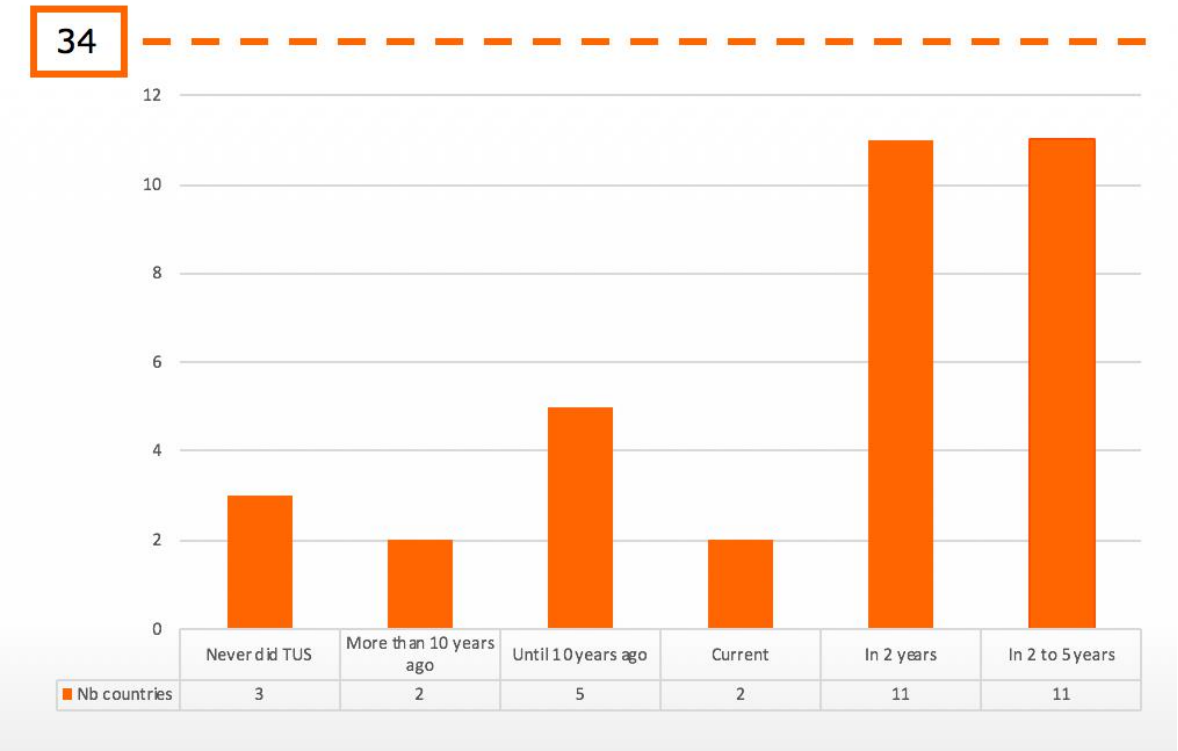
Within the scope of this deliverable we present the results that guided us to define the first prototype of an e-diary. The inventory is online available at and also includes the MOTUS-software platform[2].

Part 2.3.1 will outline the expertise in TUS, part 2.3.2 shows the adaption of the HETUS-guidelines. Starting with part 2.3.3 the survey looked to grasp the future interest: what methods and modes to be used. Part 2.3.4 deals about sampling, fieldwork setup and the parameters the define a time use diary.

2.1.3.1 Expertise in Time Use Survey data collection

The geographical representation of the responses shows the broad interest in TUS-surveys in general. Notwithstanding this willingness to respond, the variation in expertise is fairly extensive as shown in Figure 20.

Figure 20: Country expertise in Time Use Surveys, Q1 2018



[1] https://circabc.europa.eu/sd/a/51a4bcbd-2ac2-46a8-8992-cfb9e6009522/Item_3.3.%20Modernisation%20of%20Social%20statistics_annex.pdf
[2] https://webgate.ec.europa.eu/fpfis/wikis/display/ISTLCS/INVENTORY

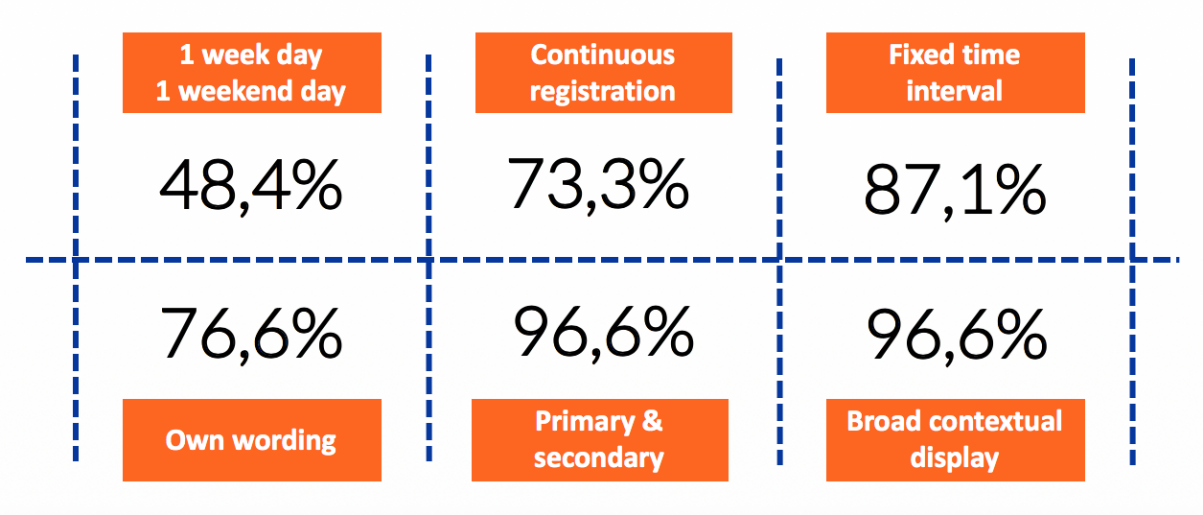
3 of the repliers never did a time use data collection before, for 2 of them the last data collection was more than 10 years ago. 5 institutions have a more recent experience, meaning that the last data collection dated back not more than 10 years ago.

At the moment the survey responses were gathered, Q1 2018, 2 institutes were in the field collecting time use data, another 11 were going to conduct a new data collection within the next 2 years. Also 11 participants to the study indicated it was very likely to field a new time use survey within the time frame of 2 to 5 years.

2.1.3.2 Adoption of the HETUS-guidelines

The HETUS-guidelines declare some recommendations to pre-harmonize the data collection and to improve the comparability of the results. As presented in Figure 2, the survey asked about the adoption of six parameters during the most recent data collection. The countries who never conducted a TUS were excluded.

Figure 21: Recommendation of time diary parameters in HETUS guidelines



The results show a fairly large acceptance of the HETUS-recommendations. Almost all data collections included the registration of a primary and secondary activity together with input on the context of the activity. Also the fixed time interval of 10 minutes is being applied by a large group. For at least 3 out of 6 parameters the HETUS-guidelines were followed to a large extent. This is also in a large sense true for the next two parameters: activities were mostly registered in their own wordings and with a continuous registration method as strategy.

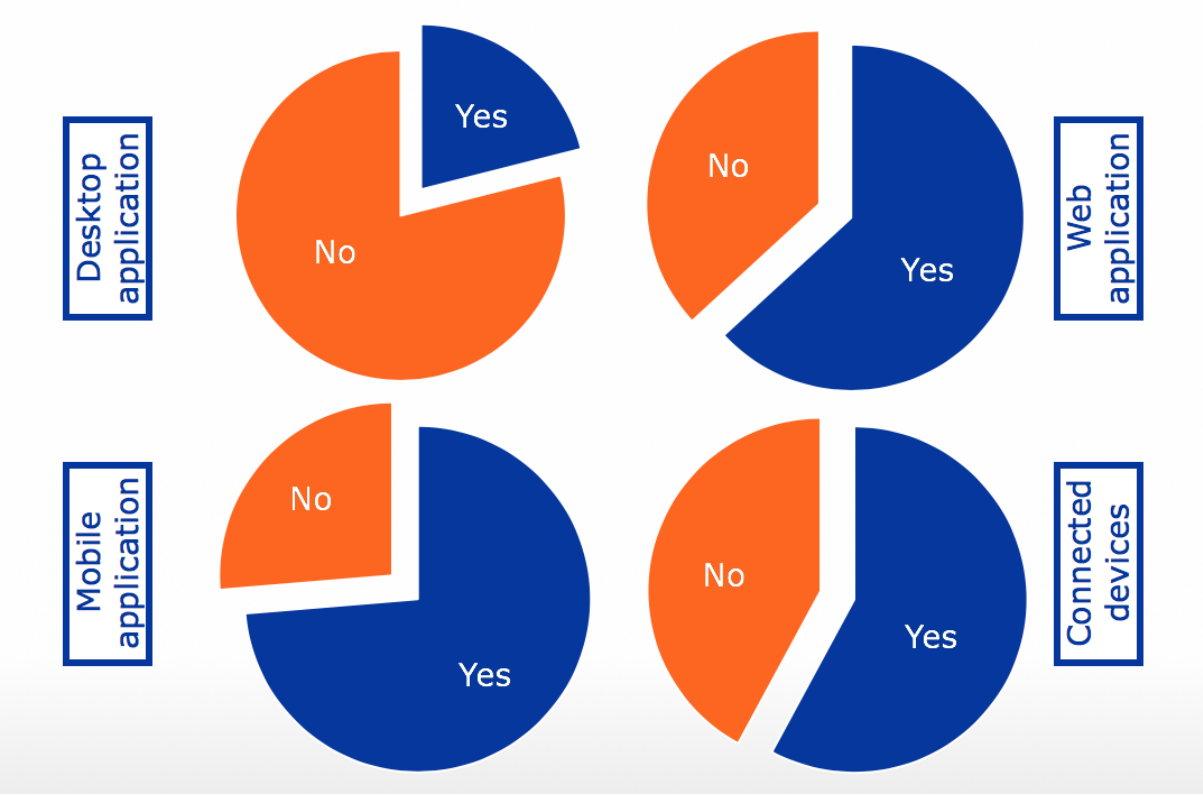
The HETUS-recommendation to collect one weekday and one weekend day is with below 50% the only parameter that was not followed thoroughly. Besides the HETUS-recommendation of one weekday and one weekend day 1 organisation kept a 1-day diary, 2 of them kept a two day-diary but consecutively. 3 hold a 3-day diary (one weekday and two weekend days, or vice versa), 5 organisations kept a 7-day diary and another 5 kept a diary during an even longer period.

The variation in the observation window is presumable biased by the expertise level. Older studies correlate more to the 2-day approach of HETUS, the recent ones tend to collect more diary days per respondent in order to capture a larger intrapersonal variance. Evenly true is the difference between NSIs and non-NSIs. The non-NSIs differ more from the HETUS-guidelines.

2.1.3.3 Inclusion of modern data collection techniques

Another level of expertise deals with the use of modern data collection techniques. 15 countries have only an expertise in the traditional data collection techniques (P&P, PAPI, CAPI, CATI, CAWI). 19 organizations plan or already make use of an application for desktop, web or mobile to collect time use data, and/or include connected devices/sensors in their collection strategy.

Figure 22: Inclusion of modern data collection techniques



The pie-charts show the interest for the inclusion of web and mobile applications, and this in contrast to the use of a desktop application. To run these applications, the smartphone is seen as the most vital device, while also 80% of the answers indicate to the importance of a computer and/or a tablet. The foreseen use of a wearable is rather modest (1/3rd), the inclusion of a smartwatch is neglectable at Q1 2018.

The future of time-use research is online. Therefore, the next part of the questionnaire posed questions on future requirements for a data collection tool (a) and the benefits expected from external sources (b).

2.1.3.4 Setting up a data collection tool

Looking to future TUS data collections the questionnaire addressed the sample composition, the fieldwork setup and the parameters for the time diary. All these various aspects define the qualities of a data collection tool. Below an overview is given on the future perspectives according to the participants to the survey at Q1 2018.

All household members 10 years and above

There is no majority to include the participation of young children (under 10) or elderly/disabled household members. An option might be to retain information via proxy input.

Intensive role for the interviewers

The interviewers operate alongside the tool, and remain important for the invitation, introduction and data collection phase, and less for the cleaning and coding phase.

Online and offline survey & diary

The main importance is to acquire an application to collect online and offline time diary data via an application. A majority would also like to collect questionnaires via an application. There is less interest for a tool that also is helpful to the communication with the respondent, to follow-up on the process of the fieldwork, to support the construction of the database (including calibration and metadata) and to support the analysis of the data.

Time diary parameters

The parameters of a diary are linked to 4 different elements: duration, precision, content and quality.

In respect to duration the survey shows that a majority still opts for the weekday and weekend day as the observation window for future data collections. In contrast, another group is in favour for a 7-day registration and even longer.

The main topic related to precision is about the registration method, where a combination of methods seems to be the way forward according to the responders. The methods were: retrospective, continuous (most favourite), time tracking and ESM. The retrospective method is the recall approach to ask people to give information about the past 24 hours. The continuous approach is the current HETUS-recommendation where respondents are asked to fill in the diary close to the end of an activity/begin of the next activity. Time tracking is used when the duration of an activity is measured by pushing the start and end button. The time in between correspondents with the duration of the activity. Experience Sampling Method has been an important element in the seventies where a random beeper signal (6 to 8 times a day) was send to the respondent in order to record the beginning and end of the activity the respondent was performing at that moment. Although being indicated less frequently it seems the ESM-approach is reviving.

A third element is the content, and deals with whether or not a pre-defined Activity Classification List can be part of the diary setup, an whether or not the same context questions should be attached to all activities recorded, or whether this can variate from activity to activity. The responses to the questionnaire show that a pre-coded activity suits better with an online application but that open recording still should be possible. Also, the specific context questions are found to be an extra value.

The quality assessment is the last element to be touched upon. It deals mainly when and how, and who does the quality assessment. The results show that the respondent should be informed about problems during, and after the diary day (period) but with the option to correct/improve the data input. To get a better grip on the composition of these parameters within an actual time diary, the questionnaire proposed a particular configuration:

- A pre-defined activity list
    - Classified in 3 (or 2) levels
    - Including detailed activities and attached codes
- + a combination of
    - Selection, and
    - Search [and the possibility to]
        - Typing [and/or]
        - Speech recognition
- + a specification of other activities in an open box through
        - Typing [and/or]
        - Speech recognition

The respondents were asked to evaluate this configuration on a scale from 1 to 5. An average of 4,6 was given. Also, the adoption of specific context questions was disclosed for review by the respondents. Here an average of 4,4 came out.

2.1.4 Other sources and inventory tools

Besides the past and current expertise of countries and institutions in the TUS data collection also the interest in other sources of information was questioned via the survey. These other sources can be administrative databases, electronic databases or sensors data captured via smart devices.

The results of this part of the questionnaire are not discussed within the SOURCE^{TM}-project, but have a large impact on the future online experience of keeping at time diary by respondents. hbits.5 and hbits.6 deal with elements that are necessary to include passive registration. Moreover the summary report hbits.12 will take up the future essence of passive data collection strategies.

Another part of the questionnaire was reserved to collect information on the platform details the institutions were developing or using to collect TUS information. Within the SOURCE^{TM}-project the MOTUS software platform is being discussed extensively. Information about other platforms can be found via the Inventory[1].

2.1.5 Reusability of components

Referring to other working reports within the SOURCE^{TM}-project, MOTUS is particular powerful because of the modularity of the components in the back-office. The available research components can be (re)defined within the MOTUS platform itself. At the same time the platform can assure within a given context comparability, reliability and quality of the data.

In doing so, an NSI can design survey questionnaires, time diaries, activity-based questionnaires, and communication strategies. Next, all research elements can be combined into an automated flow. Once configured, the research flow runs automatically, including communication with respondents.

Clearly the HETUS-guidelines provide the boundaries within which ESS-comparable TUS-data need to be collected. This means that we will use the components of MOTUS to program the TUS-ecosystem as being known from the HETUS-guidelines. For the e-diary it means the setup of:

- a household survey,
- an individual survey,
- a time diary,
- extra questions linked to the completed diary day.

However, the HETUS-guidelines are paper-and-pencil oriented while the modernization trajectory for TUS pushes forward to collect time data online via web and mobile applications and the inclusion of other data sources. In that respect, we also take into account the outcomes from the questionnaire on tools and sources as highlighted above to arrive to a HETUS e-diary. This mainly is linked to the different parameters of the e-diary:

- number of diary days,
- length of the observation period,
- start of day cycle,
- …

An extra task we took on board is the translation of Activity Classification List as a coder-oriented list to an Online Activity Classification List being respondent-oriented, and it shows again the reuse of

[1] https://webgate.ec.europa.eu/fpfis/wikis/display/ISTLCS/INVENTORY

components. The OACL is not part of an official project of EUROSTAT, and is not discussed within any meeting related to a Working Group or Task Force of TUS.

The main task within hbits.4 is to define a general version of a TUS e-diary. Furthermore, within hbits.4 the diary component is reused to variate on this general version. As an example Destatis collects 3 diary days spread over 2 weekdays and 1 weekend day.

An element what is not part of the e-diary setup is het household level. Different household members can take part to the study, and the members can be asked to keep the same diary days but the household level as such is not seen as a cluster which pass through the flow together. This element will be taken up as a recommendation for a new development within hbits.6.

2.1.6 HETUS e-diary

The MOTUS application can be used for different studies, running at the same time.

In order to test the HETUS e-diary the MOTUS application needs to be used together with a username and a password. The connection with a dedicated username and password will provide the research components and research flow of the HETUS e-diary to the user.

Test respondents can test the study via de web application and/or the mobile application. The research information is available for both applications and for multiple devices in case they are used by the respondent. In essence: the information is synced. The credentials were provided through an automated e-mail send to their inbox.

- To use the web application, go to: www.motusbuilder.io
- To use the mobile application, go to:
  - App Store, iOS: https://apps.apple.com/be/app/motus-zap-vub/id956934466
  - Play Store, Android: https://play.google.com/store/apps/details?id=be.byteworks.motus

2.1.6.1 Research flow general study

One of the main characteristics of MOTUS is that the platform supports online data collection via automated processes. The presented research flow discusses the various stages the respondents have to go through in order to complete their participation successfully. The research flow also takes into account the various actions and communications that are part of every stage. The figure below shows the research flow in MOTUS. For every research (as well as for every country) this flow can be different, as it is been build up by modular components. The communication flow prepared by Belgium that will be used in the next TUS in 2021 can be found in Statbel.4 and as the additional documents:

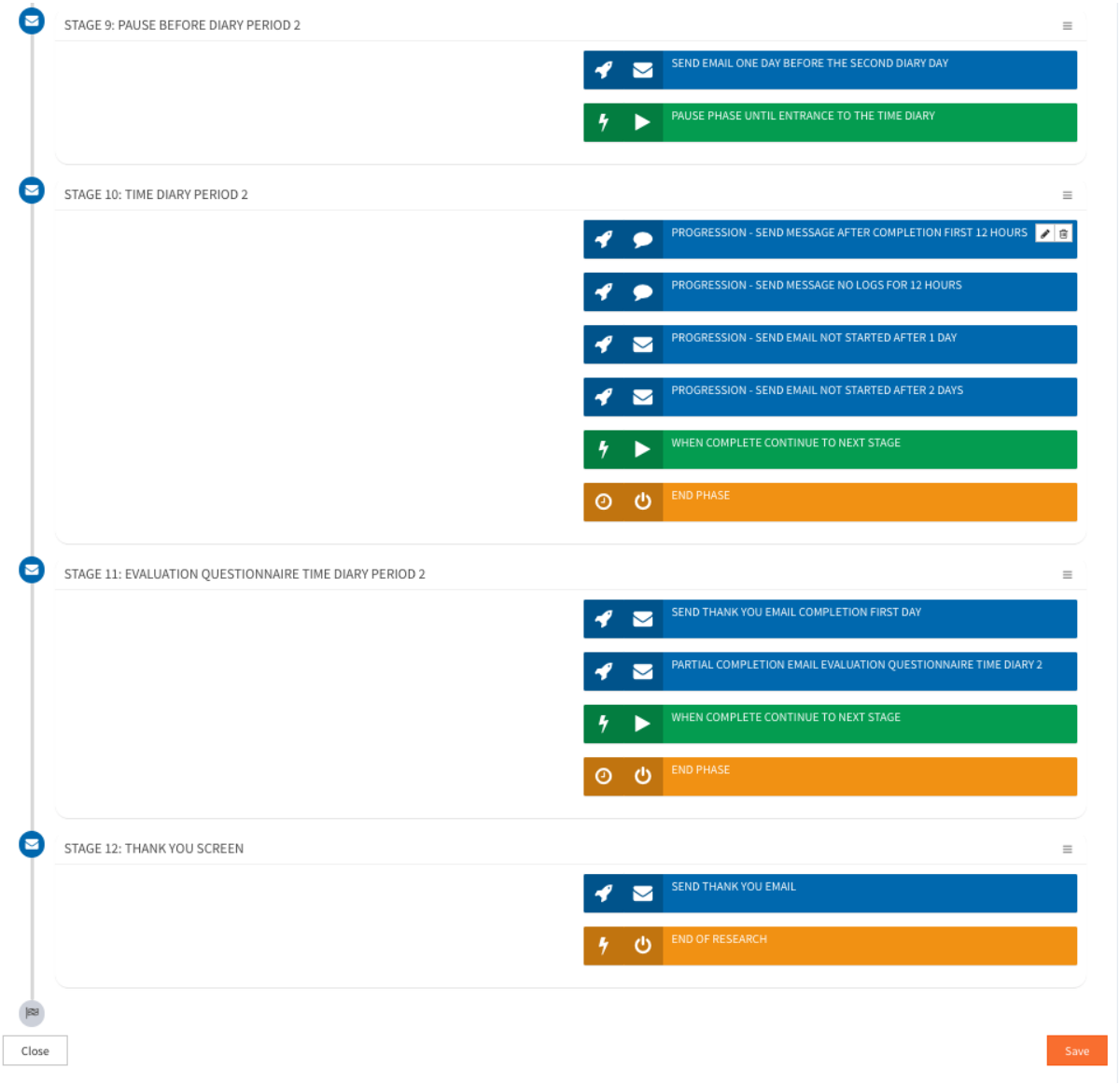
- 847218_BE_final report_Communication_Flow_ENG
- 847218_BE_final report_Communication_Flow_FR
- 847218_BE_final report_Communication_Flow_NL

Figure 23: Research flow (part 1)

Figure 24: Research flow (part 2)


STAGE 5: ALLOCATION OF THE TWO DIARY DAYS
EMAIL WITH THE DIARY DAYS TO BE COMPLETED
WHEN ALLOCATED CONTINUE TO NEXT STAGE
STAGE 6: PAUSE BEFORE DIARY PERIOD 1
EMAIL ONE DAY BEFORE THE FIRST DIARY DAY
PAUSE PHASE UNTIL ENTRANCE TO THE TIME DIARY
STAGE 7: TIME DIARY PERIOD 1
PROGRESSION - SEND MESSAGE AFTER COMPLETION FIRST 12 HOURS
PROGRESSION - SEND MESSAGE NO LOGS FOR 12 HOURS
TIME DIARY INSTRUCTIONS
PROGRESSION - SEND EMAIL NOT STARTED AFTER 1 DAY
PROGRESSION - SEND EMAIL NOT STARTED AFTER 2 DAYS
WHEN COMPLETE CONTINUE TO NEXT STAGE
END PHASE
STAGE 8: EVALUATION QUESTIONNAIRE TIME DIARY PERIOD 1
SEND THANK YOU EMAIL COMPLETION FIRST DAY
PARTIAL COMPLETION EMAIL EVALUATION QUESTIONNAIRE TIME DIARY 1
WHEN COMPLETE CONTINUE TO NEXT STAGE
END PHASE

Figure 25: Research flow (part 3)



Stage 1: Read in of the respondents

In order to invite the respondent to participate to the study, MOTUS needs to know the contact details of the respondent, and more in particularly the email address. In the best-case scenario also other background information is provided to MOTUS. There are two options: one is to upload a file of respondents to MOTUS, another is to enter the respondents via an API-link. This API-link can as an example be linked to a webpage where respondents can subscribe themselves to this study.

Action: Once respondents are linked to the study the respondents will automatically go to the next stage.

Stage 2: Send invitation to participate

In this stage an automatic invitation to the respondent is send over by email. This email contains information about the project and contact details, but most importantly also the credentials to participate to the study and the information how to participate via the web and/or mobile application. See additional document 847218_BE_final report_Communication_Flow.

- *Communication: Send invitation email*
- *Communication: Send reminder email*
- *Communication: Send reminder email*
- *Action: When logged in continue to next stage*

Stage 3: Complete household questionnaire

The completion of the household questionnaire. The household questionnaire is based on the HETUS-guidelines. See additional document 847218_BE_final report_Household_Questionnaire.

- *Communication: Send thank you email completion of the questionnaire*
- *Communication: Send email to continue the completion of the questionnaire (1)*
- *Communication: Send email to continue the completion of the questionnaire (2)*
- *Action: When completed continue to next stage*

Stage 4: Complete individual questionnaire

The completion of the individual questionnaire. The individual questionnaire is based on the HETUS-guidelines. See additional document 847218_BE_final report_Individual_Questionnaire.

- *Communication: Send thank you email completion of the questionnaire*
- *Communication: Send email to continue the completion of the questionnaire (1)*
- *Communication: Send email to continue the completion of the questionnaire (2)*
- *Action: When completed continue to next stage*

Stage 5: Allocation of the two diary periods

An allocation algorithm defines the two diary days that needs to be completed. These two diary days will be communicated to the respondent via an email.

- *Communication: Send email with diary days to be completed*
- *Action: When allocated continue to next stage*

Stage 6: Pause before diary period 1

Waiting time and provide (extra) information to the respondent.

- *Communication: Send email one day before the first diary day*
- *Action: Pause phase until entrance to the time diary*

Stage 7: Time diary period 1

The completion of a 1-day diary starting at 4 am in the morning and a 24-hour registration condition (begin first activity to end last activity > 24 hours). The respondents register their activities (primary & secondary) using the Online Activity Classification List. The begin and ending time of the activities is defined by the respondent. In addition, the respondents answer extra context questions. The context questions differ according whether or not it is a transportation activity. See additional document 847218_BE_final report_Activity_List.

- *Communication: Send email with time diary instructions*
- *Communication: Send message after completion of the first 12 hours*
- *Communication: Send message when no logs for 12 hours*
- *Communication: Send email when not started after one day*
- *Communication: Send email when not started after two days*
- *Action: When completed continue to next stage*

Stage 8: Evaluation questionnaire time diary period 1

The completion of the evaluation questionnaire for the first diary period. The household questionnaire is based on the HETUS-guidelines See additional document 847218_BE_final report_Evaluation_Questionnaire.

- *Communication: Send thank you email completion first day*
- *Communication: Send email to continue the completion of the questionnaire*
- *Action: When completed continue to next stage*

Stage 9: Pause before diary period 2

Waiting time and provide (extra) information to the respondent.

- *Communication: Send email one day before the second diary day*
- *Action: Pause phase until entrance to the time diary*

Stage 10: Time diary period 2

The completion of a 1-day diary starting at 4 am in the morning and a 24 hour registration condition (begin first activity to end last activity > 24 hours). The respondents register their activities (primary & secondary) using the Online Activity Classification List. The begin and ending time of the activities is defined by the respondent. In addition, the respondents answer extra context questions. The context questions differ according whether or not it is a transportation activity. See additional document 847218_BE_final report_Activity_List.

- *Communication: Send message after completion of the first 12 hours*
- *Communication: Send message when no logs for 12 hours*
- *Communication: Send email when not started after one day*
- *Communication: Send email when not started after two days*
- *Action: When completed continue to next stage*

Stage 11: Evaluation questionnaire time diary period 2

The completion of the evaluation questionnaire for the second diary day. The household questionnaire is based on the HETUS-guidelines. See additional document 847218_BE_final report_Evaluation_Questionnaire.

- *Communication: Send thank you email completion first day*
- *Communication: Send email to remined respondent to continuously report activities*
- *Communication: Send email to thank respondent to have completed the first 12 hours*
- *Action: When completed continue to next stage*

Stage 12: Thank you screen

The participation is completed

- *Communication: Send thank you email*
- *Action: Put the respondent to end after 2 days*

2.1.6.2 Research flow Destatis study

The Destatis study is different in setup since in Germany not only one weekday and weekend day is collected from the respondent, but two consecutive weekdays and one weekend day. Therefore, the workflow needs adaption, also with regard to the communication towards the respondent. Also other countries might differ in the number of reporting days, so that MOTUS can be easily adapted towards the different requirements.

2.1.6.3 Available languages

Another strength of MOTUS is the multi-language capability. The study can be designed in multiple languages, and the respondent can choose the language that is preferred the most. During the data collection the respondent can change between languages. The preference is remembered by MOTUS and each time the respondent uses the application the latest language is provided. Changes between languages during the study does not results in a loss of data.

If the language preference of the respondent is known before the start of the study all settings are immediately in place. This information can be extracted from the browser language, the installation language of the device or an administrative preference (or even an administrative obligation). When the language preference cannot be detected the default language is shown to the respondent.

In the proto-type the following languages were provided:

- English (default)
- Dutch
- French

The output in the data file is code based and as provided by the researcher (eg. variable names).

2.2 (Statbel.3) Description e-HBS Belgium

Deliverable	Documented experiences of e-HBS in Belgium and list of requirements for future use.

This deliverable is provided as a separate document, containing the following items:

- Digital questionnaire since 2012
- Digital diary since 2014
- Current potentials problems
    - Declining sample size
    - Reasons not to participate in HBS
    - Other problems
- Future requirements/standards for an e-HBS data collection
-

2.3 (Destatis.3) Description e-HBS & TUS Germany

Deliverable	Detailed descriptions and list of requirements for current and future use of HBS and TUS in Germany.

This deliverable is provided as a separate document, containing the following items:

- Background
- Study overview
    - Sample
    - Survey contents
    - Need for action
- Time aspects
    - Description of the professional and technical requirements
    - Overarching requirements from the ZVE and HBS
    - Detailed survey-specific requirements for the ZVE and HBS
- Appendix
    - Classification server – brief description
- Overview of requirements and classification of Must/Can-criteria

2.4 (hbits.5) Inventory MOTUS towards e-HBS

Deliverable	Report on the existing (internal) processes MOTUS includes to facilitate HBS data collections.

2.4.1 Summary functional descriptions

MOTUS is a software platform developed to support the Time Use Survey (TUS) data collection, and more in particular e-TUS. In doing so the platform makes use of different (so called) *builders* that support the design of the study, the collection of the data and the analysis of the data.

Where TUS makes use of a diary to help individuals and households to report all of their daily activities, HBS makes use of a diary to report the consumption expenditures that individuals and households make. The eco-system of both studies furthermore include questionnaires and communications to/from the respondents.

This report has the function to serve as an Inventory of which components within MOTUS can be reused to support e-HBS. To gain more insights, this report starts with the Statbel and Destatis experiences with HBS. The EUROSTAT Inventory of HBS tools is available online[1], the Statbel and Destatis experiences are written down in documents Statbel.3 and Destatis.3.

2.4.1.1 e-HBS Statbel

MOTUS still needs adaptions and further development in order to be ready for use in HBS. Belgian requirements towards an application for HBS are listed in detail in Statbel.3. From a Belgian perspective the most important developments that need to be taken into account are:

- The COICOP-classification structure, that is much more detailed (for Belgian HBS up to 6-level codes) than the classification of activities. A workable solution including a search algorithm has to be developed offering respondents a quick and easy way to code their expenses.
- Passive registration possibilities, above all receipt scanning, as it will reduce the burden of respondents entering expenses.

Based on the progress of this project, which showed some first concepts and possible solutions Belgium is confident that MOTUS will be adaptable to HBS in the future, and so will become a tool for cross-domain research.

2.4.1.2 e-HBS Destatis

MOTUS still needs adaptions and further development in order to be ready for use in HBS. German requirements towards an application for HBS are listed in detail in Destatis.3. From a German perspective the most important developments that need to be taken into account are:

- The COICOP-classification structure, that is much more detailed (for Belgian HBS up to 6-level codes) than the classification of activities. A workable solution including a search algorithm has to be developed offering respondents a quick and easy way to code their expenses.
- Passive registration possibilities, above all receipt scanning, as it will reduce the burden of respondents entering expenses.
- Setup logic for user identifiers (household/individuals) – not only for HBS, but also TUS.
- Multi capability in order to respect involvement of different roles of RSIs – not only for HBS, but also TUS.

[1] https://webgate.ec.europa.eu/fpfis/wikis/display/ISTLCS/INVENTORY

Based on the progress of this project, which showed some first concepts and possible solutions Destatis is confident that MOTUS will be adaptable to HBS in the future, and so will become a tool for cross-domain research.

2.4.2 Inventory

In report hbits.2 the High Level architecture of MOTUS was documented. As shown, MOTUS exists of in total 7 different functional components that together define the overall software architecture. In what follows, this report uses the first 5 components (3 and 4 combined) to structure the overview of what is available for e-HBS, and which elements are on the to-do list (requirements).

2.4.2.1 Database structure e-HBS

The database structure is an important component of a data architecture. The database structure of TUS is different than the database architecture of HBS. Despite this difference there is a great deal of similarity between both. Central to HBS stands the COICOP classification. The COICOP2018 is a 5-deep classification[1]. Some countries like Belgium and Germany even go deeper to a 6-deep or even 7-deep classification. However, only the most detailed information is stored in the database since, upwards, the higher-level aggregation can be subtracted from the more detailed position.

The MOTUS databases, as shown in Figure 6, from the back-end server and the analyze server are alike, and also the backup server is from the same origin.

What remains important is the relation(s) with other components, and in particular within the backend server to connect between the database and the client API of MOTUS. The client API of MOTUS is discussed further down this part of the report.

2.4.2.2 Back-office

The back-office is the environment for the researcher in which the study is designed, where the research flow for the respondent/household is defined and the data can be downloaded.

MOTUS works via 4 phases: Design, Collect, Analyze and Advise. All of these phases contain different builders.

Design phase

Device builder

With MOTUS, data is collected via the front-office: the web application and the mobile application. In this way multiple devices can be part of the data collection strategy. The internal API links between the client API (backend server) and the web and mobile application are designed in relation to a TUS-oriented database. The HBS-database will be different and so the API needs to be modified. In particular in relation to the COICOP-classification (see further – diary builder).

Besides the web and mobile application MOTUS can also interact with external APIs. These external APIs can be designed plugins (see further – event builder) or APIs from external databases (eg. administrative databases). In order to include the new possibilities a development and new build of the MOTUS web and mobile app needs to be made. The development of the API is an action of the Client API backend server. The inclusion of external data via plugin(s) or micro service(s) is part of the device builders development.

Questionnaire builder

[1] https://unstats.un.org/unsd/class/revisions/coicop_revision.asp

The questionnaire builder can be used to program survey questionnaires, like the household and the individual questionnaire, but also to ask extra (context) questions in relation to the consumption expenditures, like the price and the weight of a product. In this way the questionnaire component is a flexible part within the consumption diary itself. Different questions can be asked depending on the product or service that has been purchased.

Diary builder

Within the diary builder the content of the diary is prepared, together with the parameters. The content is related to the:

- COICOP classification
    - Accurate description of each item
- Extra questions asked
    - Quantity
    - Weight
    - Unit
    - Price
    - Time/date
    - Place

The parameters are related to the:

- Start time
- Duration of fieldwork period

Communication builder

MOTUS promotes 3 ways of communication:

- On screen (page): information is shown on the screen of the respondent, via extra links in the menu or as a stage page
- Via email: respondents can receive different kinds of emails, from invitation to support emails. The emails are sent based on predefined criteria
- Via notifications: respondents can receive notifications on their mobile device, on their home screen and in the notification center. The notifications can have different goals and are send based on predefined criteria.

These communications can be defined via Markdown options. These components are available for e-HBS, and the criteria can be designed in MOTUS.

Event builder

The event builder focus is related to (external) plugins that provide extra information and that are helpful to the respondent in order to complete the research tasks.

In MOTUS the geolocation (Cordova) plugin has been defined. The geolocation plugin captures the exact location (latitude and longitude) of the device on which the MOTUS-application has been installed. Via the event builder also geofences can be designed, which can also trigger actions on the geofences. The triggers in relation to the geofence are:

- Enter
- Dwell
- Exit

The actions are:

- Tracking
- Survey

- Communication
- Stage continuation

Equally important is that the event builder is open to host other (Cordova) plugins more directly linked to e-HBS. Examples to this are:

- iCARD: a device to collect electronic information at a point-of-sale (POS)
- Receipt scanning: a technical solution to capture essential information from receipts and e-invoices
- PSD2: following the Directive on Payment Services (Revised)[1] to create safer and more innovative European payments, and with a strong customer authentication

Collect phase

Language builder

MOTUS supports multilingual research. There are three sorts of elements that needs to be translated:

- System buttons and/or system warnings
- Content specific to the research
- Communication

Once the system buttons and/or system warnings are translated to an extra language this translation is available for all next researches. Today's available languages are English (system default), Dutch, French and forthcoming German (see additional documents). A system file can be downloaded in order to translate the system buttons and warnings to be translated into another language. After the new file is uploaded to MOTUS (and a new app build is made) the new language is available.

The specific content of a research needs to be defined for every new research, although MOTUS makes use of libraries for surveys and diaries. For every new research the default language has to be chosen and extra languages can be added. The same counts for every communication that is prepared within the research. But the functionalities are equally available for e-HBS.

A last element relates to the database and the meta-data. Both are defined according to the default language.

Research builder

Of central importance to MOTUS is the research builder. The research builder combines the components being defined in the design phase. The components can be seen as *Lego blocks* that can be composed to a specific research design. A research design contains:

- Tasks (survey, diary, communication, algorithm, …)
- Communication (e-mail, notification, …)
- Triggers (geolocation, …)
- Actions (event, condition, result, …)

The combination of tasks, communications, triggers and actions define a stage, and the combination of stages define a research flow. All in all a research flow shows the different phases a respondent/household have to go through in order to successfully participate to a study. In the same way as for TUS, the HBS eco-system (eg. research flow) is pre-defined in order to be shareable and to organize comparability over time points and between countries. The main difference is that for e-HBS the diary is different than for e-TUS. All other elements can remain the same.

[1] https://www.ecb.europa.eu/paym/intro/mip-online/2018/html/1803_revisedpsd.en.html

Invitation builder

MOTUS functions as a management system to organize the participation of respondents. There are two possible ways to create respondents for a MOTUS-study:

- Manually or upload via a .csv/.xlsx file
- Via an external API

The purpose is to store contact information, as well as other socio-demographic information about the respondent. The main usage is to invite respondents but also during the research the information is used to support the fieldwork. The API link is custom made for every research, including e-HBS researches.

This builder also creates:

- UUID-keys
- Username
- Password

Other ID-identifiers can be uploaded, as well as the criteria to create a username and password can be defined.

The management system of MOTUS is equally available for e-HBS.

Dashboard builder

The core functions of this builder are to follow-up upon:

- The fieldwork
- The individual respondent/households

These elements are available for e-HBS.

Analyse phase

Data builder

The acquired data is stored in a database at the backend sever and replicated on the analyze server. The MOTUS-back office makes it possible to download datasets. In the data builder selections can be made, which are prepared by the analyze server and presented to the researcher via the backend server.

The export of the datasets will be available as .csv, .sav and .RData. The .sav and .RData files contain variables, variable names, values and value labels. The files are available to convert to .sas7dat.

The builder is available to the e-HBS.

Quality builder

The (MySQL) database holds the uncleaned data. Via a MOTUS-Package for R these data are cleaned and prepared for further analysis (see above). Extra quality criteria can be added. In the quality builder an overview is given of the quality of a dataset, and the researcher can make custom made decisions what to include or not to include.

For e-HBS the MOTUS-Package needs to be extended and the quality criteria need to be defined.

Compute builder

The MOTUS-package holds information about how to analyze the data. In such a way it provides syntaxes to do simple and more complex analysis.

E-HBS specific analysis need to be developed.

Advise phase

Visualization builder

The MOTUS-package holds information about how to visualize the data. E-HBS specific analysis need to be developed.

2.4.2.3 Front-office

The front-office is the environment for the respondent, where respondents can register data, consult data and provide extra details.

Important evaluation points are (1) the User Interface of the applications, and (2) the availability.

User Interface

The interaction with the respondent goes via the MOTUS-app and the User Interface. The UI's goal is to facilitate the respondent in his/her actions to provide the information that is needed within a research. A good interface design balances between technical functionalities and visual elements, and supports the task of the respondent to be less burdensome. This includes also the infrastructure logic and the business logic of an application. This first logic is the logic that makes the application function, while the business logic is a specific flow and rules that makes (only) sense in the context of the user' business.

Both the technical functionalities and the visual elements differ for e-HBS. While the technical functionalities rely on the underlying platforms used for the MOTUS-application (meaning that the basis is supposed to be largely the same for TUS as well as HBS), the visual elements need to designed completely in accordance to the requirements of e-HBS. These requirements are related to the COICOP-classification, the extra questions and the parameters defined in the diary builder (see higher up).

All these elements count for both the web and the mobile application.

Local storage

All the data that is gathered through MOTUS is sent over via APIs to the server database. No information is stored on the local storage of the device as long as there is an internet connection. This is also a security measure. When the device is offline the collected information is stored in the local storage of the device. At the moment a stable internet connection is achieved the local storage is emptied and the server database updated.

When one application (see next) is available for both e-TUS and e-HBS the database structure and local storage of the device needs to be extended.

Availability of the application

An important characteristic of MOTUS is its *modularity*. In part it means that through the back-office of MOTUS specific researches can be designed by defining the underlying *builders*. It also means that there is no need to have one application for TUS and one for HBS. It is based upon the credentials that the content of the application is stored/updated on the device of the respondent.

- The web application can be reached through: www.motusresearch.io, other domains (dns) and subdomains can be linked
- The mobile application is available at:
  - iOS: https://play.google.com/store/apps/details?id=be.byteworks.motus
  - Android: https://apps.apple.com/be/app/motus-zap-vub/id956934466

Updates are automatically available, unless the user has changed the system settings.

2.4.2.4 Client API backend server

The client API is the central (sub)component that links together the input from the front-office (web and mobile application; active data) and external sources (passive data). It is the strategy of MOTUS to work with external plugins/microservices to include external data via the Client API. An example is the iCARD-concept, or the geolocation plugin.

Table 10: To do's for MOTUS towards e-HBS

#todo	Description	Available
Device builder e-HBS		
#1	Database structure (for e-HBS and e-TUS)	
#2	New web app build with HBS functionality	
#3	New mobile app (iOS & Android) build with HBS functionality	
#4	API connection HBS external plugin(s)/microservice(s) to client API	
Questionnaire builder e-HBS		
#--	Questionnaires before/after diary	✓
#--	Extra questions in relation to the consumption in the diary	✓
Diary builder e-HBS		
#5	Define COICOP-classification structure	
#--	Define extra questions in diary	✓
#--	Define parameters in diary	✓
Questionnaire builder e-HBS		
#--	Define on screen information	✓
#--	Define emails	✓
#--	Define notifications	✓
Device builder e-HBS		
#6	Include geolocation/geofence plugin - POS sensing	
#7	Include iCARD plugin – POS purchases	
#8	Include receipt scan plugin - scan and OCR analysis	
#9	Include PSD2 plugin – personal bank account	
Language builder e-HBS		
#--	Multilingual System buttons	✓
#--	Multilingual Content researches	✓
#--	Multilingual Communication settings	✓
#--	Default language database	✓
#--	Default language meta-data	✓
Research builder e-HBS		
#--	Creation of a stage	✓
#--	Assignment of a task	✓
#--	Assignment of communication	✓
#--	Assignment of triggers	✓
#--	Assignment of actions	✓

Invitation builder e-HBS		
#--	.csv/.xlsx file functionality	✓
#10	External API to register as participant	
#--	UUID creation	✓
#--	Username creation	✓
#--	Password creation	✓
Dashboard builder e-HBS		
#--	Follow-up fieldwork	✓
#--	Follow-up respondents/households	✓
Data builder e-HBS		
#--	Download datasets as .csv, .sav., .RData	✓
Quality builder e-HBS		
#11	Extension MOTUS-Package for R to clean/prepare the data	
#12	Definition of quality criteria	
Compute builder e-HBS		
#13	Extension MOTUS-Package for R to analyze the data	
Visualization builder e-HBS		
#14	Extension MOTUS-Package for R to visualize the data	
User Interface e-HBS		
#--	Technical functionalities web and mobile app	✓
#15	Design web app (incl. feedback to respondent)	
#16	Design mobile app (incl. feedback to respondent)	
#17	Infrastructure logic web app	
#18	Infrastructure logic mobile app	
#19	Business logic web and mobile app	
Local storage e-HBS		
#20	Local storage device	
Availability application e-HBS		
#--	Web app infrastructure	✓
#--	Mobile app infrastructure	✓
#--	Updates applications	✓
Availability application e-HBS		
#21	Update Client API to database	
#22	Update Client API to plugins/microservices	

2.5 (hbits.6) Overview of critical developments of TUS & HBS

Deliverable	Definition of business requirements to support ESS shareability of MOTUS, both for TUS and HBS

2.5.1 Business requirements

Both TUS and HBS are key elements of the social statistical architecture. TUS captures the activities households and household members perform and how time patterns are displayed over the period of a day, a week, a year. HBS captures what households buy and more in particular how the consumption patterns of the households look like.

TUS and HBS both have a long history and until today the information is mainly gathered via paper-and-pencil, with the diary as the central methodology. The fieldwork is executed with the help of interviewers and post-coders. In terms of validity and reliability this methodological setup has proven its added value in comparison to other methodological architectures. The data are the source of information for many purposes and their information is used and re-used in several contexts.

Notwithstanding these positive references there are shortcomings. And those shortcomings are not only related to User Interface (UI), or the environment that is available to the respondents. Therefore the TUS & HBS Work and Task Forces has defined the following domains to evaluate:

- Functionality & maintainability
- Reusability
- Online availability
- Usability, user friendliness, accessibility
- Data comparability
- Statistical aspects
- Costs

It is anticipated that these shortcomings are going to be solved through new technological developments. The following parts will use the requirements as a guideline to describe the critical developments within TUS and HBS, from out the position of MOTUS.

Whereas the first 5 requirements are the ingredients to become shareable, the requirements of 'Statistical aspects' and 'Costs' are seen as an end of process phase where it is being evaluated whether the statistical aspects are still in place, and whether or not the costs (in budget and time) are reduced.

Below an overview is given of the 'critical' developments/requirements for TUS and HBS. The overview also includes the actions that are needed to arrive to an ESS-shareable tool.

2.5.2 Requirement 1: Functionality & maintainability

In this document functionality and maintainability are understood as reflections of the front- and back-office of the software development, here MOTUS. Towards the respondent the front-office (being the application) has to function, towards the researcher the back-office have to provide the tools to make the application function, and to adapt it to the needs of the research question. Below we discuss these aspects.

2.5.2.1 Functionality

In this document functionality is seen as the ability of the tool to collect the information that is needed. On the front-office side it would mean that the business logic of the application supports the respondent to provide the required information. Both TUS and HBS make use of a diary. For TUS it means to register

the activities they have done through the registration period in a time diary, for HBS to report the products and services that have been bought by the household in a consumption diary.

Within this part of the report a number of elements are summed up, later being tested in an international pilot test (see report hbits.8 & 10). More concrete, these are (a) functional elements of the application, and (b) elements of the application that are related to usability, accessibility, compatibility, performance and privacy.

With the MOTUS-setup we test 14 different functionalities:

1. Functionality 1: Downloading and going to the MOTUS-app
2. Functionality 2: Login process
3. Functionality 3: Task functionality: going from task to task
4. Functionality 4: Partial completion process: logging out and resuming the research without a loss of data
5. Functionality 5: Synchronization of input: synchronization of data on different devices
6. Functionality 6: Offline usage of the app
7. Functionality 7: Language toggle: the ability to witch between languages
8. Functionality 8: Questionnaire functionality
9. Functionality 9: Time diary functionality
10. Functionality 10: Different registration modes to register an activity
11. Functionality 11: Function to add different context questions
12. Functionality 12: Ability to change and adapt your input
13. Functionality 13: Warning functionality
14. Functionality 14: Finalization functionality: ending a questionnaire and time diary

With the MOTUS-setup we test also 9 other elements:

1. Usability 1: Ease of use
2. Accessibility 1: Accessibility of the app to all groups of people in society (older people, disabled people etc.)
3. Accessibility 2: Learning curve of the app: how easy it is to use to app without a lot of instructions
4. Compatibility 1: Compatibility between the web app and the mobile app
5. Compatibility 2: Compatibility between different platforms (iOS, Android…) and devices
6. Compatibility 3: Functioning of the app in different web browsers
7. Performance 1: Speed of the app
8. Performance 2: Battery-use of the app
9. Security: Security of the app

The list above can be further extended with criteria related to e.g. communication modes, content presentation, font (size), colors, … .

Possible problems or malfunctions can be solved by either redevelopment, but also in supporting the respondents by providing guidelines and training material (see hbits.3).

Important to note is that these elements related to functionality, usability, accessibility, comparability, performance and security will be further stretched into other dimensions at the moment also passive data are included in the data collection strategy.

2.5.2.2 Maintainability

Maintainability deals with the easiness to maintain and (even) further develop the software platform. One aspect is the choice of the programming language. For its front and back-office MOTUS makes use of the frameworks Angular, Ionic, jQuery and Koseven (see also hbits.2). The code is documented in Git, and uses code history to track changes in the source code. Particularly important is that the logic

between the web and mobile logic is stored in a common library to improve maintainability, and/or to organize the work between collaborators, whereas the design code has been separated for web and mobile.

Another aspect is the organization of responsibilities via a release management process. This process takes in to account (at least) the following elements:

Deployment strategy

MOTUS today uses a 2-stage deployment strategy having a development and production environment. In the future a more phased deployment would have benefits including substages for rollout, testing, and rollback in case of problems.

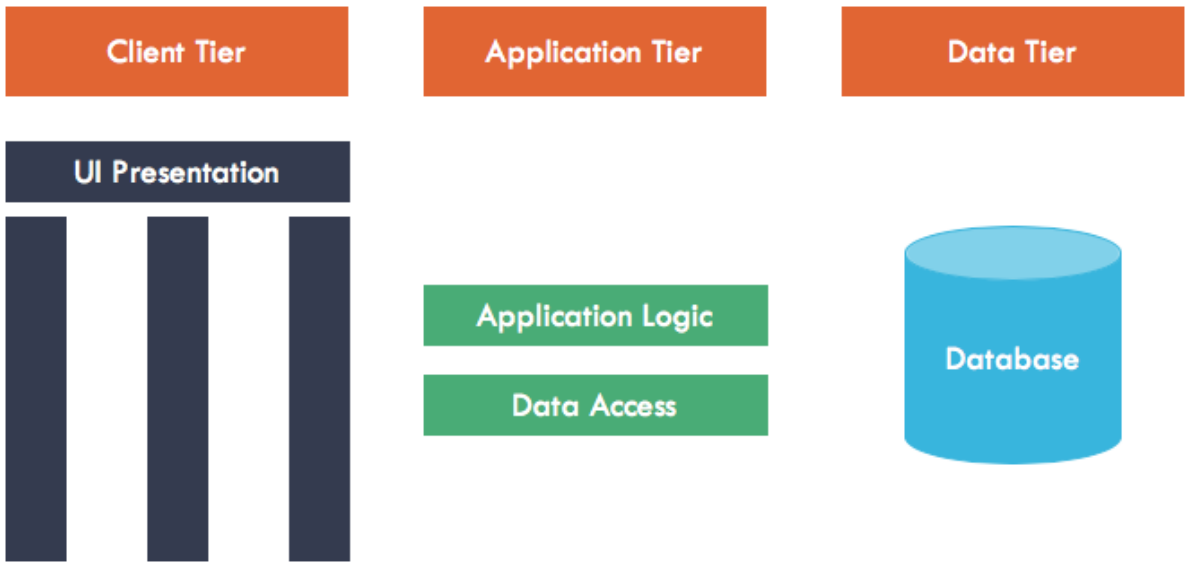
Modularity client-server

MOTUS aspires to a 3-tier application architecture. A 3-tier application architecture is a modular client-server architecture that consists of 3 parts:

- A presentation/client tier: includes the graphical user interface, and communicates (API) with the other tiers.
- An application tier: includes the business logic.
- A data tier: includes information storage.

The three tiers are logical, not physical, and may or may not run on the same physical server.

Figure 26: Tier architecture MOTUS

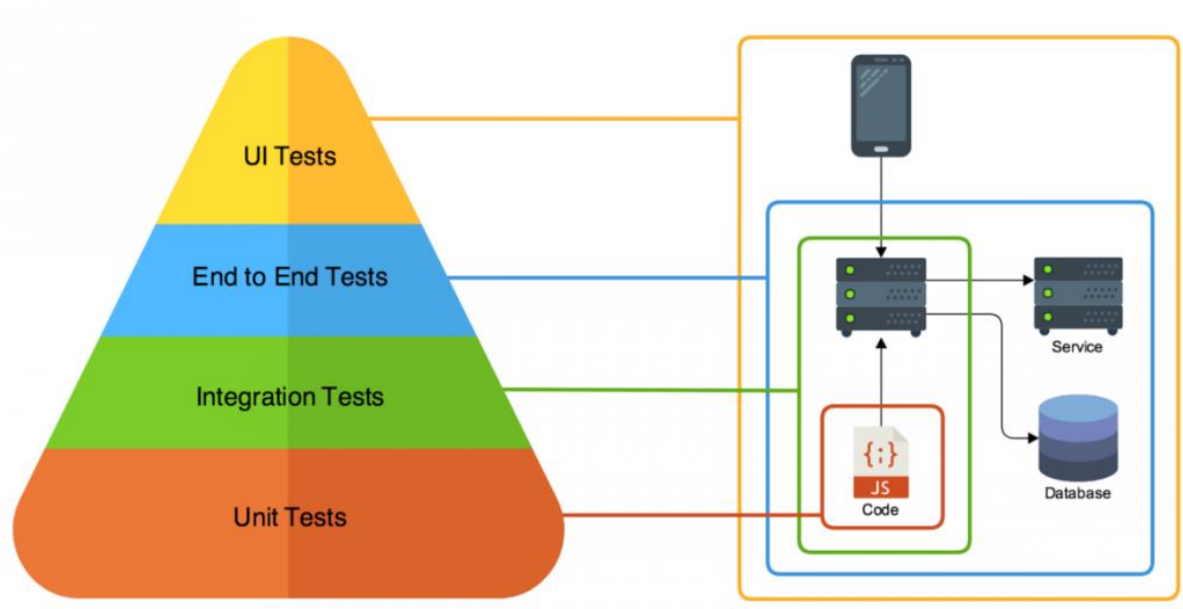


Agile management

MOTUS organizes development stories via an iterative and incremental method of managing new stories, new actions and bugs. Nevertheless, the methodology of Scrum needs to be further refined. Based on the Scrum, a governance strategy can be developed with rules and parameters to accept/decline and rank the stories coming from institutions. hbits.7 goes more into depth to the governance aspect.

Agile management will also benefit from the development of Unit Testing. Unit testing is a level of software testing where individual units/components of a software are tested. The purpose is to validate if each unit of the software performs as designed. A unit is the smallest testable part of any software. It usually has one or a few inputs and usually a single output.

Figure 27: Unit testing



A third aspect deals with how the software platform becomes available to others. This aspect deals with the shareability idea of the ESS-platform where there would be a platform which other NSIs and institutions could make benefit of. To put the idea into practice an platform architecture needs to be defined, and how the software can be provided to an NSI. It would be beneficial when this software architecture is central in the development and maintenance/governance of the different tools that are included in the platform. Report hbits.7 goes more into depth to this aspect.

Table 11: Actions functionality & maintainability

#action	Description
#1	Test and adapt functionalities
#2	Test and adapt elements in relation to usability, accessibility, comparability, performance and privacy
#3	Test and adapt guidelines for respondents
#4	Develop training material for respondents
#5	Include the scope for passive registrations
#6	Critical view on development software and user platform strategies
#7	Phase out extra development stages
#8	Support to a 3-tier architecture
#9	Develop Scrum methodology
#10	Develop unit code and unit testing
#11	Define ESS-platform strategy

2.5.3 Requirement 2: Tool reusability

In this document tool reusability is been understood as the capacity of the tool to reuse existing elements of the code and software components so that the usability of the tool becomes more wide-ranging. More specifically, this document evaluates the tools' capacity to collect statistical data cross-domain. For easiness of reading the concepts intra and inter reusability are used.

2.5.3.1 Intra reusability

With intra reusability the capacities tool is addressed to adapted from the core strategy and to variate in its setup to be able to collect data, both different in content and in context. The blueprint of MOTUS

started with the HETUS-guidelines as reference. Today MOTUS' main quality is to modulate every component in order to be reused and to collect data in accordance to other research questions. In doing so, MOTUS is defined through different MOTUS-builders.

As being explained in document hbits.1 MOTUS holds the Build, Collect and Process Phase (see GSBPM) as business functions of the platform. Also, other phases which are now seen as input/output will become part of MOTUS in the future. The modularity of MOTUS is linked to different MOTUS builders.

All of these builders are to be seen as components in the setup and execution of a fieldwork. They hold different parameters in the background. The parameters can be managed through the MOTUS-back-office. To become an ESS-platform, the management tool needs to be evaluated, both in its current possibilities/functionality as well as to missing components/functions of the tool.

An example of a missing functionality is the Open text box option within MOTUS. To date MOTUS handles open text boxes as part of the context questions. However, it needs to become more intuitive for respondents. See also hbits.8 & hbits.10.

An example of a missing element is the cluster aspect. Individuals belong to a household, and within TUS and HBS the household is the level on which the participation and progress in participation is evaluated and coordinated. Participation and follow-up are part of the invitation builder, but also the research builder has to be injected with extra decision rules since household members are requested to keep the same diary days/period. A solution to this is to work with tokens. Which then also inclines a new aspect of GDPR.

An example of a missing component is the dashboard component. Being able to follow-up the fieldwork in a large detail will save both costs and time from the NSIs.

2.5.3.2 Inter reusability

When looking further than only TUS, the inter reusability criteria is at play. A first evaluation is the capacity of the tool to become cross-domain.

Document hbits.5 discusses the possibility to incline HBS into MOTUS. The conclusion was that a great deal of the capacity of the MOTUS-builders can be reused within the fieldwork setup of HBS, but that other builders or components have to be developed towards HBS specific requirements. The same could be done for other cross-domain statistics, e.g. transport, labor, or even tourism.

To improve the strength of a software platform and to contribute to the vision of an ESS-platform it is recommended to organize the complexity of cross-domain research in one tool. This means that in a first step there would be one application compiled from the code base for every statistical domain, while in a second step there is only one application serving different statistical domains, and it is even possible to combine different statistical domains within one survey. Herein lies the decision to develop an app per statistical domain (1-1) vs. all statistical domains (1-N), and the choose of the software environment (e.g. a virtual machine – docker as an example - or other strategy).

Another level of inter reusability is the flexibility to attach context questions to activities. Context questions gives you a deeper-lying insight into an activity, being asked into the action itself. In combination with the notification facility, MOTUS could also send an extra question in the moment the activity is being done. Compared to ESM (Experience Sampling Method – where at random times the respondents get presented an question) this functionality makes it possible to trigger a (particular) question right into the action itself.

MOTUS today is (mainly) focused on the active involvement of respondents: respondents use the tool to provide information on the activities they have done, (and in the future) the products and services they have bought, etc. In the future also passive data needs to be included. So, a second evaluation is how the tool is able to incline input from external sources, and more specifically person-based information derived from sensors available in smartphones, smartwatches and wearables.

This implies two important questions that need to be addressed, being the strategy to include sensor data and the design of a data structure model. Both questions are related to each other. In the first case it handles the overall collection architecture that deals with how data is captured and accordingly presented. TUS and HBS need to gain added value from external data, to reduce the response burden from respondents, to reduce the data collection tasks for NSIs, to lower the data collection costs. However due to the plethora of sensors, and at the same time the multiplicity of the possibilities, the requirement would be to define a general collection strategy, and in such a way different inflows provide the data in the same structured way (harmonization strategy). The suggestion here is to work accordingly the plug-and-play strategy, and so to develop different plugins that can be opted in into a research strategy. Examples for TUS is a geolocation plugin, for HBS it is the iCARD-plugin that collects the products respondents have bought directly from the POS-system in the supermarket.

In a second stage the input coming from the plugins need to become available and flow into the data collection chain. In that case there is a need to define a data structure with tables and variables, and the relations between the tables.

Table 12: Actions tool reusability

#action	Description
#12	Evaluate functionalities of the MOTUS-app UI
#13	Evaluation/assessment of the available components in the MOTUS-back office
#14	Definition of extra components in the MOTUS-back office
#15	Develop one app per statistical domain (1-1)
#16	Develop one app for all statistical domains (1-N)
#17	Setup a Docker environment
#18	Roll out of the in hbits.5 defined HBS requirements
#19	Inventory capacity MOTUS toward transport, labor, tourism [...]
#20	Promote the added value of customized context/triggered questions
#21	Define plug-and-play strategy
#22	Define a data structure
#23	Define the inflow in the data collection chain, including the interaction with the respondent, and vice versa

2.5.4 Requirement 3: Online availability

The requirement to be available 'online' has more dimensions than the sole perspective to be connected to the internet. It also includes topics as:

2.5.4.1 Web and mobile application

The MOTUS platform includes both the web application and the mobile application. The data is synchronized via the client-server. Both the web and mobile are designed to be user centric.

A more recent concept is the progressive web app (PWA). It is a web application using coming web technologies but includes working offline, it is also able to receive notifications and the user experience of a mobile application is introduced. Most of these features are already included in the MOTUS web app, however a local database storage to work offline is not yet available. The extra value of a PWA needs to be investigated, and if the added value is clear developed.

2.5.4.2 Devices and responsiveness

The MOTUS applications can be used on all devices and in every browser. Exceptions are e.g. a smartwatch or Internet Explorer. In relation to the last still many NSIs work with IE11, which returns important problems.

The web application can be used when internet is available. Since the design is responsive also devices with a small screen can benefit of the web application.

2.5.4.3 Offline vs online registration

Having the mobile application means that the MOTUS-app can also be used offline. The precondition is that the respondent needs to login. Once logged in the local storage is instantly provided with the synced information.

Information that is added online is immediately send over to the client server. When the respondent is not online the data is temporarily stored on the local database of the device. When the mobile device has a bad internet connection the mobile application goes in the offline modus for some minutes before trying to connect again.

2.5.4.4 Active and passive registration

Another element that evaluates the requirement of online availability is the ability to connect to sensor data. MOTUS is split apart in a CORE part and a PLUGIN part. In the CORE part the back-end, web app and mobile logic are defined, including the database structure. The PLUGIN part connects to customized plugins. A plugin takes into account a tool to capture the sensor information, to interpret the data, to add extra context and to send over the data over HTTP to a customized plugin-server. The CORE and PLUGIN part connect via the client server API.

Table 13: Actions online availability

#action	Description
#24	Evaluate the need for a progressive web application
#25	Develop a progressive web application
#26	Evaluate responsiveness of web application over all devices
#27	Evaluate business logic offline registration, including sequence login – logout
#28	Establishment of a plugin server, including database structure
#29	Establishment of an API connection between client server and plugin server
#30	Development of a plugin component, e.g. geolocation or iCARD plugin

2.5.5 Requirement 4: Usability, user friendliness, accessibility

Usability touches upon the degree to which a software can be used by specified consumers to achieve quantified objectives. The requirement of accessibility opens up the focus to as many people as possible, from children to older persons, for respondents with a disability to users with a preference over a certain device over another device, or even respondents speaking a non-official language. User friendliness handles about the easiness to use the application, in the sense it is not difficult to learn and understand to use the application.

All of the concepts have one element in common: they deal with the interface or UI of the application. But it is broader than only to how the respondent uses the application: Moreover, the privacy aspect and the feedback to the respondent is part of the requirement.

2.5.5.1 User interface

As indicated above, MOTUS uses as gateway to the respondent a web app and a mobile app. Time Use Surveys include questionnaires and time diaries. User tests are included in part hbits.8 and hbits.10. Critical developments on the business logic and design are mapped and need to be taken on board in a new development cycle.

In order to test the accessibility, the Web Content Accessibility Guidelines (WCAG: https://www.w3.org/WAI/standards-guidelines/wcag/) can be used. WCAG 2 also covers the mobile accessibility. It also is known as the ISO/IEC 40500:2012 standard. Above all, the time diary needs special attention. Including the use of the ACL (Activity Classification List) to select an activity. The same is true for HBS and the COICOP list of goods and services. Besides the TUS and HBS diaries also the questionnaires and the communication is to be tested in detail.

A minor element overall are some differences in the look-and-feel between Android and iOS. An example is the time selector, which is different for Android as for iOS but which stays closer to the user experience smart device owners have with their device.

2.5.5.2 Privacy and GDPR

An important dimension of accessibility is privacy, which in its own respect is of a large importance for all controllers and processors of personal data. Since May 2018 the European GDPR regulation became effective and enforceable.

No personal data may be processed unless this processing is done under one of six lawful basis specified by the regulation (see Wikipedia). One of these six basis is consent. In case of the collection of personal data the respondent has to give his/her consent to collect this data. This consent is given based on a Privacy Notice that explains what is exactly going to happen during the data collection and also what the purpose of the data analysis is after the data collection has been closed.

At the moment sensors from personal devices are used to capture person-related information, a new variety of risks will come into play. Also for TUS and HBS, as these studies can benefit from different sorts of IoT devices and as these devices have the ability to transfer data over a network without the necessity of human interaction.

Within the scope of Smart Statistics, IoT devices are seen as tools to capture data of a higher quality (faster, more frequent, more accurate), and at the same time reduce the respondent burden and lower the (administrative) cost for NSIs. The input from IoT can also be used to enhance the user experience of the respondent and to become more interactive with the respondent.

Since the TUS and HBS ecosystem include both questionnaires and diaries, the respondent participation is spread out over multiple steps, over a longer period of time. This also means that the consent required from the respondent is different than for more traditional researches, and that the privacy assurance and confidentiality of the data needs to be evaluated for these types of studies. Only then Smart Statistics can become Trusted Smart Statistics.

To become GDPR compliant a number of phases need to be evaluated:

- Information/acknowledgement on study protocol and further use of the collected data
- Introduce the added value of each sensor
- Consent to use sensors in Smart devices (including foreground and background tracking) and IoT devices (Android/iOS vs. IoT devices without an interactive screen e.g. Netatmo)
- Ability to adapt the consent to use sensors
- Evaluate whether a consent to use sensors is a prerequisite to participate to a Thrusted Smart Survey

Besides the above, the domain of privacy overlaps with security. Security deals with how data is stored and protected. It this way also the aspect of the back-office and the server setup (+ database structure) needs to be evaluated as well.

2.5.5.3 Feedback

Feedback can also be considered as a leverage to higher the usability, the user friendliness and the accessibility. Feedback also comes in multiple forms.

In first order feedback is seen as the graphical representation of the input that has been provided by the respondent. Graphical representation not only provides data back to the respondent, it also gives the respondent an insight in his/her own life and living situation. This is called the 'quantified self'. Feedback in this way can also be used as an incentive strategy.

In second order there is however one element missing to really understand oneself, and this is the context in which we spend our activities. How much time do I spend to child care having 2 kids, compared to others also having 2 kids? How much fruit does our household buy in comparison to others living on the countryside? The ability to compare oneself with others, and more specifically with (combined) groups of people with the same characteristics gives an added value.

Table 14: Actions usability, user friendliness, accessibility

#action	Description
#31	Test the user interface against international standards
#32	Test MOTUS against the GDPR legislation
#33	Design a consent-centric user model
#34	Design a feedback strategy

2.5.6 Requirement 5: Data comparability

According to the OECD "comparability is the extent to which differences between statistics from different geographical areas, non-geographical domains, or over time, can be attributed to differences between the true values of statistics".

The use of standard concepts, classifications and target populations promote coherence, as does the use of common methodology across surveys. In the nineties of the previous century EUROSTAT organized a 'working party' of TUS experts from NSIs and academics to come to a harmonized approach to collect time use data. The 'Harmonized European Time Use Survey' or HETUS-guidelines was the result and came into effect in 2000. Since then two data rounds of data collections were organized within Europe and 18 countries participated. A number of associated countries adopted the guidelines, just as some other organizations. In 2019 a new version was defined. This last revision is still in line with the paper-and-pencil method, which has an effect on the preparation and execution of the fieldwork and the use of interviewers and post-coders. For HBS no such guidelines are in place. Nevertheless, there is a common agreement on the surveys and classification list in both HBS and TUS.

The more standardization is reached, the more comparable the results will be at the end. To be as effective as it was (and still is) for 3 decades a new Guideline needs to be developed with the view on modern/smart data collection tools. The following elements are important to take into account:

2.5.6.1 Sample design, sample handling and preservation

The sample design is part of the guidelines and the decision lies outside the functions of the MOTUS software platform. The sample handling however is a function within the MOTUS Invitation builder. This function needs further evaluation to see whether or not it fits exactly to the needs of TUS and HBS. One of the elements to investigate is the household as a cluster level. Another element is the quota strategy that is being used for instance by Destatis.

Once the sample design and handling is in place the respondents are monitored, and the interactions with the respondents are preserved. These data can be part of the META-data of the study, in such a way it can be uploaded as an SDMX-data file.

2.5.6.2 Method comparability

Method comparability takes into account the setup of the questionnaires and the diaries, but also the organization of the fieldwork and the collection tools.

In first instance the survey and the activity lists for TUS and HBS need to be evaluated in the light of an online data collection. Of key importance is the classification of activities (TUS-ACL) and the purchase of goods and services (HBS-COICOP). With paper-and-pencil, respondents write down in a diary what they did (TUS) and what they bought (HBS). In a next phase, post-coders converted the respondent input to a code. In that way, these classifications are setup from a post-coder perspective. When asking respondents to straight-away choose an activity from a list, it is important to evaluate the current classifications and to see what changes have to be made to transform it to an e-classification list.

To achieve comparability in the design of the research, MOTUS uses different builders. In this case the survey and diary builder. Together with the communication builder - to create information screens, emails, notifications and text messages - these builders are the 'lego' blocks to define a research journey/research flow for the respondent. A research flow is defined by tasks and actions. When in the future also sensors are included, also events become part of this research flow. Events can be defined in the Event builder.

Once the research flow is prepared, the automated data collection cycle can start. Every study can have its own flow, but when the flow and the automated processes for TUS and HBS would be standardized, the method comparability in general would be enforced.

Another element to achieve comparability is through the use of the same applications. The MOTUS applications can assist to this. To even enforce shareability virtual machines could be developed to keep the app configuration on the same level(s). For this purpose a Docker or Kubernetes environment can be used.

2.5.6.3 Data verification and data cleaning

Another level to reach comparability is to streamline the data verification and cleaning process. There are two dimensions:

- During and after the data collection
- By the respondent and by the software platform

What important is, is the development of verification trajectories that include the respondent in a supportive way during the participation. This means that quality indicators need to be determined, and that during the data collection built-in notifications are displayed giving a warning about an error or a registration of bad quality.

However, some determinants only become important at the end of the registration period. At the moment the diary comes to an end, the respondent receives a dashboard with quality indicators, showing actions how to improve the diary. Only when the diary is of a sufficient quality, the diary can be finished by the respondent.

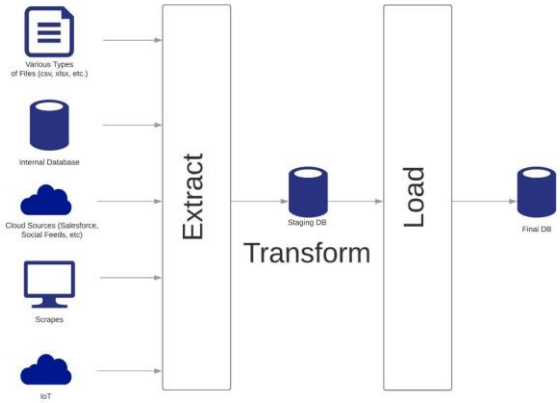
After the data has been collected [at the respondent level], the data cleaning can start on the database level. And this according to the ETL-process cycle idea. What this process does is to copy the data from one or more sources into a destination system. Accordingly, the destination system represents the data differently from the source(s) or in a different context than the source(s).

The above is a further extension to the 1-to-N strategy MOTUS - wants to – stand-s- for. More concrete, first the data is extracted from the source system(s) which can be different for each other (MOTUS data, administrative data, plugin data, …). The goal is to convert the data into a single format appropriate for transformation processing. In the next stage, the data are transformed according to a series of rules and functions. This transformation also includes data cleaning. The goal is to send only 'proper' data to the target. This is the third and last stage: load the data into the end target. In the case of MOTUS this is the MOTUS-backend server so the data can be made available for download in the MOTUS back-office.

Via the back-office the researcher can intervene into the transform phase by the selection of parameterized quality criteria. After the load phase, the researcher can download the results. It is also this instance that – will be – is responsible for the contextualized feedback to the respondent.

The focus is to run this in Real-time. Other options are Scheduled-time and Right-time. This could be necessary to postpone results to respondent, or to attach role restrictions.

Figure 28: Overview MOTUS platform Extract - Transform - Load



2.5.6.4 Training courses & workshops

'Training & workshops' is overarching the comparability requirement. A training program is an essential element for all levels of expertise to improve the quality of national and European statistics. Providing a training course and a workshop about the TUS and HBS data collection strategy and standardization tools will support data comparability, but also functions as a platform to exchange experiences and best practices.

For this purpose the MOTUS-back-office needs to be more user-friendly and intuitive. Also, the MOTUS R-package(s) need(s) further improvements. The trainings/workshops than would introduce the audience to the MOTUS-platform, and how to handle and valorize the data by means of a dedicated R-package.

Table 15: Actions data comparability

#action	Description
#35	Define sample strategy
#36	Define comparable components (questionnaires, diaries, communication,...)
#37	Define data collection flow strategy
#38	Define sensor inclusion strategy
#39	Define data verification and cleaning strategy via an ETL-approach
#40	Setup of a back-office training facility
#41	Work out training material
#42	Organize workshops

3 WP3 – Collect

Overall goal	Setting up a collecting strategy with a focus on governmental practices, panel invitation and the household level. These experiences will support MOTUS to become ESS-shareable.

3.1 (Statbel.4) Listing up new ways of invitation techniques

Deliverable	Documented conditions, challenges and current use of panel research within Statbel.

Since 2017, Statbel started working with representative panels for LFS. Since 2012, HBS was linked to LFS, where respondents for HBS were recruited at the end of the LFS survey. Due to the decrease of LFS respondents since the panel setup, HBS has to rely on at least 3 sources to include respondents/households since 2018: LFS, the previous HBS wave and a fresh draw on the Population Register. These changes have some consequences:

- There is no possibility to link TUS in 2021 to another survey.
- For HBS, the possibility of a new way to draw a sample is needed.

Therefore, this subtask's goal is to document the possibilities within MOTUS to include new ways of respondent invitation. For the next TUS in Belgium, MOTUS will be used, including the communication flow. Because there is not yet a database available in Belgium, the initial invitation to the households to invite them to participate in a diary survey still needs to be sent by letter through the post office. Some specifications need to be taken into account:

- How to persuade respondents to participate in a diary based survey?
- How to invite them to participate only online (through a web application of mobile application)?
- What with respondents who do not have the possibility nor the knowledge to participate digitally?
- Within the next year, some of these features will be tested in the ESSnet "Trusted Smart Surveys", others will be discussed within Statbel.

After the initial invitation, the respondents are sent to a digital platform to register to participate. From here on, MOTUS takes of the communication through mail. The flow of this automated mail flow was already determined and translated in the additional documents:

- 847218_BE_final report_Communication_flow_ENG
- 847218_BE_final report_Communication_flow_FR
- 847218_BE_final report_Communication_flow_NL

3.2 (Destatis.4) Setup logic for user identifiers and sample design

Deliverable	Documented household/quota sampling strategy in the TUS and HBS data collection in Germany.

TUS and HBS studies are household based. To respect these guidelines, the household level should also be addressed in the setup of a MOTUS fieldwork. Destatis will define a strategy for discussion with TOR. An extra requirement MOTUS should deal with is that in Germany quota-samples (seen as a cluster of people) are used to collect HBS data, as well as TUS data.

3.2.1 Quota sampling strategy

In contrast to the other European countries, in Germany EVS and ZVE are based on a quota sample (disproportionate distribution). The net sample size for the EVS covers approx. 60,000 households and in the ZVE to date approx. 5,000 households (in 2022 sample size shall be increased up to approx. 10,000 households). The quota plan for all three surveys splits up the population set of the households into groups by combining the following characteristics: federal state, household type, social status of the main income earner, and – for EVS only – household net income (in 5/6 categories).

Within the scope of the recruitment (done by RSIs for each region separately), various measures are undertaken to recruit households for each group until the defined quota target is attained. Each RSIs uses different data sources for **recruiting**:

- Addresses of households, that have indicated their consent to take part in studies of official statistics
- Addresses from national register (only in some regions)
- Addresses from organizations, associations, companies (e.g. email list)
- Indirect advertisement: e.g. flyer, social media such as youtube-video, facebook, twitter, ads in newspaper, online ads, press releases, etc.)

Depending on the source RSIs compile address lists with a standard format and import them (manually) into the administration program. In case contacted households - directly or through indirect advertisement - intend to take part in ZVE/EVS, they may register via printed form or online (via IDEV[1]). Data from participation interests via paper or online get recorded in the administration program, where data get checked towards doublets. Remaining households automatically receive a confirmation of receipt and serve as **sampling source**.

The quota plan is compiled centrally by Destatis for all RSIs and gets imported by Destatis to the administration program. The sample is drawn based on the quotaplan.

In EVS for each quarter (of the year: I to IV) based on the sampling source a sample is drawn (regarding the above mentioned criteria). Addresses of households with participation interest, that cannot be considered in the sample of quarter I, get assigned to the next quarter(s).

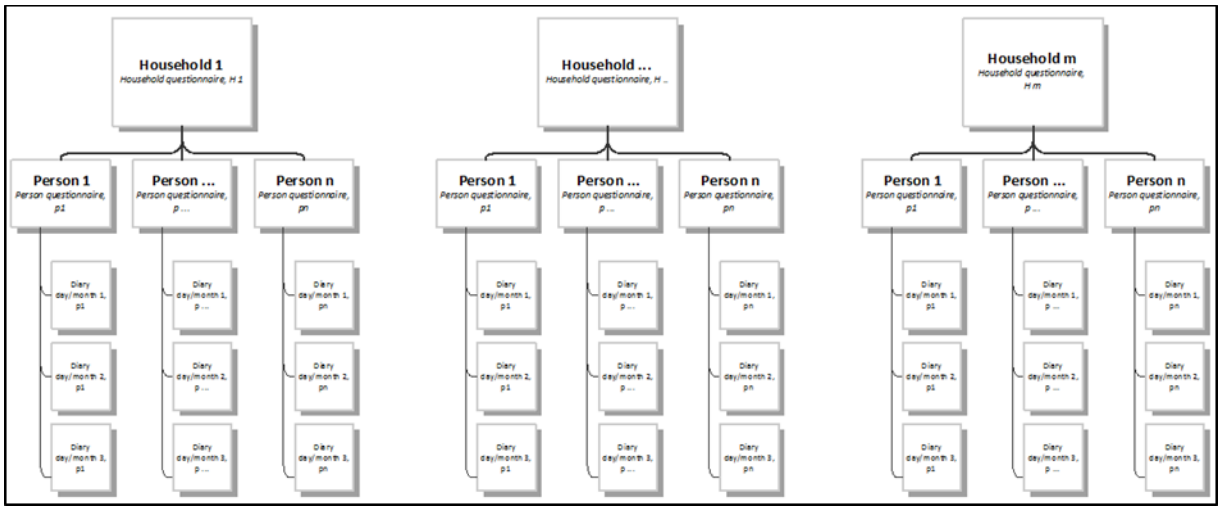
In ZVE the households selected in quarter I will be randomly distributed to the days in that quarter. For this reason the first day of the reference period will be selected by random and the second and third day will be selected by using an algorithm.

[1] Internally developed online registration procedure used by the Statistical Offices in Germany, https://www-idev.destatis.de/idev/OnlineMeldung

3.2.2 Set-up logic for user identifiers

German TUS and HBS collect data directly from private households as well as from the persons living in them. The data models of the surveys are described in the following figure.

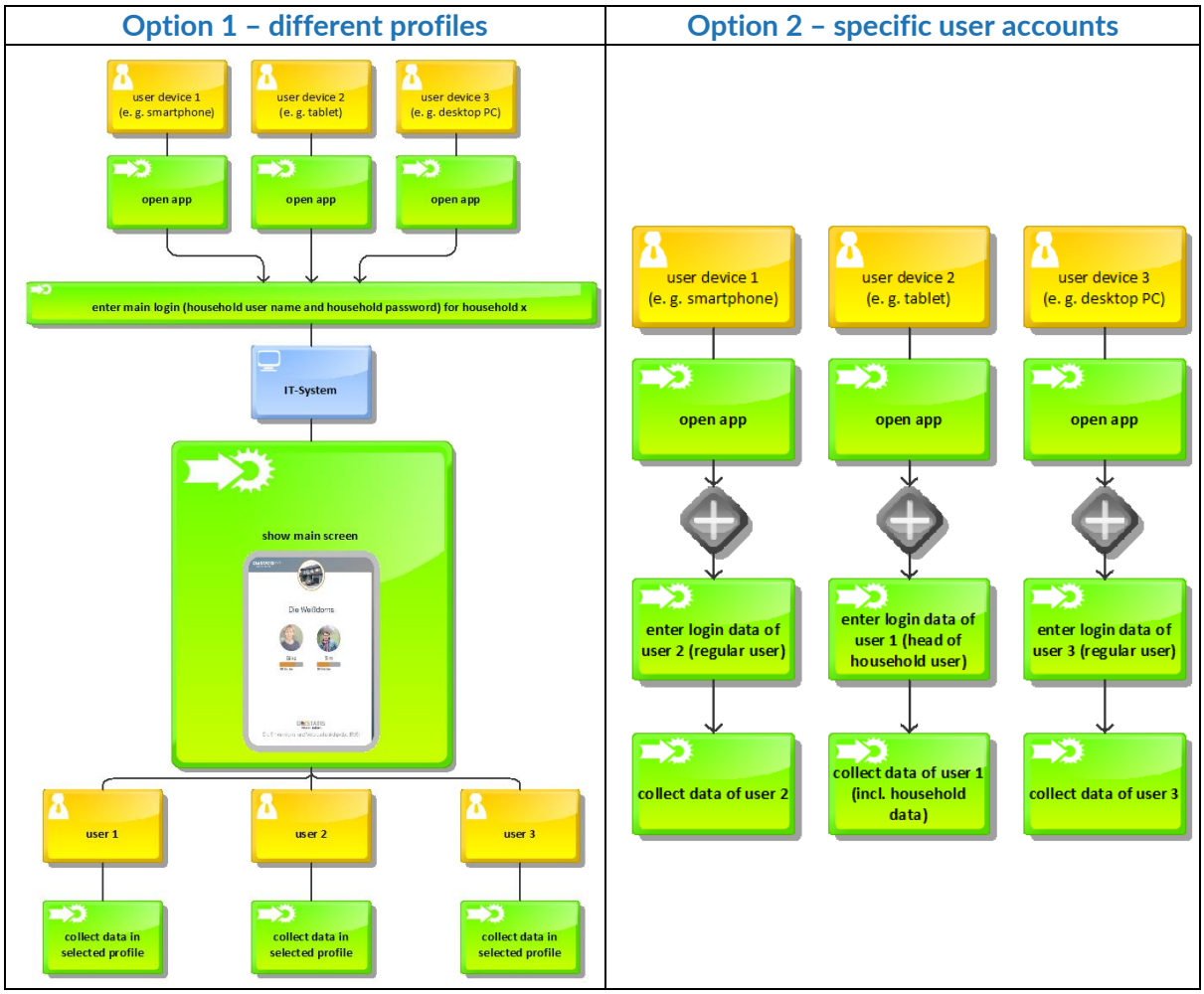
Figure 29: Relationships between the survey units in German TUS and HBS



In general, the developed application for data collection in the surveys should be used by each member of a participating household. Nevertheless, the sampling unit as well as the unit for a couple of analysis of the surveys is the complete household. Furthermore, one aim of German HBS is to correctly collect expenditures that are spent for the whole household (e.g. housing rent). In addition, it must be possible in the participating households to enter data by someone else (e.g. parent, spouse) than the person about whom information is being sought (e.g. expenditures of a child). Due to these reasons Destatis decided to develop a concept with the household as main user unit of the application. Beside this option there is another possibility to collect data on different levels using different user accounts combined with universally unique identifiers (UUID) to merge the resulting datasets. The processes according to the both options are roughly displayed in Figure 30.

In the following both options are described in detailed in connection with the main requirements connected to the mentioned concepts. It needs to be discussed, whether MOTUS can meet these requirements in a suitable way. MOTUS should be able to implement at least one of these concepts. Also other NSIs probably have developed strategies for different options. An exchange within the Task Forces TUS and HBS about suitable ways could support solutions for a practicable set-up logic for user identifiers on household and person level.

Figure 30: Possible options of data collection on household and person level

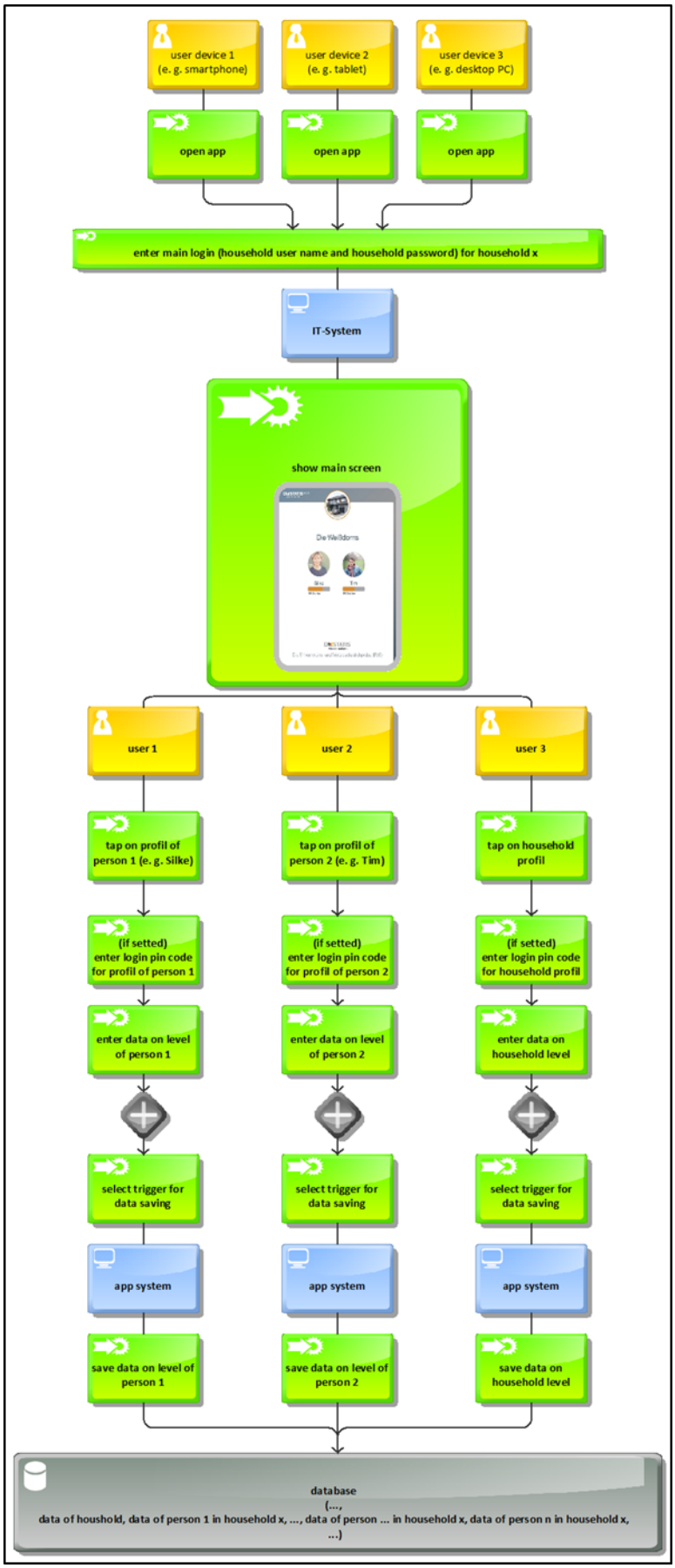


3.2.2.1 Option 1 – Requirements linked to a concept based on user profiles

Access to the application

After the members of the participating households have downloaded the application onto the used end-user devices and click on the icon (or after opening a web browser-based application for desktops by clicking the link on the website), they are asked to enter their login credentials (user ID and password) for further use of the functionalities. User name and password are the same for all members of the participating household. I. e. the login is used by multiple users from different devices (see activity “enter main login for household x” in Figure 31).

Figure 31: Rough depiction of the German model for data collection on household and person level

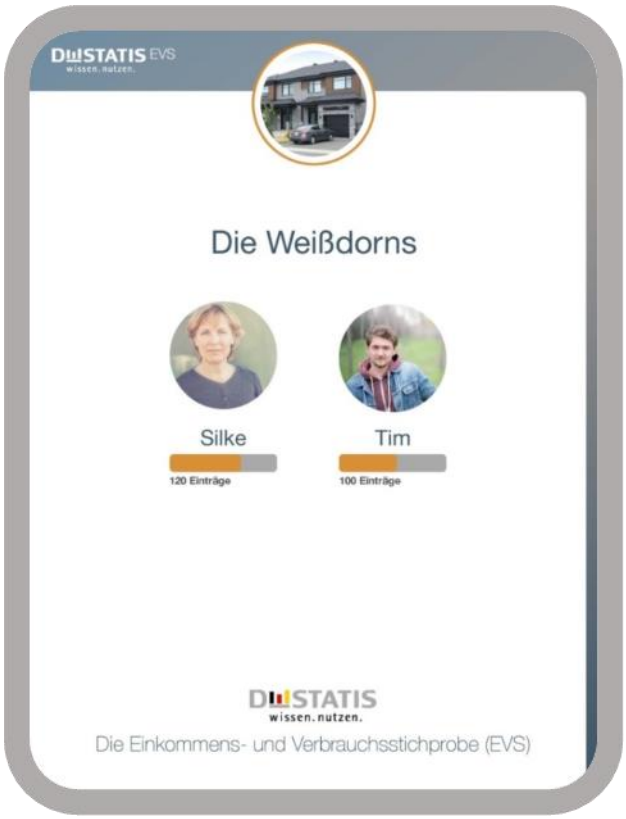


Collecting data on household and person level via profiles

After the user entered the correct login data for the household he will be directed to the main screen of the application, the "profile screen" (an exemplary design of this screen is shown in Figure 32). From that screen, the user can reach to the following different profiles:

- The household profile: At the household level, information is recorded which concerns the household as a whole. This is information that can be entered by usually one person (normally the head of the household) since it involves characteristics that can be assumed to be known to all members of the household (e. g. highest school leaving certificate, social status, current school attendance, net household income).
- The personal profiles: The personal profiles, and in particular the individual diaries integrated in them, are respectively the centerpiece of the application. There must be one personal profile for every member of the household (maybe based on the information given in the household profile). Beside the individual diaries these profiles contain another questionnaire to collect even more person based data.

Figure 32: Exemplary design of the profile screen



Household profile

Personal profiles

Protect the profiles via pin code

In case a household member does not want to give other members the possibility to see his or her entered data it must be possible to protect every profile with a pin code separately. These pin code can be set optional.

Main issues to solve in the concept using profiles

There are a couple of questions that need to be answered – especially from the technical view – if the above described concept for data collection on household and person level could be implemented in MOTUS.

- Which rules must be stated when two users from different devices try to enter (and save) data in the same profile? Especially in the case one user enters data while the device is offline.
- The centerpieces of the surveys as well as of the application are the individual diaries. Users will sequential enter data in the diaries (e. g. activities as soon as they end one activity and start another, expenditures as soon as they buy a product). Therefore, they should as immediately as possible be directed to a screen for entering an activity or expenditure (and not always to the above mentioned main screen) or to the active screen the last time when they used the application. Is it possible to immediately direct the user to the last screen he or she used the session before when he or she uses
  a) the same device (see scenario 1 below)
  b) another device (maybe after entering the main login data, see scenario 2 below)
- Could push notifications (e.g. to remember one household member to use the application) be delivered just to one specific household member (e.g. if he did not enter data whereas all other household members have started data entry) instead of delivering it to all household members using the application with the main login data?
- Should or should not personal profiles be protected with a personal password in order to protect access?
- Especially in the case of German HBS the application needs access to data from all profiles (e.g. for plausibility checks or evaluations across the complete data of the household).
- Which further requirements result out of the implementation of these use cases?

Figure 33: Scenario 1 - user reopens the app using the same device

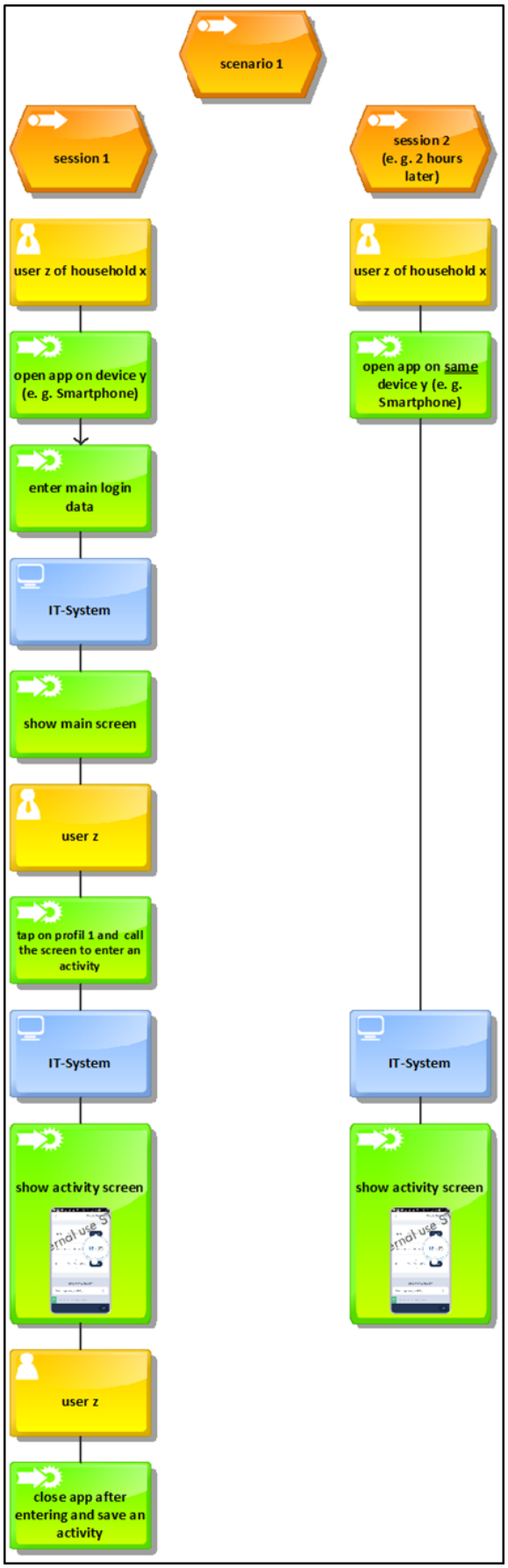
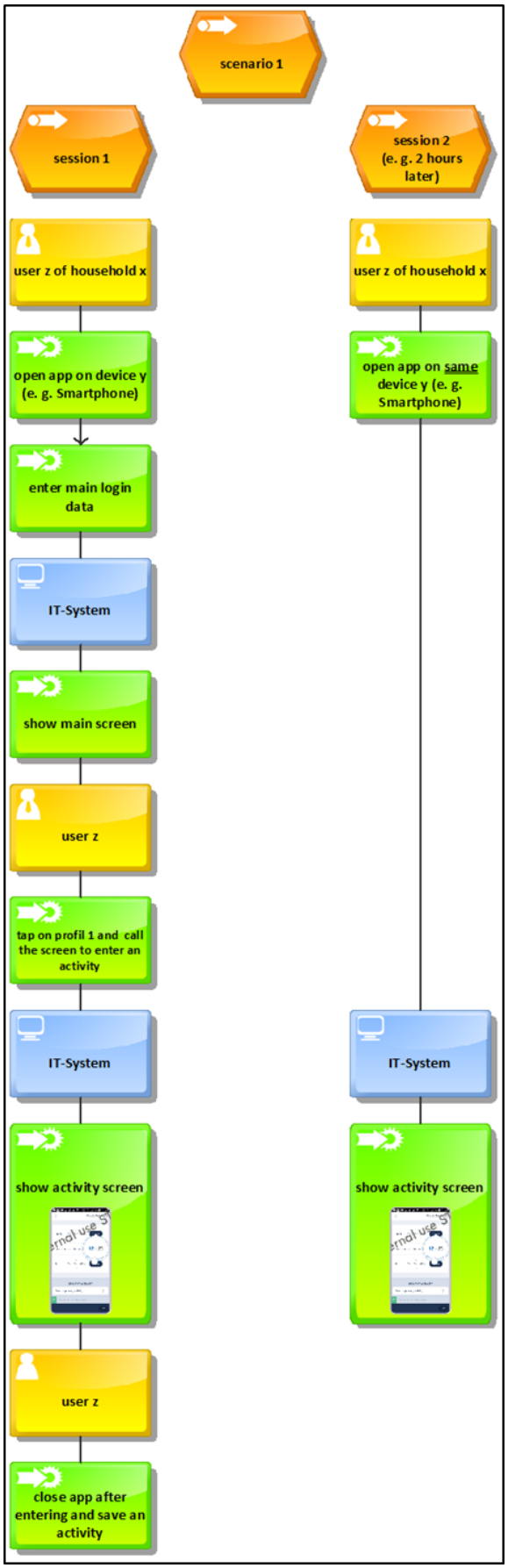


Figure 34: Scenario 2 - user reopens the app using another device but the same profile



3.2.2.2 Option 2 – Collecting data on household and person level – possible solution without profiles

If MOTUS cannot match the requirements mentioned above in a suitable way especially for the German TUS, but with some adoptions maybe as well for the HBS, an alternative concept could be implemented. This concept and the connected requirements are described in this chapter.

Access to the application

Instead of using one main account for the household every member of the participating household will get separate login data. Households have to state the size of households (number of household members) already in the participation rate. Prior to the start of the recording period of the household, the login data for each household member will be sent to the household, for IT security and privacy reasons this information most likely has to be sent by letter.

Collecting data on household and person level via different user types

To collect the information that concerns to the household as a whole, one member of the household (normally the head of the household) will get an additional account linked to a specific questionnaire. That questionnaire contains additional questions on household level (e.g. characteristics that can be assumed to be known to all members of the household or in case of German HBS expenditures that are spent for the whole household like housing rent). All other members of the household receive accounts, which are (only) linked to the personal questionnaire and the individual dairy.

Generation of the household during the data processing

As mentioned above especially in case of the German HBS the main unit of analysis is the complete household. Therefor it is necessary to (re-)build the household after collecting the data from all household members. Because of that, every member of the household must have a unique ID that is linked to the corresponding household ID. With this ID it must be possible to match the data sets of all household members and calculate for example the sum of all expenditures of the household.

Main issues to solve in a concept via different user types

Because the sampling unit of the surveys is the complete household there are some issues to solve in the phase of data collection. For example, just the complete household (or one specific member of the household, e.g. head of household) should be reminded when the data is not complete. Meaning when the dataset of one household member is missing the whole household should get a reminder, not the person whose data is missing.

Especially in the case of HBS it is important for the data quality of data, that expenditures are not reported twice (or a number of times). This issue can be solved during the data processing via data evaluation.

Furthermore, for HBS it is foreseen, that households should be given an overview of the overall consumption, therefore it is important that a matching of data of all household members should be available in the app (i.e. not only in the data evaluation). This could also avoid double reporting.

3.2.3 Conclusion

Due to the problems addressed within option 1, Germany has – at this stage – a preference for option 2. This applies especially to ZVE, as in the Time Use Survey mostly data on individual level are asked. Furthermore overlaps (double reporting) are not expected within the households. For HBS (further) validity checks must be developed, in order to identify double reported expenses.

3.3 (hbits.7) Implementation of a governance model to use MOTUS

Deliverable	The focus within this subtask lies within the necessity to provide multiple countries the opportunity to use MOTUS. Therefore a governance model needs to be defined to give national institutions a private entry to the MOTUS-software environment.

This deliverable is provided as a separate document, containing the following items:

- Definition of governance
- Development Governance
- Technical Governance
  - Architecture A: MOTUS as a service
  - Architecture B: MOTUS as a data collector
  - Architecture C: MOTUS virtualized
  - Architecture D: MOTUS native installation
  - Four different architectures: one conclusion
- User Governance
  - Multi-client capability
  - Role management
  - License approach

3.4 (hbits.8) Testing of the e-diary for TUS

Deliverable	Roll out of a proto-type e-diary that can be tested and evaluated via an open link on www.motusresearch.io

3.4.1 Evaluation of the proto-type

3.4.1.1 Evaluation strategy

Throughout the SOURCE™ project consortia members became familiar with the MOTUS application.

The mobile application itself went from version 2.3.14 to version 3.4.11, and a next version 4.0.0 was released at the beginning of April 2020. The new versions take into account a shift in design, but most of all a migration of the source code within the underlying software platforms Ionic and Angular. In different steps MOTUS went from Ionic 1 to Ionic 6 (5 + bèta 6) and from Angular JS to Angular 8. These shifts are seen as necessary actions since the App Stores request updates of software components that match with new Smart devices versions, or Operating Systems. Since MOTUS makes use of a common code also the web application received updates.

The front-office is been discussed in meetings and in a joint workshop. To get uniformized input the proto-type was setup and input is been asked from test respondents.

This test setup is oriented to test:

- the time diary
- the TUS eco-system, and
- the automized procedures within MOTUS. These automized procedures have the possibility to replace the interviewers during the time diary data collection. Respondents are read in and go after having logged in from phase to phase, and from task to task. In between, communication can be sent to the respondents, or information pages can be shown. Figure 35 provides an overview.

The different phases are displayed on the left in, the actions to continue from phase to phase are shown in green, the communication in blue and end of state/end of test in orange.

In hbits.8 the procedure of collecting the data is evaluated by the consortium and academic experts, in hbits.10 the proto-type including the evaluation questionnaire is made available to the test respondents. hbits.8 also describes the Evaluation questionnaire as a result of this report.

3.4.1.2 Questionnaires

The content for the three questionnaires is based on the HETUS-guidelines. The focus of the proto-type is not to test the content as such, but to test the relation between the technical elements of MOTUS and the content within a questionnaire.

3.4.1.3 Time diary

For the time diary a modification of the Activity Classification List or ACL is used. As referred to in hbits.4 the proto-type makes use of the OACL pointing towards the Online version of the ACL. This OACL has been developed by the Research Group TOR of the Vrije Universiteit Brussel.

The OACL has an adapted organization of the Activity Rubrics, has new activities included and makes use of tags to search an activity, in variation to the tree-selection option that is often been used. Respondents can also define a favorite list.

3.4.1.4 One proto-type, 3 languages

The default language of the proto-type is English. Dutch and French are the two other languages. The German translation was not available on time to test in this phase.

When the language of preferences of the respondent is known, the respondent will receive the communication and the study in the preferred languages. Otherwise the English version is provided. Respondents can switch between languages within the same study.

3.4.1.5 Evaluation questionnaire

To evaluate the front-office of MOTUS an evaluation questionnaire was developed. There are in total 8 blocks of questions that are being presented to the test respondents:

1. Demographic and contact information
2. General usage information
3. The content of the MOTUS application
4. The design of the MOTUS application
5. The functionality of the MOTUS application
6. The usability, accessibility, compatibility, performance and privacy of the MOTUS application
7. The future developments of the MOTUS application
8. General ratings questions and rating of the MOTUS application

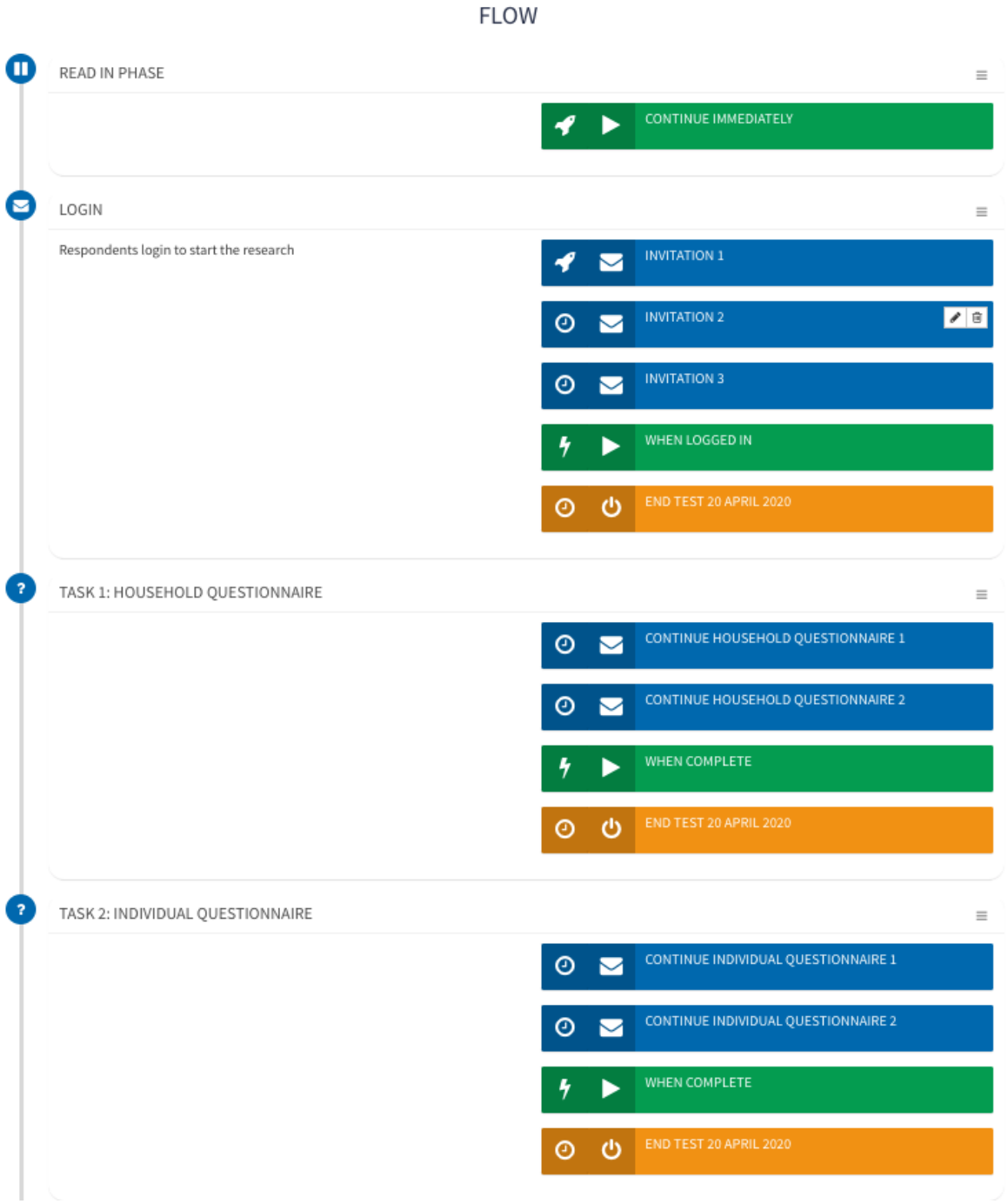
Most of the blocks also include ratings. The Evaluation questionnaire is a separate document 847218_BE_final report_Evaluation_Questionnaire.

3.4.1.6 Research flow proto-type

In hbits.4 Statbel and Destatis came to a proto-type, with a variation in time diary days and periods to be completed by the respondent.

The goal of this report is to test the proto-type while also simulating the TUS eco-system. This means the inclusion of a household, an individual questionnaire, and an after diary questionnaire. These are tasks 1, 2 and 4 as shown below in Figure 35.

Figure 35: Research flow e-diary test



Task 3 is the testing of a 1-day diary. The time diary starts at 4.00 am at the moment the test respondent arrives to the state of the time diary. The diary ends the next day at 4.00 am. The time diary remains open for at the maximum 3 days.

After the completion or closing of the diary the test respondents are asked to evaluate the front-office of MOTUS. The front-office is the respondent view and includes a web application and a mobile application.

3.4.2 Expert panel

In this report the expert panel are employees from Statbel and Destatis, as also researchers from the Research Group TOR and people from the IATUR research community. They tested the MOTUS-applications and became more familiar with the modular approach of MOTUS through an introduction of the back-office environment of MOTUS. The modus operandi included an introduction to MOTUS, a live presentation, a live try-out and an immediate feedback.

This has been done on an informal basis. In total 18 experts have participated.

The summarized feedback below will also include comments being made during presentations at the TF/WG group meetings of TUS and HBS and during the kick-off meeting of the ESSnet Smart Statistics in Wiesbaden, 16-17 of January 2020.

3.4.3 SWOT-analysis: a summarized feedback

On the next page a summarized feedback is given, shown as a SWOT-analysis.

Table 16: MOTUS SWOT analysis

	Strengths	Weaknesses
Internal origin	• Questionnaire functionality • Time diary functionality • Automatic communication • Automatic task orientation • Automated research flow • Automated fieldwork follow-up • Multi-device / Multi-platform • Multi-language • CMS-system – back-office • CRM-system – back-office • Modular components • Modular research flow • Standardization • Reusability • Comparability • No third party components (like Google) • APIs (input and output) • CSPA-documentation • GSBPM-documentation • TUS-eco system (survey + diary) • Immediate data availability • Privacy & security by design • Libraries	• Web app responsiveness • Individual-Household cluster • Not yet a training facility for researchers • Not yet an informative website • Not yet a well-balanced guideline for respondents • Not yet a well-balanced guideline for researchers • No yet an online help-desk • No yet an immediate feedback • Growing gap between groups of individuals • Steep learning curve • Burdensome registration • Length of the participation
	Opportunities	**Threats**
External origin	• Shareability • Fast setup • Scalability • Lower cost & time investment • Built-in quality assessment • 3-tier architecture philosophy • Virtual deployment • Country specific adaptations • Dynamic application build • Role management • 1-to-N strategy • Acceptance of other sources of information • No or less need for interviewer capacity • Combination with an interviewer • Link to IoT + inclusion Microservices • Inclusion of R + TUS R-packages • Compatibility with SPSS, SAS, … • On the go research • International interest • Multi-disciplinary • Cross-domain opportunity (HBS, transport, tourism, …) • Sustainable Development Goals • Employability during pandemics • Community building, panel opportunity	• License strategy not yet defined • Governance model not yet defined • System integration/harmonization • National laws • External privacy issues • External security issues • External ethical issues • Changes in the underlying software platform (Ionic, React, Flutter,…) • Old, not updated devices • Old, not updated browsers • Stability and size of development team • Server capacity • Stress test not yet executed

3.5 (hbits.9) Speech recognition as a new mode

Deliverable	An exploration on how (future) tools can support speech recognition to broaden up the method of time-registration.

This deliverable is provided as a separate document, containing the following items:

- What is speech recognition?
- Basic requirements to include speech recognition in time-use research
  - Data collection devices
  - Self-completion on the go
  - Efficient quality checks for fast processing
- The boundaries of speech and voice recognition technologies
- Tentative & committed data

4 WP4 – E-data

Overall goal	Towards a harmonized approach to support ESS shareability of MOTUS: pilot test and dissemination.

4.1 (Statbel.5) Coordination pilot test Belgium

Deliverable	Logbook on the contacts

Statbel will be 'executive' responsible for the pilot test towards to test respondents. A logbook of the contacts is available at Statbel and was only used for the purpose of this test. Because of GDPR regulations, the logbook can't be shared in a public document.

Below, you will find the report of the pilot test in Belgium, where this and the following deliverable is discussed together.

4.2 (hbits.10) Pilot test Belgium

Deliverable	Report on the pilot test to evaluate the e-diary under the Belgian population (non-representative sample) and further recommendation based on users experiences and qualitative analysis.

"In this task we will perform a test to receive feedback from pilot-users. Comments will be documented for further conclusions and the retrieved data will be used to perform quality analyses. These results will also impact the further refinement of the e-TUS."

4.2.1 Description of testing

The setup of the study is a result of the hbits.8 report, where the evaluation strategy was defined and an evaluation questionnaire was developed by the consortium. Test respondents are guided through the different steps of the TUS-survey with a household, an individual questionnaire, a one day time diary and an end of diary day questionnaire. After the test the respondents were asked to complete the evaluation questionnaire.

4.2.1.1 Invitation

Originally the strategy was to invite the test respondents during a live MOTUS-presentation in Luxembourg at the grant-closing Workshop at the 18th of March 2020. This workshop was unfortunately cancelled due to the COVID-19 measures. The intention was to introduce respondents to the MOTUS-application, to the setup of a TUS-survey without an interviewer and to receive feedback on content, design and technical elements of the test application.

With the cancellation of the workshop the invitation strategy was adapted, and the evaluation questionnaire was reworked to receive also remotely detailed feedback.

The new strategy was to invite respondents in 3 different batches. The first batch was send out on the 16th of March, the second, on the 15th of April and the last one on the 16th of April. In between there was a MOTUS update to version 4 because of new iOS requirements. This information and the number of participants is shown in Table 18.

Table 17: Information on the invitation phase of the pilot test of MOTUS

When	Who	Number
March 16	Consortium – Statbel & Destatis	3
MOTUS update to v4 on April 8th		
April 15	Statbel	37
April 15	Destatis	7
April 16	IATUR	5
April 16	TF/WG TUS&HBS	103
April 16	Sogeti	2

Some information about…

The invitation

- 157 respondents were invited to take part
- For Statbel, an internal testers panel was used. This panel includes all different levels of the organization
- The invitation list was based on known members of the TF/WG TUS and HBS and was approximately 1 year old
- Some people were not working anymore in their function, and were excluded from the list
- Some people updated their situation and became part of the TF/WG TUS and HBS
- 3 languages were available: English, Dutch & French
- All communication was automated
- The study was open world wide
- Countries were able to participate in their own Time Zone
- Due to the COVID-crisis not everyone could reach their inbox

4.2.1.2 (Country) response

The goal was to make the MOTUS test app open for every member, and to ask comments in order to proceed with the development of the MOTUS app and the underlying platform.

A large group of invited persons took part.

The response

- The database used for this report was downloaded on Monday the 26th at 10.00, Brussels Time (CEST).
- 93 respondents logged on to MOTUS
- 8 respondents were still busy with the household questionnaire at the moment of download
- 15 respondents were still busy with the time diary at the moment of download
- 5 respondents completed the test but did not complete the evaluation questionnaire at the moment of download
- 65 evaluation questionnaires were completed
- In several cases there was a joint evaluation, meaning more than one respondent combined their evaluation in one questionnaire
- Respondents of 24 different NSIs completed the evaluation questionnaire at the moment of download
- Respondents of 4 different NSIs finished the testing but did not complete the evaluation questionnaire at the moment of download

Countries with participating respondents

Albania / [Australia] / Austria / Belgium / Bosnia and Herzegovina / Bulgaria / [Chile] / Denmark / Finland / France / Germany / Hungary / Italy / Latvia / Malta / North Macedonia / Norway / Poland / Portugal / Romania / Serbia / Slovakia / Slovenia / Sweden / The Netherlands / Turkey

Countries with respondents having completed the test but not the evaluation questionnaire (so far)

Estonia / Ireland / Luxembourg / Spain

4.2.1.3 Socio-demographic and work related information

The respondents are spread over 4 defined age classes: <30 years old, <40 years old, <50 years old and 50 years old and over), as shown in Figure 36. Besides the first category, there is a more or less equal representation of the age classes in the pilot test. In relation to gender, the figure shows that men more than woman have completed the evaluation questionnaire.

Figure 36: Breakdown of the test respondents by age and gender

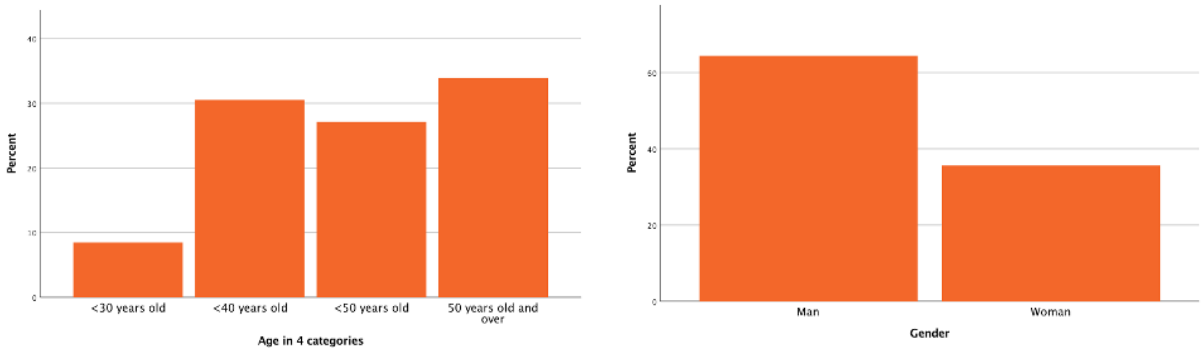
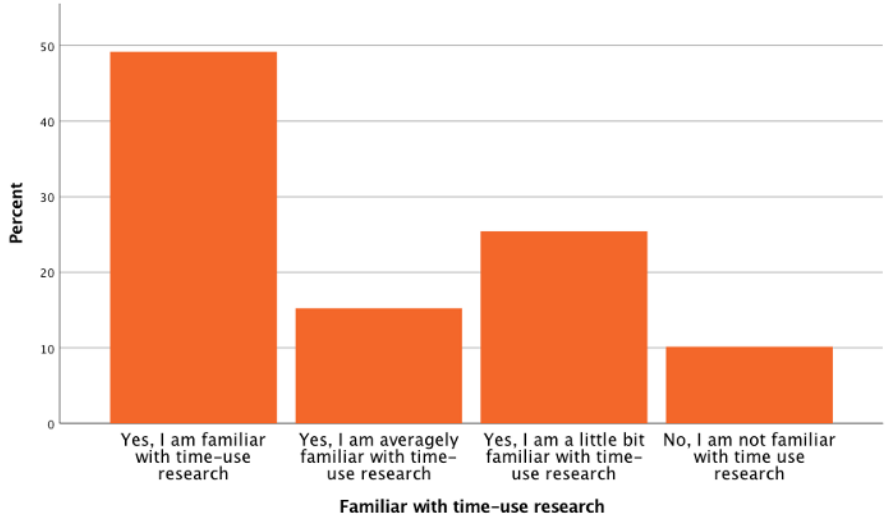


Figure 37 presents the division of expertise with time use research. It shows a division between respondents with a high expertise in time use research versus those with at maximum a moderate expertise in time use research.

Figure 37: Breakdown of the test respondents by expertise with time use research



In this document, the focus lies on the front-office of MOTUS.

4.2.2 Overview ratings

The evaluation questionnaire has two goals: to gather remarks on the test application, both negative and positive, but also to evaluate the MOTUS application by giving a rating from 1 to 5 (highest score) on the various aspects of the application.

From section 4.2.3 onwards, this report focusses on the comments that are given in the open questions. This section wants to give an overview of the different ratings. In total more than 20 ratings were presented to the respondents. These ratings are related to (different aspect of) the content, the design, the technical and non-technical qualities of the MOTUS application. At the end of the evaluation questionnaire the respondents were asked to rate the Mobile and Web application and the MOTUS-application overall.

A summary of these ratings is presented below in sections 4.2.2.1 and 4.2.2.2. Since Statbel employees cover 22 out of the 65 respondents, the results in these section are broken down in two groups.

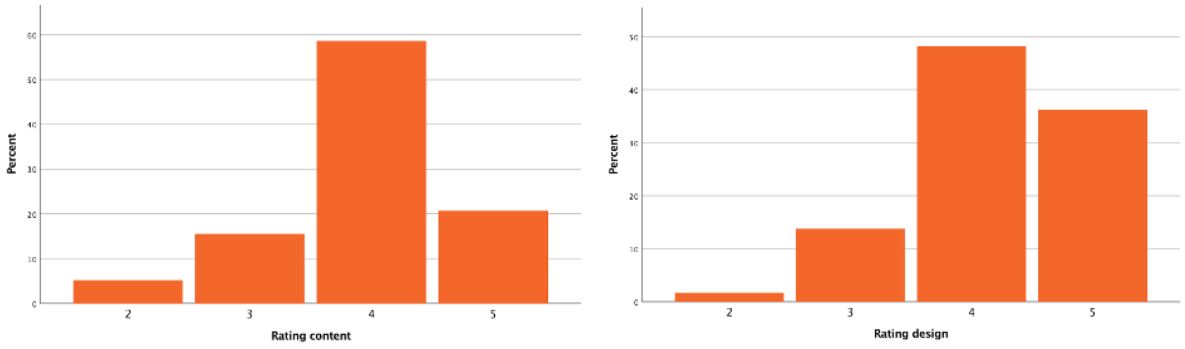
As will be noticed, the average ratings from the Statbel employees are lower. This has to do with the larger variance in computer competence, educational level and expertise in time-use research in comparison to the other NSI respondents. Which is, of course, on its own already an important conclusion.

4.2.2.1 Rating of the qualities of the MOTUS application

Figure 38 presents the average score for the content and the design of the application. Based on all respondents a 3,95 on 5 is given to the content, and a 4,19 on 5 for the design of the application.

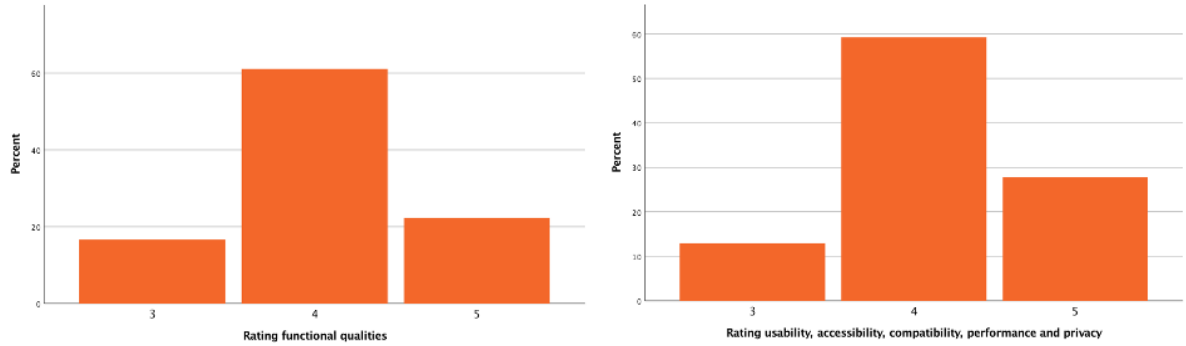
The Statbel employees gave with a 3,77 on 5 a lower score to the content in comparison to the 4,09 on 5 given by the other NSI employees. For the design of the application the scores were, respectively, a 4,09 vs. 4,29 on 5.

Figure 38: Rating given by the test respondents to the content and design



The technical aspects of the application were rated with the same appreciation from the Statbel employees and the others (4,06 average, 4,02 for Statbel employees and 4,09 for the others). A larger difference was noted for the non-functional qualities (4,15 average, 4,03 for Statbel employees and 4,24 for the others).

Figure 39: Rating given by the test respondents to the functional, usability, accessibility, compatibility, performance and privacy qualities



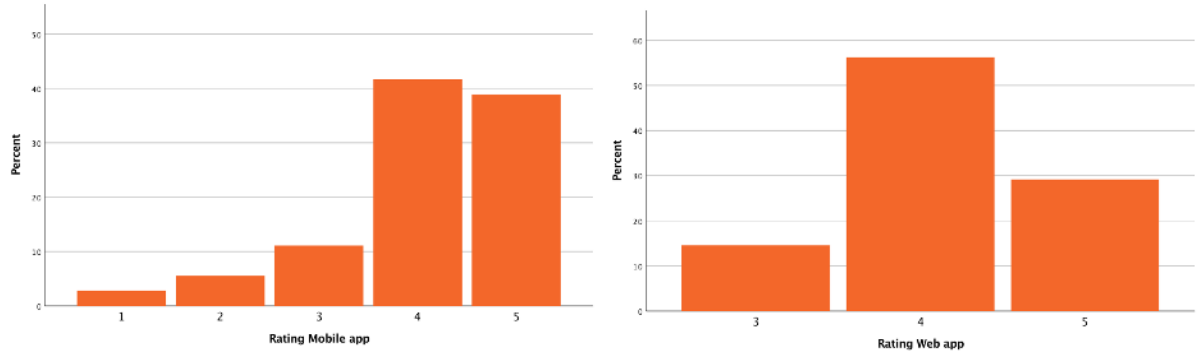
For every rating the majority of the respondents gave a 4 on 5.

4.2.2.2 Ratings overall of the MOTUS application

At the end of the evaluation questionnaire, when all the technical and non-technical components were evaluated, the questionnaire asked the respondent to evaluate the Mobile and the Web app separately (Figure 40), and MOTUS in general (Figure 41).

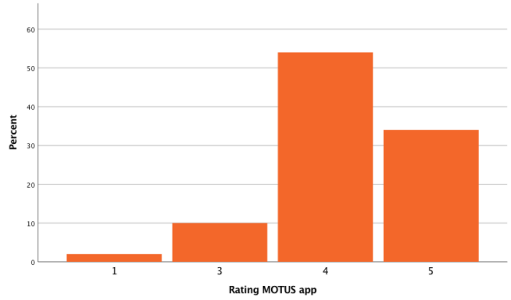
The Mobile application showed an interesting variation between the Statbel employees and the other NSIs: 3,82 vs. 4,20, and a total average of 4,08. This gap is closed for the Web app which received a total average of 4,15 (4,11 vs 4,17).

Figure 40: Rating given by the test respondents to the Mobile and the Web app



The effect of the Mobile app is noticeable in the overall MOTUS rating, scoring on average 4,18 on 5. The Statbel employees gave a score of 4,01, while the others marked a 4,27 on 5.

Figure 41: Rating given by the test respondents to the MOTUS application (overall)



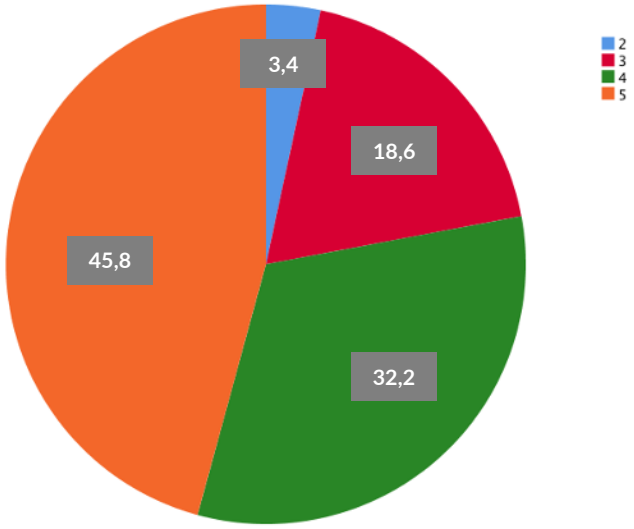
In the continuation of the report the focus lies on the remarks, therefore we don't break-out the results anymore between Statbel employees and other NSI test respondents.

4.2.3 General usage information

4.2.3.1 Understanding the modular character of MOTUS

The test respondents were introduced to MOTUS and the modular idea behind MOTUS. As indicated in Figure 42 78% respondents gave at minimum a 4 on 5 and therefore are considered to have understood the philosophy of the MOTUS software platform to define components and to organize these components in a research flow in order to run a study independently from the aid of an interviewer.

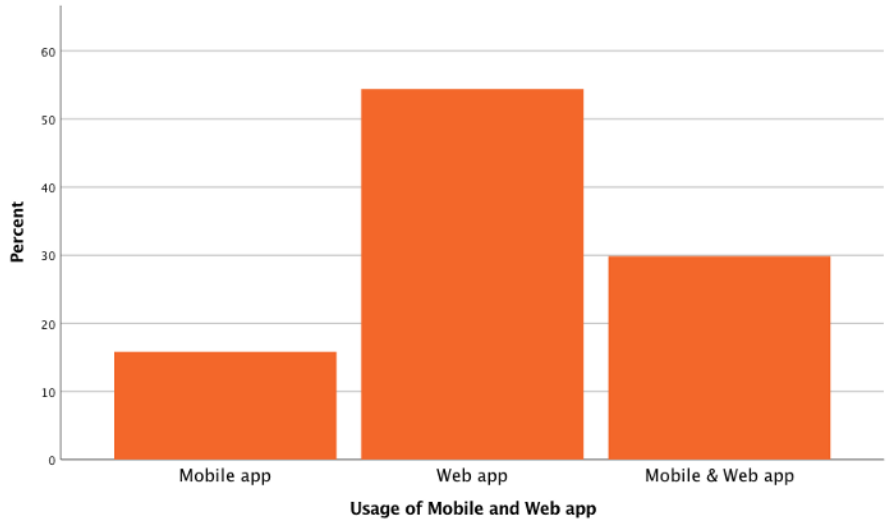
Figure 42: Test respondents being familiar with the modular idea of MOTUS



4.2.3.2 Use of MOTUS Mobile & Web app

The evaluation questionnaire asks the respondents which devices they have used during the test. The largest share of the test respondents used the MOTUS web application to complete the questionnaires and the diary. Near to 30% used the web application together with the mobile application. A smaller percentage only used the mobile application. The usage of both of the applications is probably related to the setup of the test, but a combination between a mobile and web application seems at least to be essential. In addition, for the future of the collection of official statistics.

Figure 43: Test respondents using Mobile and/or Web app



When testing the web application, the most popular browser was Google Chrome with more than half of the NSI employees using it. Second was Firefox with 30%. Apple users also tested the MOTUS web app via Safari. In general no problems were reported for these browser.

Respondents using Internet Explorer encountered difficulties to start the questionnaire. They received a 'blanc' screen. Advised was to use another browser because IE is outdated since 2017 and considered to be unsafe. Therefore IE is not supported by MOTUS. In 2019 IE had a market share of about 6%, with a sharp decline over de recent years. It is generally assumed that this browser will disappear as these computers are going to be replaced and IE cannot be pre-installed anymore. However, some NSIs still use IE as their standard browser.

Depending on future insights, MOTUS might need some backward compatibility towards IE.

4.2.3.3 Testing the quality of the application

The quality of an application can be evaluated on the basis of three criteria: the content of the application, the design of the application and the technical components of the application. These elements are treated below.

In section 4.2.2 the different ratings were presented. Here the remarks of the respondents are given, translated into English and in a limited form.

4.2.4 Remarks on the content of the application

The content of the test application is linked to the HETUS-guidelines, with some (essential) modifications. This applies especially to the activity list. For this test, the ACL or Activity Classification List was adapted. The list was designed for post-coding by coders, while now (with the OACL or Online Activity Classification List) the respondents use it as a pre-defined activity list to register their activities. A first introduction was given during the Joint Task Force meeting HBS/TUS of November 2019.

The focus was to get a first insight on the remarks. For every phase of the research flow, the respondents were asked to provide their remarks. Below in Table 19 an overview is given, showing the points to work at.

As being explained in hbits.1 does MOTUS work with different builders defined in the back-office. In the survey builder a questionnaire can be adapted and new questionnaires can be created. Thus, country specific questions in a questionnaire or activities in the activity list, even in different languages, can easily be attached to a research.

Also considered to be part of the content is the support information. In this test setup no extra information was provided to the respondents. Therefore a question asked for suggestions where to provide this information. A number of possibilities were given:

- In the recruitment materials (e.g. invitation e-mail)
- In the task overview
- Via series of screens the show the basics of the application
- In the menu
- Via pop-ups
- Via a FAQ-section
- On a related website
- Via an email
- Other

The top 3 was to include this information in the menu, via pop-ups and via a series of screens that would show the basics instructions of the application.

Table 18: Remarks on the content of the test application

Household questionnaire	
	Update of the household questionnaire – paper-and-pencil - online
	Discuss the general flow of the household questionnaire
	Better routing between questions – more consistency rules
	Too much in-between screens
	The questions are asked to administrative
	Include a category not applicable
	Define a more fitting household composition question – include also levels
	Aim of the reference person should be more clear
	Privacy issues with the details that had to be given about household members
	Gender: male – female - X
	Currency is not specified for income question
	Not pleasant to give income at the beginning of the study
	Childcare questions do not fit entirely
	Open up the questionnaire for more time specific questions (e.g. roles in the household)
Individual questionnaire	
	Update of the individual questionnaire – paper-and-pencil - online
	Double questioning with household questionnaire
	Better routing between questions – more consistency rules
	Hours work, what is the reference period?
	Educational question needs rework
	Additional questions on working patterns
Online Activity Classification List	
	Translation review (e.g. Je n'ai rien fait d'autre)
	Review of the activity list – ordering, depth, logic
	Return to the original HETUS activity list
	Sometimes the activities are detailed, sometimes quite broad
	Too much activities are in the list
	One open text category
	It needs some time to know what is in the list
Extra (context) questions	
	Better mapping between activities selected and extra questions asked
	Conflicting answer categories (nobody, no device, …)
	Clearer definition of 'interaction'
	Age children did not include 10 years old
	Include Smart TV as option
	Satisfaction level should run to 10 instead until to 7
	Remark when not answered the questions

4.2.5 Remarks on the design of the application

With these questions the idea was to learn more about how the design of the MOTUS-application can facilitate or hinder the user-friendliness of the app. With MOTUS the idea is to keep the research environment as clear and simple as possible.

There were two different topics: the questionnaire design and the time diary design. For the questionnaire design the remarks were fairly modest as shown in Table 20. Necessary adaptations can be made.

Table 19: Remarks on the design of the questionnaire

Questionnaire	
	Bigger font, smaller font
	A ticker font
	Smaller text boxes
	Indicate the amount of characters that are allowed
	Different indicators for bullet/check boxes
	Indicate obligatory questions
	Sometimes when the length of the page is deeper and still some questions need to be asked, you can already hit the continue button to go to the next page.
	Not clear where to type the answer in case of a numeric question

Almost all components of the questionnaires are also part of the time diary. Nevertheless, in this test specific attention was asked to evaluate the timeline, the registration of an activity, the extra context questions and the summary of an activity.

The online time diary is the main focus of this test and at the same time the most novel element. Despite the good rating it is nevertheless of no surprise that the time diary received besides positive remarks also some important points to work at. Table 21 gives an overview of these remarks.

In general, there are 3 sorts of remarks. There is a need for:

1. More introduction, more information
2. Better visual support to the registration
3. Better responsiveness of the web app in combination with smaller devices

These elements will be taken into account for the next version(s) of MOTUS.

Table 20: Remarks on the design of the time diary

Time diary	
Introduction/more information	
	Introduction to the diary use is necessary
	Make more clear how to start the time diary, and the steps to be taken
	Make more clear how to change an activity
	Logic of registering an activity: time selection – activity – context, or first activity and then time selection and context
	Include some extra information for every category in the activity list to make more clear which activities are included
Visual support to the registration	
	Show both the primary and the secondary activity in the timeline
	It is not clear whether a secondary activity is to be selected
	Timeline on the web app takes much space, make it collapsible
	<5 minute gaps are not shown in the timeline
	More action buttons: to remove an activity, copy/paste, …
	Work with icons to show the context question is on location, on transport, on social network, on IT, …
	Show first the day, then month, then year
	Indicate when an activity is registered
	The function of the magnifying glass needs to be introduced
	Show the activity list in one page
	Warnings should be more detailed, e.g. why is there an overlapping time?
Responsiveness of the web app	
	The responsiveness of the web app on smaller screens needs to be improved

4.2.6 Remarks on the technicality of the application

Besides the content and the design of the application, it is the technicality of an application that is important. The technicality of an app can be understood in various ways. The evaluation questionnaire asked the respondent questions about the:

- functionality,
- usability,
- compatibility,
- performance and
- privacy of the MOTUS application.

4.2.6.1 Functionality

In information technology, functionality (coming from the Latin functio and means "to perform") is the sum or any aspect of what a product, such as a software application or computing device, can do for a user. The evaluation questionnaire discussed in total 14 different functionalities of the MOTUS application.

In Table 22 the different functionalities are listed. Test respondents could make remarks, both positive and negative. The table lists critics that suggest a functional improvement. The 3th column shows for every element the average rating from 1 to 5, from 'Totally unsatisfied until Very satisfied'. The functionalities that score the highest are ranked higher in the table.

The different functionalities that define the MOTUS-applications received a score between 4,40 and 3,37 on a maximum of 5. For each functionality also the Standard Deviation is given to provide an

indication of the underlying variation between the ratings given by the test persons. The higher the St. Dev., the lower the similarity between the ratings of the respondents.

Seven out of 14 functionalities have a score above 4 on 5. The top 4 have received positive critics and are to be seen as more operational qualities of the application that relate to the (re)entering of the application. The comments given are seen to support the respondent even more.

Especially the partial completion function is of importance as respondents have to enter the application multiple times during their participation: to complete questionnaires but also to keep the diary over a number of days. Because of this, it is important that respondents can resume their participation without any loss of data, while at the same time the information is up-to-date on all devices (see functionality 5).

Another operationally important quality of the MOTUS application is the task functionality. The task functionality received a 4,19 on 5. When respondents go themselves from task to task there is no need for an interviewer, support is given at any time of the day, at the moment it is needed and without any extra costs. Many respondents found this a novel element of the application. Some respondents suggest to provide even more information in the task overview, and the develop an option to go back to the previous tasks.

Lower in rank are the aspects that related to registering content (giving input). The main aspects are the questionnaire and the time diary functionality, which were rated respectively with a 4,19 and 3,89 on 5. The average score for the time diary functionality has a St. Dev. of .979, which shows an underlying variance between respondents who are more convinced about the way activities can be registered and those who have some (important) remarks on the modus operandi of the time diary. The same is true for the different registration modes. Some remarks are related to the HETUS-recommendations (e.g. the starting time of the day) but can be changed in the diary builder of MOTUS. Other comments that relate to, for instance, the time selector, or the vagueness how to change an activity needs to be redeveloped.

What is however surprising is that there are no comments related to the search tag-functionality in MOTUS. It means that by typing in a key word respondents get a list of activities from which they can choose from. Possibly this was not visible enough in the design for the respondents.

Attached to the diary are the context questions. The biggest remark here is the overload on questions for every activity.

The offline usage of the application received the lowest score, but also received no comments. It looks like it has not been tested thoroughly.

When asking for the stronger and weaker points, it is clear that the more operational qualities are considered to be high level. The online time diary is for a lot of test respondents a new reality. But this is also the case for a respondent. All the remarks are essential, certainly when an application is due to collect population statistics it is important to provide a solution to the more negative remarks without losing out of sight the overall idea of time diary research.

Table 21: Remarks on the functional elements of the application

Functionality	Remarks	Rating (St. Dev)
[Functionality 2] The login process [Functionality 1] Finding the app: downloading and going to the MOTUS-app		4,53 (.557)
	The creation of a new password after initial login should be required	
	It should be better indicated when the device is offline when trying to login	
	Need for a permanent login during the diary phase	
[Functionality 1] Finding the app: downloading and going to the MOTUS-app		4,40 (.695)
	There are a lot of 'MOTUS' named applications in the store which makes it troublesome to find	
	The mobile app is not available for older iOS versions	
	The web app does not work with Internet Explorer	
[Functionality 4] The partial completion process: logging out and resuming the research without a loss of data		4,39 (.823)
	Answers given on a page that is not submitted are not stored in the questionnaire	
	Health check of the connection with the server, including communication when the connection is not valid anymore	
[Functionality 3] The task functionality: going from task to task		4,19 (.776)
	Provide an overview of all the tasks in the task overview. Indicate the state in which they are (use colors or icons to show the state of completion)	
	Button to go back to the previous task(s) also after completion	
	Provide mouse-over to receive more information on the tasks	
	After the time diary closes and overview of the timeline is needed before going forward	
[Functionality 8] The questionnaire functionality		4,19 (.739)
	Better routing between questions – more consistency rules	
	The country chooser should be a dropdown to avoid typos	
[Functionality 14] The finalization functionality: ending a questionnaire and time diary [Functionality 6] The offline usage of the app		4,08 (.874)
	The pop-up was not clear, more information is needed	
	Button to go back to the diary after end screen	
[Functionality 5] The synchronization of input: synchronization of data on different devices		3,97 (.865)
	Synchronization is sometimes a bit slow	
[Functionality 9] The time diary functionality		3,89 (.979)
	Difficulty with the clock to select times, better use typing	
	Difficulty to select the time of the next day (over midnight)	
	Type in hour and minutes instead of time selector	
	Unable to choose a particular day	
	Be able to select several secondary activities	
	Be able to only fil in one activity	
	Be able to fill in separately the different parts of an activity	
	How can other household members participate?	
[Functionality 13] The warning functionality		3,82 (.869)
	More plausibility checks in the questionnaire	
	More specific warnings in the diary	
[Functionality 11] The function to add different context questions		3,81 (.889)

	Higher burden when asking all of these questions for every activity	
	When tracking an activity it is not logic to complete already the context questions	
	It was possible to indicate that no mobile was used and to another device at the same time	
[Functionality 7] The language toggle: the ability to witch between languages		3,73 (.828)
	There was a Dutch insertion in the English text	
	The reload time for a change of language takes a moment	
	Arrows in Firefox are covering the language toggle	
[Functionality 10] The different registration modes to register an activity		3,71 (.893)
	The functionality of the tree selection is not always clear	
	Provide a list of activities in the menu	
	No strict starting time (e.g. 4 o'clock)	
	Keep to the 10-minute grain	
	Use the recognition of the term to code an activity	
	Allow open text descriptions	
	Time tracking is not clear	
	The link between the categories and the tags is not yet complete	
[Functionality 12] The ability to change and adapt your input		3,53 (1.028)
	It is not clear enough how to change given input	
	Add buttons: remove, copy/paste, insert	
[Functionality 6] The offline usage of the app		3,37 (.629)
	[No comments, it seems this was not tested]	

4.2.6.2 Usability, accessibility, compatibility, performance and privacy

Besides the technical aspects, the evaluation questionnaire takes into account 5 non-technical qualities: usability, accessibility, compatibility, performance and privacy.

Just like with the functionality of the application also now the test respondents have made remarks and ratings. 4 out of the 9 criteria have a score higher than 4 on 5. It is an important finding that the test respondents find the applications fast, easy to use, compatible between mobile and web app and have (in case of the mobile app) a modest battery consumption.

The ease of use here relates to the overall usability of the application, more than the specific elements that were technically evaluated in the previous section. This in itself is a good starting point for new innovations and even redevelopments in respect to the remarks that were given by the test respondents.

As was stated in the previous part of this report, the compatibility between browsers is hampered due to failures with Internet Explorer. It seems that still some of the NSIs make use of this browser.

The fifth place, with a score of 4,06 on 5, goes to the security of the application. The low St. Dev. of .406 points to a consistent response pattern of the test respondents. The application does not store information on the device(s) (besides when logging offline), all information is sent via a HTTPS connection, and above all has no third party components (e.g. Google components, …) included.

Table 22: Remarks on the non-functional elements of the application

Functionality	Remarks	Rating
[Performance 1] The speed of the app		4,51 (.651)
	[No comments]	
[Usability 1] The ease of use of the application		4,19 (.822)
	There is a need for an informative guideline	
	More explanation is needed to start the diary	
	Provide instructions via an icon or mouse-over (or 'bubbles')	
	Instruction video can be helpful to indicate the time and to select the activities	
	A learning phase might be essential to suppress less qualitative input that is related to the start of the diary	
[Compatibility 1] The compatibility between the web app and the mobile app		4,07 (.829)
	Tracking of time does not seem that easy on the web app, in comparison to the mobile app, also the context is different because you have your mobile with you all the time, and not your laptop	
	Problems with older iOS-versions	
	Responsiveness of the web app for small screens might be better	
[Performance 2] The battery-use of the app		4,06 (.840)
	Noticed a moderate burden on my smartphone	
[Security 1] The security of the app		4,06 (.406)
	Some personal questions seem irrelevant	
	Require a new password at the beginning of participation	
[Compatibility 2] The compatibility between different platforms (iOS, Android…) and devices		3,92 (.845)
	[No comments, it seems this was not tested]	
[Accessibility 2] The learning curve of the app: how easy it is to use to app without a lot of instructions		3,75 (.841)
	A trial or learning period is necessary	
[Compatibility 3] The functioning of the app in different web browsers		3,52 (.926)
	Less good functioning in Firefox	
	MOTUS does not function with Internet Explorer	
	Edge gives a problem when updating an activity	
[Accessibility 1] The accessibility of the app to all groups of people in society		3,46 (.730)
	The display of the activities might pose problems for some people	
	Visual impaired people might need voice support	
	Compatibility with paper diary since still people will need to use the paper diary, certainly for older people	
	A longer learning curve will be necessary for lower educated people	

The remaining aspects relate to the learning curve of the app, and the accessibility of the app to all groups of people in society. Time diary research is not only a demanding study, also many actions need to be done to register an activity. This is probably more burdensome for lower educated people, older and disabled people. These people have of course equal rights to express their opinions and to show how they spend their time.

It is therefore important to evaluate the application in order to see what and how changes can be made to make the application more accessible.

4.2.7 Future developments of MOTUS

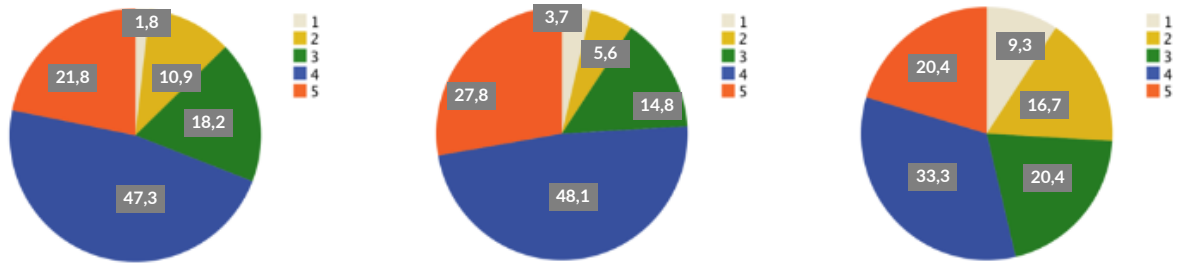
Although TUS is seen as the most valid and reliable method to capture the micro-behavioral elements of our daily life, the method suffers from a high respondent burden and, as a result, from low response rates. On the output side, this means a lower quality (e.g. less activities reported) and a selective representation of the population. For NSIs this means a higher data collection cost.

In order to reverse this trend the collection of time use data needs to be modernized via technological developments. These technological developments would need:

- to improve the participation of the respondent
- to better integrate other sources of information, and
- to arrive to a more efficient data collection for Member States

As introduced to the test respondents, the setup of MOTUS makes it possible to provide/include personal data in different ways. In the evaluation questionnaire 3 scenarios were presented and which were by the test respondents rated from 1 to 5. Below Figure 44 shows the results.

Figure 44: Ratings given by the test respondents in favour of (a) the inclusion of administrative data, (b) to use earlier research input and (c) to use passive data via sensors



All 3 Pie Charts show a fairly large variation on the options to:

- [Figure 41a – 3,76 – .981] Include administrative data (e.g. from the National Register)
- [Figure 41b – 3.91 – .996] To use earlier research input of the respondent
- [Figure 41c – 3.39 – 1.250] To use passive data registration via sensors (e.g. your location tracked via the GPS on your phone

While some test respondents have their doubts about including administrative data or even to retrieve earlier given information by the respondent, still more than 2/3th is in favor. For the inclusion of passive date (e.g. geolocation data), the pro-majority is reduced to 54%. For all three options the group in favor consist more of respondents that gave a 4 on 5.

The evaluation questionnaire also introduced the position of the respondent towards the inclusion of personal data with the question whether the test respondent 'would be for or against a central position of the respondent having control of their own data'?

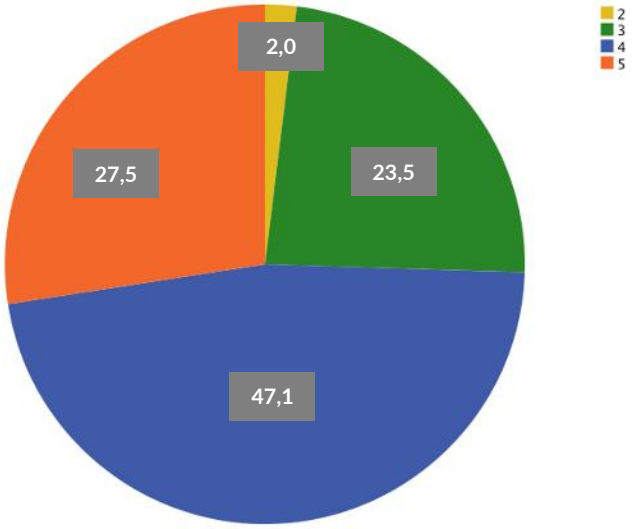
The answers show that 31% of the test respondents is totally in favor (score 5), and another 55% gave a 4 on 5. This element is important when including external data, and the test respondents seem to support this in a strong way.

4.2.8 Overall ratings and ESS-platform

The last part of the evaluation questionnaire asked to respondents to rate the Mobile and Web application but also whether the respondents thinks MOTUS could be used as a platform to collect official statistics on a European or international level.

The mean score was 4,02 on 5. The biggest group of 47% returned the question with a 4, about 28% gave a 5 on 5.

Figure 45: Rating given by the test respondents to the question whether MOTUS could be used as a platform to collect official statistics on a European or international level



In the last table of the report an overview is given of the comments made by the test respondents.

As the reading of Table 24 learns, test respondent see a future for MOTUS, conditionally:

- When technical problems are solved
- When more languages can be included
- When the content can be adapted to country specific needs
- When also available to lower educated, older people, visual impaired persons, …
- When it can be combined with paper-and-pencil diaries and interviewer support
- When there is a clear knowledge on ownership, architecture, development, license, privacy

All in all, it seems that test respondents are mostly concerned about the last point in the list.

On the next page you can find the table with the overall comments given by the test respondents to the question whether MOTUS could be used as a platform to collect official statistics on a European or international level.

Table 23: Overall comments given by the test respondents

MOTUS is very good and user friendly app.
For some rural places, there are people who don't use internet. For these people and old people, this application is difficult to use. Perhaps a mixed way could be conducted in our country. Some people, MOTUS, some people pencil and pen diary.
In general the app can be used at an European level. With more translations the app will reach a larger population. In some countries the sample will need to be restricted due to the level of computer skills.
It could be included after making improvements.
MOTUS is a well-developed application, however some changes (and country-specific developments) are necessary - especially in the activity list. But overall it can be the base of a well-designed platform on international or European level. This way the collection of the official statistics could be much more coherent and comparable among the countries.
Some countries will have problem with elderly people, with not so educated people, with language etc. also having no smartphone or internet.
More languages are needed, adapting the options (for each question) in the questionnaire in relation to the country is needed to.
It should allow to integrate different data collection techniques, it should be clarified what the ownership of the survey is, the data should be stored on national servers, the NIS have many constraints on this aspects with GDPR. The problem of episode formation should be solved, to achieve comparability between the online diary tool and the paper diary.
I think that MOTUS is well designed, but there could be problems with integration due to different country specifics issues (different systems, privacy, law, survey management ...).
It could be useful (if adapted) for HBS data collection.
MOTUS can be used if the questionnaire can be made more complex and so longer?
Could MOTUS be combined with interviewer support?
It is a clear structured diary/application/platform. Country specific differences should be considered. The activity list might be demanding for some people - so free text entries should be possible.
The MOTUS-platform would be a positive and expected outcome, however issue such as localizations (in 22 + language) are not secondary; ownership, development, licensing issues need to be tackled but are not show stoppers.
Not sure how different expectations concerning privacy could be fulfilled.
MOTUS is very intuitively to use but has a very steep learning curve.
More attention needs to be given to digital low skilled persons, non-native speakers, ... Also attention needs to be given to the legislation of linking other sources of data. Better use of pop-ups and supportive elements needs to be considered.
MOTUS is easy to use after explications are given. MOTUS is available to many platforms and devices that are used by a large part of society.
MOTUS needs to be available through the server of an NSI or Eurostat to protect the answers of the respondent.
Technical problems need to be solved. It needs to be clear where the server is and how national laws can be applied. The content must be adaptable to country specific demands.
MOTUS perfectly anticipates to the future!

4.3 (hbits.11) Dissemination of database and results

Deliverable	After the data collection, the next most important phase is to make the database available, in a cleaned and well-documented way, supported with META-data information.

4.3.1 Data collection in MOTUS

As being described in hbits.1 and hbits.2 a research is prepared in MOTUS, respondents are invited and participate to the research by using the web application and/or the mobile application. During the data collection the data is stored on the back-end server over a Client API. Through an API-connection with the Analyze server the reports are being made available to the researcher. These phases are part of the GSBPM-architecture 3, 4, 5 – Build, Collect and Process.

MOTUS makes use of internal running and external running R-packages to prepare, evaluate and clean the data. The scripts relate to:

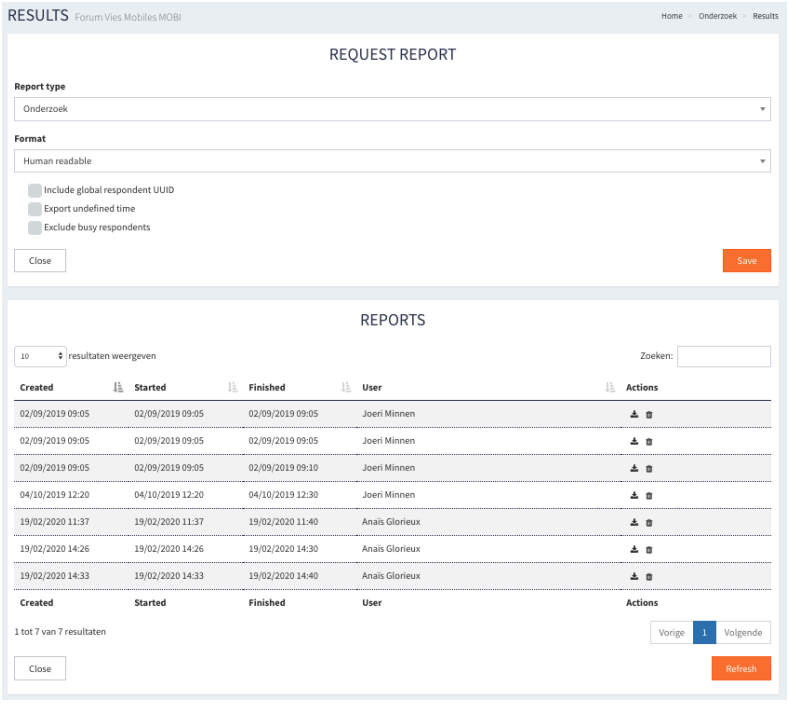
- Internal processes MOTUS
- Download database and quality assessment MOTUS
- Library and Time Use Diary book MOTUS

The internal processes via R running straight-away on the MariaDB server are not documented here. The R-package results in a dataset provided to the MOTUS-builder.

4.3.2 Download database and quality assessment MOTUS

The internal processing of MOTUS runs continuously and makes it possible to download the available data from the servers, also when the data collection itself is still running. The researcher can via de MOTUS-builder Data download the data of a research.

Figure 46: Downloading a dataset in MOTUS



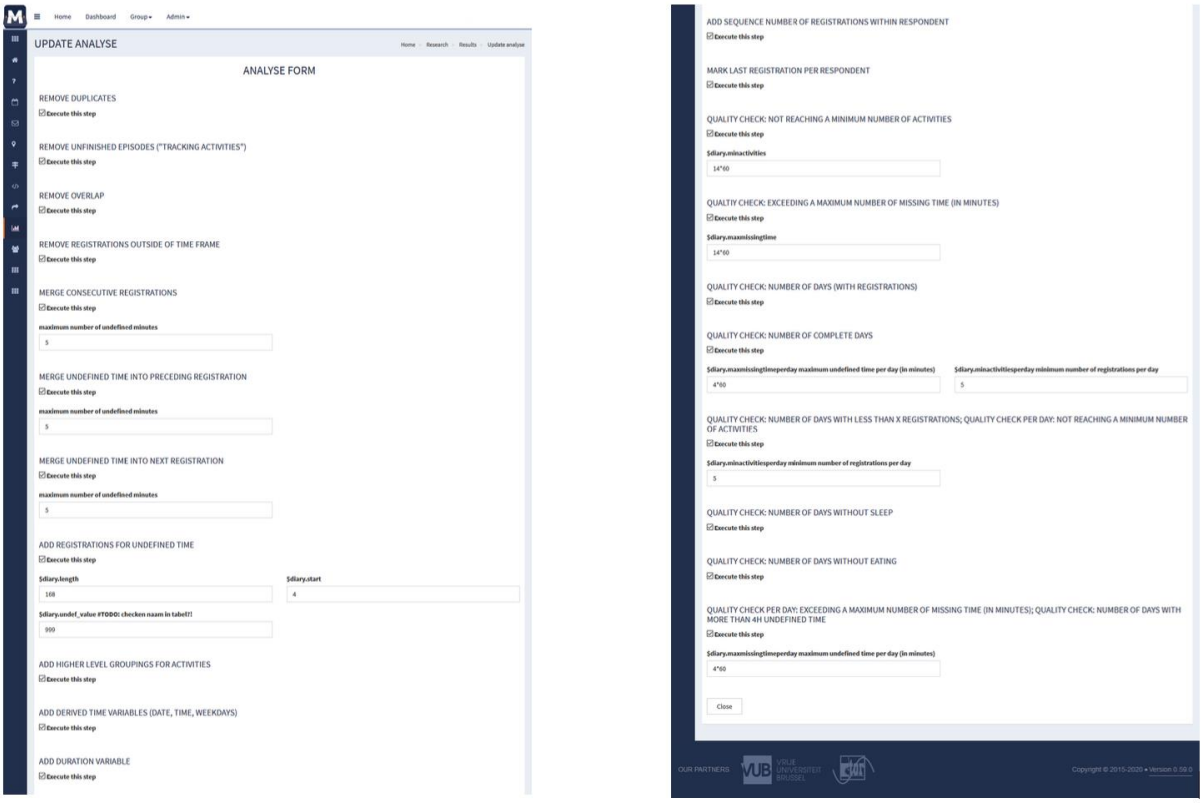
When a research flow includes multiple tasks, the download includes per task a dataset. The dataset can be a questionnaire, a time diary but also a dataset with event-information coming from a GPS-plugin. The download can include partial completions.

The downloads are provided in .Rdata, .csv and .sav. .Rdata and .sav include data labels and can be easily read into SAS. A straight-away export to SAS is not functional as it leads to import problems. A further strategy would be to cover this in an additional R-package.

Time diary research is a burdensome task for respondents, and taken into account the complexity of activity categories, context questions, as well as the length of the observation period at lot of quality issues can lead to a wide variety of quality problems that normally are solved in a post-cleaning phase.

Before downloading, the researcher can request to execute a quality assessment for the time diary using the MOTUS-platform. Below a figure of the MOTUS Analyze builder is shown taking into account quality criteria, and modifications to the dataset.

Figure 47: Quality assessment MOTUS



To the reader, these actions are:

- Remove information
  - Remove duplicates
  - Remove unfinished episodes (“Tracking activities”)
  - Remove overlap
  - Remove registrations outside of time frame
- Merge information
  - Merge consecutive registrations (Maximum number of undefined minutes)
  - Merge undefined time into preceding registration (Maximum number of undefined minutes)
  - Merge undefined time into next registration (Maximum number of undefined minutes)
- Add information
  - Add registrations for undefined time (Diary length, Diary start, Diary undefined value)

    - Add higher level groupings for activities
    - Add derived time variables (date, time, weekdays)
    - Add duration variable
    - Add sequence number of registrations within respondent
    - Mark last registration per respondent
- Quality check
    - Quality check: Not reaching a minimum number of activities (Diary minimum activities)
    - Quality check: Exceeding a maximum number of missing time (in minutes)
    - Quality check: Number of days with registrations
    - Quality check: Number of complete days (Diary maximum missing undefined time, Diary minimum activities per day)
    - Quality check: Number of days with less than x registrations (Diary minimum activities per day)
    - Quality check: Number of days without sleep
    - Quality check: Number of days without eating
    - Quality check per day: Exceeding a maximum number of missing time (Diary maximum missing time per day)

This work is work in progress.

4.3.3 Library and Time Use Data book

R-packages are a collection of R-functions, complied code and sample data. They are stored under a directory called "library" in the R-environment. By default, R installs a set of packages during installation. More packages can be added later, when they are needed for some specific purpose. They increase the power of R by improving existing base R-functionalities, or by adding new ones. Well-used examples are dplyr and data.

For time use research the availability over a dedicated R-package is modest. To accommodate to this the MOTUS-R-package is in development.

In this R-package there is room for fairly simple analysis syntaxes like the calculation of the duration per respondent, the participation rate and the duration per participant:

Figure 48: MOTUS-R-package is in development

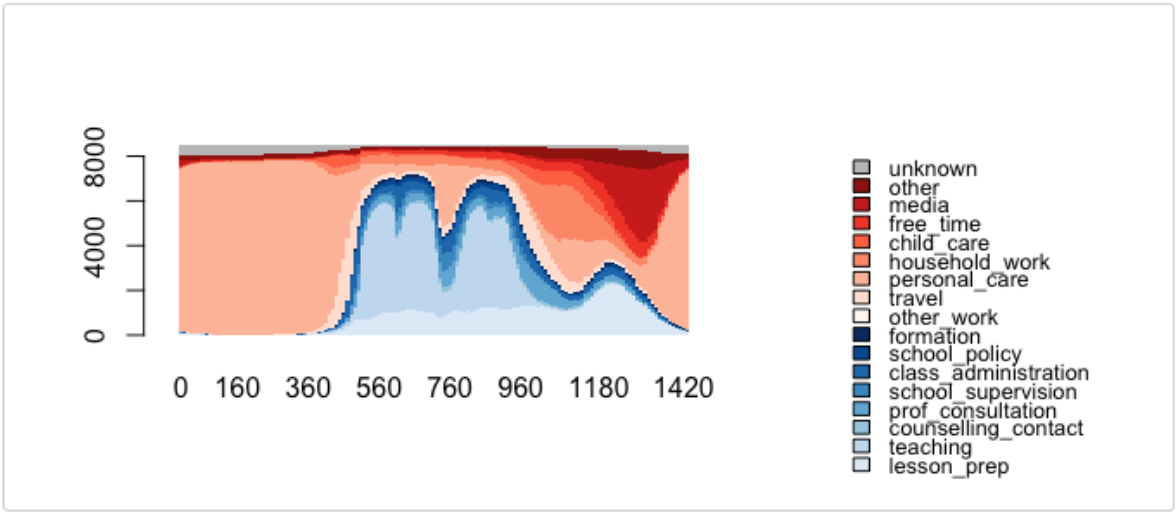
```
# and aggregated
summary(timeindicators_activity)
## averaged base time parameters (N=4454)
##  for every value in  mainact_level1
##    mainact_level1   duration participation   episodes Ntotal
## 1               1 1294.38931     0.6699596  8.1977997   4454
## 2               2 1088.15694     0.9813651 24.0060620   4454
## 3               3  154.95397     0.3713516  3.8709026   4454
## 4               4  951.57903     0.9997755 30.5422093   4454
## 5               5 3628.50045     1.0000000 11.2851370   4454
## 6               6  199.03862     0.2642568  1.5954198   4454
## 7               7  559.14122     0.9431971  7.0083071   4454
## 8               8 1564.63404     0.9982039 17.0026942   4454
## 9               9   13.68298     0.2339470  0.5875617   4454
## 10             10  523.01976     0.9483610 17.6376291   4454
## 11             11  102.90368     0.7108217  3.8118545   4454
##    durationperparticipant episodesperparticipant Nparticipants
## 1              1932.04088              12.236260          2984
## 2              1108.81972              24.461908          4371
## 3               417.27025              10.423821          1654
## 4               951.79272              30.549068          4453
## 5              3628.50045              11.285137          4454
## 6               753.20136               6.037383          1177
## 7               592.81481               7.430374          4201
## 8              1567.44939              17.033288          4446
## 9                58.48752               2.511516          1042
## 10              551.49858              18.598011          4224
## 11              144.76721               5.362603          3166
```

Where in this example
1=Paid work;
2=Household work;
3=Child care,
4=Personal care, eating and drinking;
5=Sleeping and resting;
6=Education;
7=Social participation;
8=Leisure time;
9=Waiting;
10=Travel;
11=Other.
But there are also more advanced data computations that can find a place in the R-library. An example is a rhythm analysis.

Figure 49: Example of a rhythm analysis in MOTUS

```
data(teachers18_timing)
# aggregate over all respondents
timevars = paste("t",(0:143)*10,sep="")
per10min = aggregate(as.formula(sprintf("cbind(%s) ~ dayofweek + cat", paste(timevars,collapse=","))),
teachers18_timing, FUN=sum, drop=FALSE)

library(RColorBrewer)
# 1 day plot (monday) of time use timing
barplot(as.matrix(per10min[per10min$dayofweek==1,3:146]),
        space=0, border=NA,
        col=c(brewer.pal(n = 9, name = "Blues")[2:9],brewer.pal(n = 8, name = "Reds"),"gray"),
        legend=per10min[per10min$dayofweek==1,"cat"],
        args.legend = list(x = "topright", bty = "n", cex=0.8, y.intersp=0.7),
        xlim=c(0,250),
        names.arg = (0:143) *10)
```



An example of an R-package is the Teachers18 database being used during the Big Data Hackathon 2019.

The R-pacakage: http://socipc1.vub.ac.be/pub/Rpkg/MOTUSteachers18_0.3.tar.gz

A pdf-manual with META-data: http://socipc1.vub.ac.be/pub/Rpkg/MOTUSteachers18.pdf

Figure 50: MOTUS R-package Teachers18

Package

May 15, 2019

Type Package

Title Data Collected with MOTUS: Teachers study 2018

Version 0.3

Author Ilse Laurijssen; Joeri Minnen

Maintainer Ilse Laurijssen <Ilse.Laurijssen@vub.be>

Description Flemish teachers' time use was collected during 1 week.
This package contains activity data (registration level data) in teachers18_act
and background data (individual level data) in teachers18_char.
Use data(teachers18_act) or data(teachers18_char) to load them into your workspace.

License License: file LICENSE

Encoding UTF-8

LazyData true

RoxygenNote 6.1.1

Depends R (>= 2.10)

Suggests knitr,
rmarkdown

VignetteBuilder knitr

R topics documented:

It is the goal to continuously collected information about data techniques, functionalities and dataset. This knowledge could come together in a Time Use Data book available via GitLab.

5 WP5 – Overall management

Overall goal	IT-support, communication, coordination and support to meetings from Statbel & Destatis.

5.1 Overall summary and recommendations

Deliverable	Overall summary and future recommendations to EUROSTAT.

5.1.1 Introduction

With the report hbits.12, the SOURCE™-project comes to an end. The project started in March 2018 and ended 14 months later in April 2020. The coordinator of this project is Statbel, the Belgian statistical office and the beneficiary is Destatis (Statistisches Bundesamt), the German statistical office. As a subcontractor the company hbits CV (www.hbits.io) as a Spin-Off of the Vrije Universiteit Brussel (Belgium) was appointed.

The general goal of this project was to get to know more about MOTUS (or Modular Online Time Use Survey). The MOTUS software platform is a continuous development of the Research Group TOR of the Vrije Universiteit Brussel since 2012. As a research group TOR studies the organization of time. For this it uses own collected time diary data since 1984 (www.vub.be/TOR). As of today the research group still collects time use data. The focus lies both on small and large samples, and often in collaboration with different research disciplines. Over the years, a fruitful relationship with Statbel has arisen. This is showed in the partnership during the HETUS-oriented data collections of 1999, 2005 and 2013. TOR was an advising partner during the fieldwork the valorization of the data. Also for the future Statbel, the Vrije Universiteit Brussel and the Spin-Off hbits are partners in the collection of TUS data.

The fact that TOR is still able to collect time use data is due to the development of an online diary. This online diary was a response to the growing costs and the on-going cuts in research funding. MOTUS was an answer to this in order to respond to this situation, while at the same time there was a window of opportunities to innovate this research field, to become 'Modular' by using different components or builders. This modularity defines the most powerful character of the platform.

5.1.2 The SOURCE™-project

To share this knowledge the project defined 4 working packages:

(5) Software Outreach
(6) Redefinition of flows and
(7) Collect
(8) E-data

Each working package has the function to introduce MOTUS step-by-step; to the consortia members, but also to other experts throughout the project. The latter was done towards the end of the project via a pilot data collection that gathered comments from 28 different NSIs both inside and outside of Europe. These comments will be used to bring MOTUS to a higher level.

This higher level is achieved when MOTUS would be (accepted as) a shareable platform on the ESS-level. To introduce the MOTUS-platform to the readers of this report the different reports provide:

- an introduction of MOTUS to Statbel and Destatis
- an evaluation of the data collection processes within Statbel and Destatis
- an overview of which solutions MOTUS can provide

- an oversight of the actions that need to be taken so MOTUS can be further developed to become an ESS-platform
- an evaluation whether MOTUS would be able to operate cross-domain and would be able to collect HBS data, and even can be available for other statistical domains like transportation and tourism

5.1.3 The MOTUS platform

MOTUS combines a back-office (www.motusbuilder.io) and a front-office (www.motusresearch.io & via the app stores). The back-office supports the researcher to design a research and to collect and disseminate data. The front-office is available to the respondents to take part in the studies.

The use of builders comprised in the back-office supports MOTUS in its most powerful asset: modularity. It is the composition of the builders, and the choices being made within these builders that define the actual set up of a particular research. As such, MOTUS makes it possible to define multiple researches, than can run at the same time, even for the same respondent.

Today the MOTUS-builder counts 11 builders:

- Device builder
- Survey builder
- Diary builder
- Event builder
- Communication builder
- Language builder
- Research builder
- Invitation builder
- Dashboard builder
- Data builder
- Quality builder

The builders above will be further developed in the future but also new builders will be created:

- Computation builder
- Visualization builder

With MOTUS, a continuous development trajectory is foreseen, to grow stronger but also to include new data collection techniques and to make the transition to Smart Surveys. From the beginning of MOTUS privacy and security was a primary goal. To keep respondents in the center of the data collection is one of the fundaments to arrive to Trusted Smart Surveys.

MOTUS supports online time use surveys via a mobile (iOS and Android) and web application (via browser; www.motusresearch.io). To participate via a browser an internet connection is needed. Combined online-offline registration is possible via the mobile application. Respondents can use any preferred device as the design for both applications is similar and the information collected by the devices is shared and synchronized between the devices. The web app is responsive to function on different screen sizes. Behavioral information can also be captured via sensors in the smart devices.

Below we summarize this project within the envision of the concept of shareability, and this in 4 stages:

- Share insights
- Share knowledge
- Share ideas
- Share the MOTUS platform

5.1.3.1 Share insights

In the beginning of the project the goal was to share insights by means of a CSPA-documentation and architectural insights.

The MOTUS-CSPA describes the platform on a conceptual and logical level. MOTUS is a software platform performing activities in 3 different core phases of the GSBPM: the build, collect and process phase. These phases have all sub phases of which MOTUS replies to a great deal of them. Through the CSPA-documentation the NSIs and other interested parties are now informed about the possibilities of MOTUS, and what the inputs and outputs are. This information will be updated continuously, and can be found via an online inventory of tools and sources[1] that is been designed by EUROSTAT-ESTAT.

A second document describes the software architecture of MOTUS. MOTUS foresees/can foresee in all essential hard and software components. The MOTUS-software architecture is composed as follows:

7. Backend server: the backend server stands central in the MOTUS-software platform. It holds the database, the back-office API and the client API.
8. Back-office: the back-office serves as the research environment where the researcher sets up a research and the fieldwork can be followed. The back-office runs in a browser.
9. Analyse server: the analyse server holds a replicate of the database of the backend server and prepares the reports for the backend server, which at its part can be called by the back-office.
10. Back-up server: the back-up server is a replicate for secure storing from the backend server and the analyse server.
11. Client portal: the client portal holds the MOTUS-web application and an underlying webserver.
12. Mobile devices: the mobile application is available for Android and iOS.

There are three API's that arrange the entrance to the components:

4. Back-office API: both ways webserver back-office and analyse server.
5. Analyse server API: both ways database (to prepare reports) and back-office API to send over reports and other analytics.
6. Client API: Receives the input from the web & mobile app and syncs the data on both applications. It could also function as a data harmonization tool.

The CSPA and the architecture of MOTUS are important elements in setting up a data collection strategy. With MOTUS a particular strategy is developed where the different MOTUS builders prepare research components, and where these components are used as 'lego' blocks to define a research flow. This research flow are the different steps a respondent has to take in order to successfully participate to a study.

This knowledge about MOTUS is been used to document and evaluate the Statbel and Destatis data collection strategies for TUS and HBS. In total six phases were discussed:

1. Sample selection
2. Recruitment
3. Training and selection interviewers
4. Research instruments
5. Data collection and
6. Data dissemination

Accordingly Statbel and Destatis have developed ideas and strategies for the next data collections for both TUS & HBS.

[1] https://webgate.ec.europa.eu/fpfis/wikis/display/ISTLCS/INVENTORY

To support the knowledge building, this project also developed two guidelines, one for the respondent and one for the researcher. Also two posters and a leaflet were produced that explain the added value of the MOTUS software platform.

5.1.3.2 Share knowledge

After having documented information about MOTUS it was important to share the knowledge through testing. This project included 3 phases spread across 3 different work packages.

First a prototype diary for the TUS was defined using the MOTUS back-office. As a basis the HETUS-guidelines were taken. To show the power of the MOTUS back-office country specific variations were introduced. Variations are within the questionnaires and the online activity list but also in the definition of the time diary periods. For Belgium this was one weekday and one weekend day, for Germany one weekday and the entire weekend. Within this project also the communication towards the respondents was defined.

Next, this prototype was used during presentations and bilateral meetings with experts. The goal was to collect information about both the front and back-office of MOTUS, but as well to evaluate MOTUS as a software platform. Based on the input of 18 in-depth consultations with national and international experts, a SWOT-analysis was defined showing the Strengths, the Weaknesses, the Opportunities and the Threats of MOTUS to become an ESS-platform.

Table 24: SWOT analysis MOTUS

	Strengths	Weaknesses
Internal origin	• Questionnaire functionality • Time diary functionality • Automatic communication • Automatic task orientation • Automated research flow • Automated fieldwork follow-up • Multi-device / Multi-platform • Multi-language • CMS-system – back-office • CRM-system – back-office • Modular components • Modular research flow • Standardization • Reusability • Comparability • No third party components (like Google) • APIs (input and output) • CSPA-documentation • GSBPM-documentation • TUS-eco system (survey + diary) • Immediate data availability • Privacy & security by design • Libraries	• Web app responsiveness • Individual-Household cluster • Not yet a training facility for researchers • Not yet an informative website • Not yet a well-balanced guideline for respondents • Not yet a well-balanced guideline for researchers • No yet an online help-desk • No yet an immediate feedback • Growing gap between groups of individuals • Steep learning curve • Burdensome registration • Length of the participation

	Opportunities	Threats
External origin	• Shareability • Fast setup • Scalability • Lower cost & time investment • Built-in quality assessment • 3-tier architecture philosophy • Virtual deployment • Country specific adaptations • Dynamic application build • Role management • 1-to-N strategy • Acceptance of other sources of information • No or less need for interviewer capacity • Combination with an interviewer • Link to IoT + inclusion Microservices • Inclusion of R + TUS R-packages • Compatibility with SPSS, SAS, … • On the go research • International interest • Multi-disciplinary • Cross-domain opportunity (HBS, transport, tourism, …) • Sustainable Development Goals • Employability during pandemics • Community building, panel opportunity	• License strategy not yet defined • Governance model not yet defined • System integration/harmonization • National laws • External privacy issues • External security issues • External ethical issues • Changes in the underlying software platform (Ionic, React, Flutter,…) • Old, not updated devices • Old, not updated browsers • Stability and size of development team • Server capacity • Stress test not yet executed

This SWOT-analysis shows the characteristics of MOTUS which already now can provide an added value to official statistics, but also a list of criteria to which MOTUS should grow to and which lie within the possibilities to be developed. In doing so the points that are listed as opportunities should (over time) be able to migrate to the list of strengths.

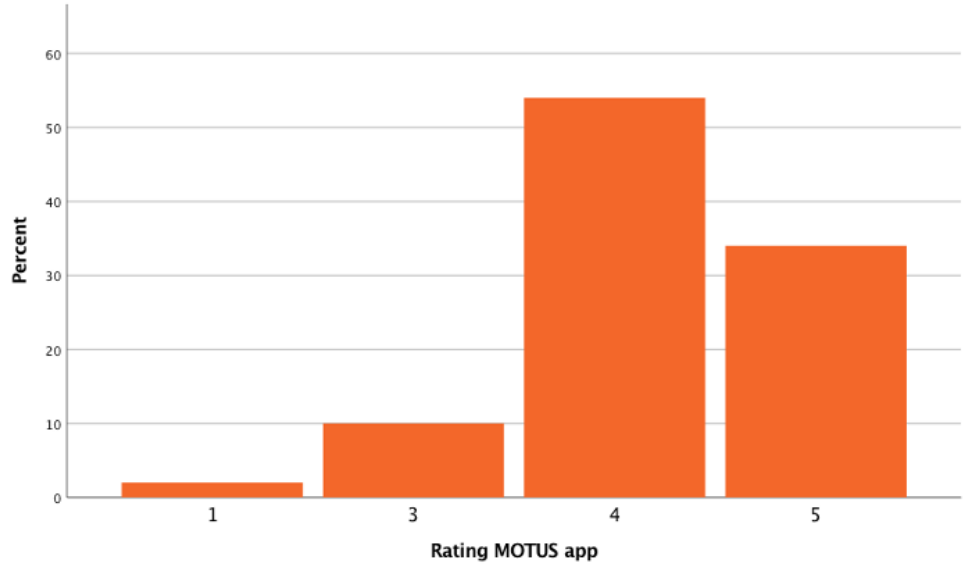
The weaknesses are important shortcomings of MOTUS today. Some points need software development, others belong more in the atmosphere of communication. These points need urgent attention. The threats have less to do with the platform as such, but are an essential part in order to get MOTUS accepted as an ESS-platform. And so of importance. MOTUS has by design a privacy and security requirement included. Nevertheless it is up to the national and international countries and levels to make their evaluation and, subsequently, to the development team of MOTUS to respond to this in a positive way.

With all the knowledge in hand, a test environment was setup for all TF and WG members TUS and HBS. In total 157 NSI employees were invited to evaluate the test applications of MOTUS. Test respondents were guided through the different steps of the TUS-survey with a household questionnaire, an individual questionnaire, a one day time diary and an end of diary day questionnaire. After the test the respondents were asked to complete the evaluation questionnaire.

The evaluation questionnaire asked the test persons to give comments (both positive and negative) and ratings on 4 different domains: the content, the design, the functional qualities and the non-functional qualities of MOTUS. At the end MOTUS was rated towards the question 'whether or not it could grow out to an European or international platform to collect official data'.

65 evaluation questionnaires were completed. In total respondents from 28 different NSIs took part in the test. The output of the questionnaire showed that content, design and technicality go hand in hand. Overall a 4,18 on 5 was given by all respondents completing the MOTUS test application.

Figure 51: Rating given by the test respondents to the MOTUS application (overall)



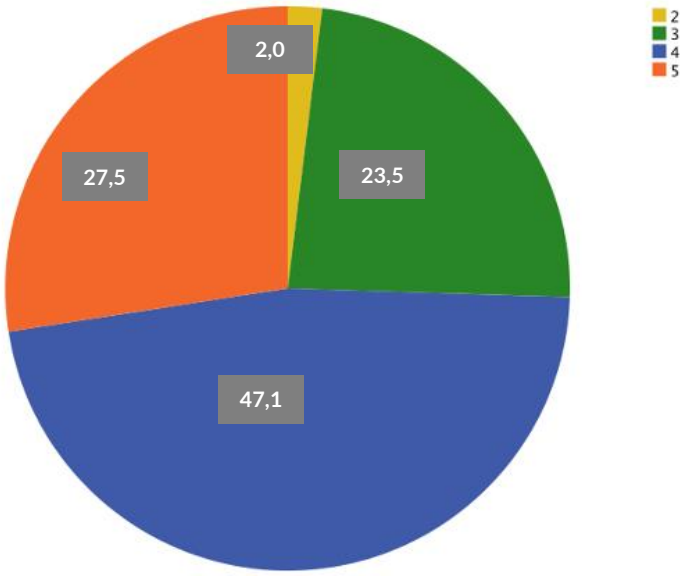
Nevertheless some essential remarks were made and not in the least these remarks were made to the most novel part of the test application, being the time diary. It shows that some development work needs to be undertaken to the core-purpose of the application, but also that the HETUS-guidelines need to be evaluated, and especially the Activity Classification List.

On the other hand the responses to the questionnaire showed a large appreciation for the technical setup of MOTUS. This technical appreciation is for an important part related to the operational qualities of MOTUS, which at their part is related to the modular character of MOTUS of the back-office to define and execute a fieldwork.

This appreciation was also noticeable in the rating when evaluating MOTUS as a possible platform to collect official statistics on an European an international level.

The figure below shows the rating given by respondents to the question whether MOTUS could be used as a platform to collect official statistics on a European or international level.

Figure 52: Rating given by the test respondents



On average MOTUS scored a 4,02 on 5 as a platform. However, when respondents are hesitant it is mostly related to the aspects of ownership, architecture, development, license and privacy. This is completely in line with the SWOT-analysis.

Looking to the inclusion of IoT and external sources the test respondents were more in doubt, but at the same time there is a high average rating of 4,15 on 5 when respondents receive a central position in the control of their own data, which means that Privacy, Security and Going Smart go hand in hand.

Above all interesting results about the future inclusion of new sources of data.

5.1.3.3 Share ideas

The correlation between ideas and innovation is high. Without sharing ideas, without organizing debates and reflection there would not be a fertile sole for innovation.

A first innovative take-up was to evaluate the current qualities of MOTUS in the light of organizing a HBS data collection. More concrete the underlying questions were 'Which are the components that are already available in MOTUS that can be reused for HBS?' and 'Which are the components that need to be developed to be able to organize HBS via MOTUS in the future?'.

To start this work a detailed review has been made of the different MOTUS-builders. This review resulted in the finding that MOTUS already has an important amount of elements included that are essential to collect HBS data. One of these elements is the (once more) availability over the builders to define a questionnaire, to define communication, to define diary parameters, to define extra languages, to define an invitation strategy, to define a dashboard for fieldwork follow-up and to download the datasets.

Another element is that also the task-to-task functionality that was evaluated positively by the test respondents is an absolute necessity within the ecosystem of HBS. HBS respondents also get questionnaires on the household and individual level and have to complete a consumption diary over a longer period, be it 15 days, a month or even longer. This task functionality gives NSIs the opportunity to organize a data collection without the use of an interviewer, or to reduce these costly interventions (both in time and budget).

A third and last element is that TUS and HBS can be organized via one and the same (web and mobile) application. The MOTUS application receives its content at the moment the respondent logs in. This is called the 1-to-N strategy. Therefore the app is really flexible and content can be (re)defined at every moment. It is even possible to include more than one research for the same respondent.

Nevertheless there is also a 22-point strong todo-list, which need to be translated into a development story. This list contains the creation of an HBS database structure, the creation of specific HBS diary functionalities, the design of a COICOP-classification structure and the adaptation of a dashboard system that fits HBS purposes.

In these 22-point list also new ideas are taken into account. These ideas discuss the inclusion of external sources and more specific the inclusion of plugins or Microservices.

Time research collects rich data but the data collection process is burdensome for respondents, especially when respondents are being asked to keep a record of their activities on the go. When moving more to an online data collection, and the use of Smartphones and applications from the iOS and Android platforms are growing, it is not a surprise that new features to improve the registration by the respondent are investigated. With the use of Microservice MOTUS again becomes extra modular as these services can be plugged in and plugged out depending on the research that has been defined in the research builder of MOTUS.

An example for HBS is the iCARD, for TUS it is the geolocation plugin. Below a visualization is presented of a MOTUS-tracking, and next of the determination process of a geofence. Both aspects belong to the Event builder of MOTUS.

Figure 53: Output of a geofence survey

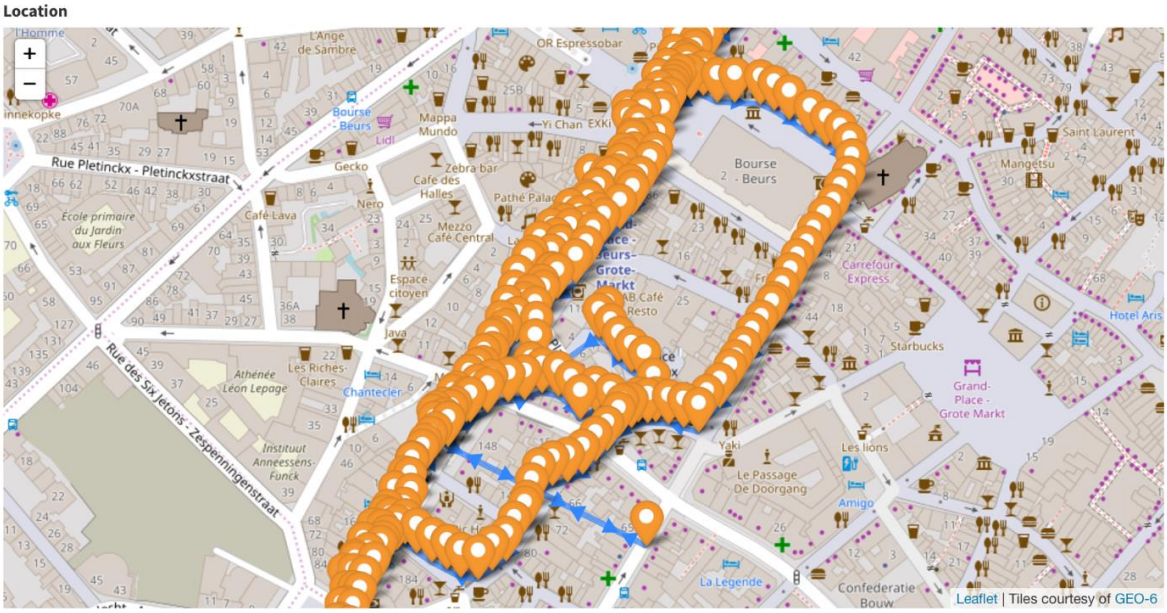
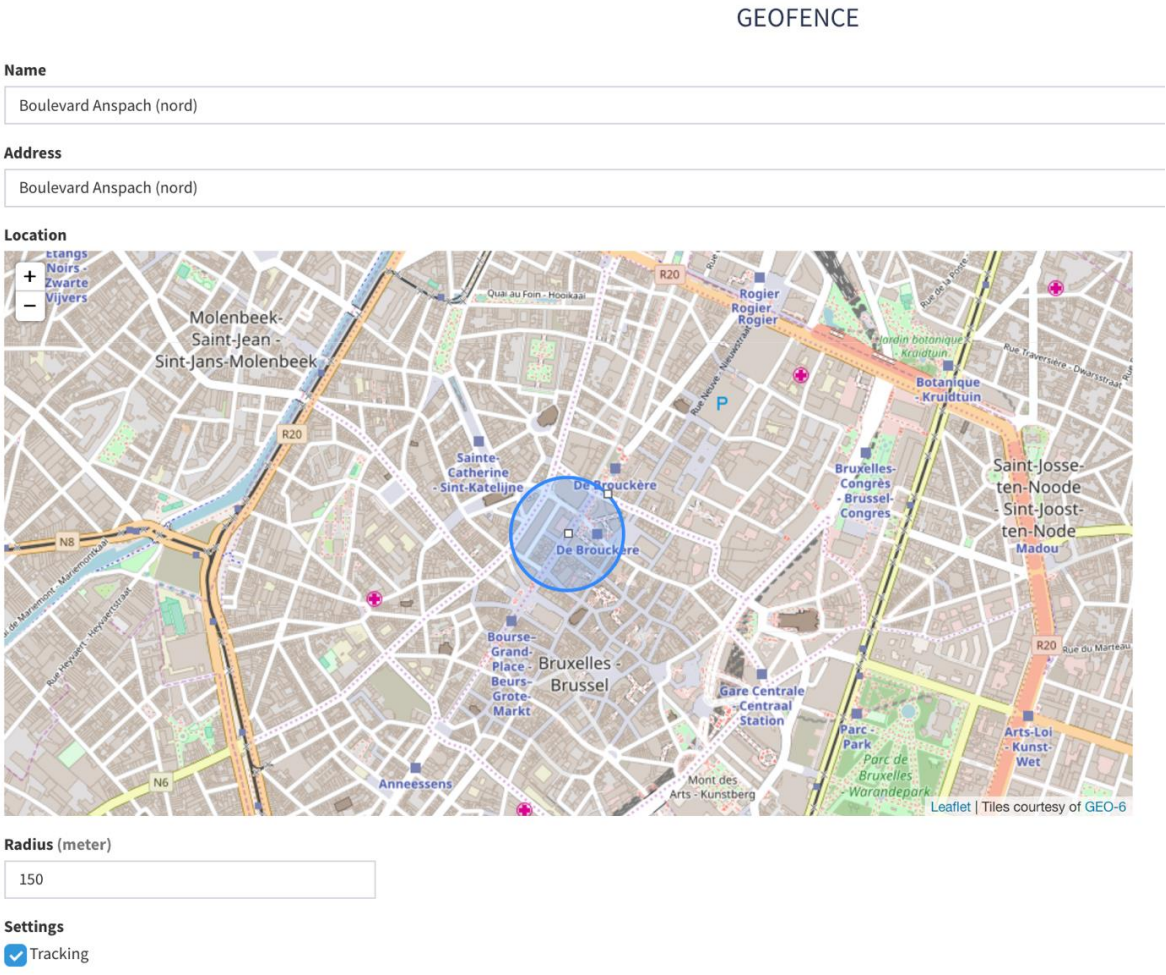
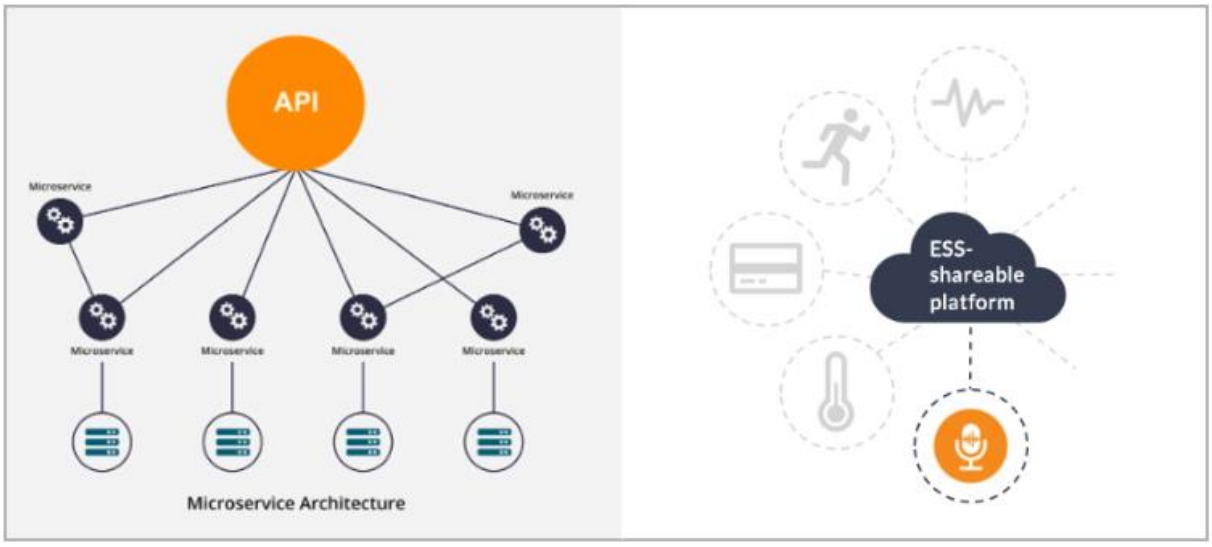


Figure 54: The determination of a geofence



A report on speech recognition on the inclusion of speech recognition makes the inclusion of Microservices even more tangible.

Figure 55: Microservice Architecture and Speech recognition as an example of a plugin available via the ESS-shareable platform



Given the current state of the art of speech recognition, such as Siri or Google Assistant, an error free implementation into time use research is fairly impossible at this time and for the near future.

However speech recognition could provide benefits if included as a Microservice and linked to a core data collection environment as MOTUS. In this way data coming in from the speech recognition plugin does not have to be error free, because the respondent has full control over the input. This also shows that a tool must comprise both a web and a mobile application.

The strategy to work with a core architecture and with Microservices also has clearly an open view for future improvements thanks to the modular definition of MOTUS.

Another plugin of MOTUS is the inclusion of R as a statistical platform. To streamline the output of the collected data MOTUS makes use of the open source statistical software package R. This package is used for internal processes to support the cleaning phase and the quality assessment of the input. These processes run continuously and automatic so that data is immediately available, also through the research. Next, the R packages are being used to define TUS libraries that other researchers can use to disseminate their data. An example is the teachers R-package being used during the Big Data Hackathon of 2019 in Brussels.

5.1.3.4 Share the MOTUS platform

The WG/TF have discussed the criteria to which a tool and platform should comply to. These domains are:

- Functionality & maintainability
- Reusability
- Online availability
- Usability, user friendliness & accessibility
- Data comparability
- Statistical aspects
- Costs

The first 5 requirements are used as a guideline to evaluate MOTUS and the methods of TUS and HBS. This resulted in a 42-action list which should lead the way to arrive to a state of Trusted Smart Statistics.

Not despite all points are essential, it is in particular the first criteria that holds the basic ingredients for MOTUS to become a shareable tool. The most important question is how to govern the MOTUS-code, so that the outcome of the code is available to the NSIs while at the same time comparability in the data collecting is guaranteed. In doing so this report looked into 4 different architectures to implement MOTUS.

These 4 architectures are:

- A - MOTUS as a service
- B - MOTUS as a data collector
- C - MOTUS virtualized
- D - MOTUS native installation

In total 21 criteria are scored with + and – with 3 different grades (+++/---). In this way it offers an architecture quality assessment.

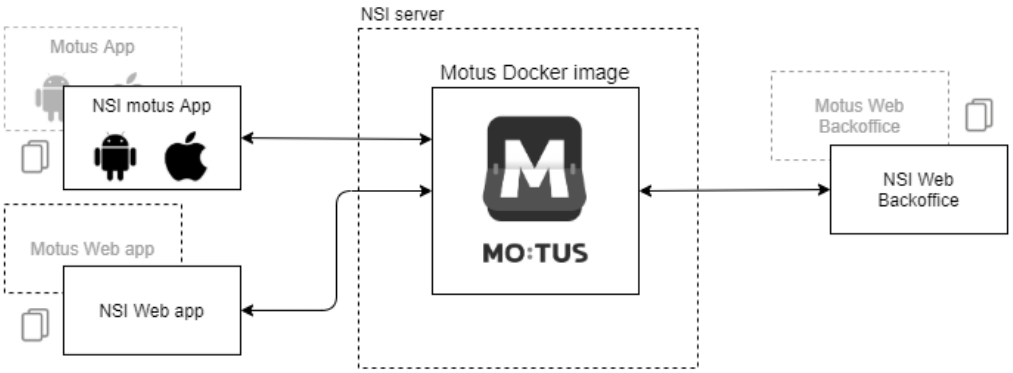
Table 25: MOTUS governance correspondence table

Criteria	MOTUS-governance: options			
	A	B	C	D
	Full Service	Data collection	Virtual application	Native installation
Simplicity	+++	+++	--	---
Stability	++	+	+++	-
Relational cohesion	+++	-	+	--
Maturity	+++	+	++	---
Efficiency	+	+	+++	-
Maintainability	+++	-	+++	---
Responsibility	+	++	++	--
Support	+++	+	+++	--
Usability	--	--	++	+++
Suitability	+++	-	+	++
Extensibility	+++	+	+++	---
Scalability	++	+	+++	---
Interoperability	+++	--	+++	--
Availability	+++	+++	+	-
Security	+	-	++	+++
Comparability	--	-	+++	---
Country specific	--	+	+++	---
Shareability	+	-	+++	---
Cost installation	+++	+++	-	---
Cost update	+++	++	+	--
Legal	+	++	+++	---

Based on all these criteria it shows that the installation of a virtual machine (Architecture C) is the most promising to arrive to a true ESS-platform that gives high values to shareability and comparability.

Below a schematic overview is given of Architecture C, including the position of MOTUS as a Docker image.

Figure 56: Architecture C – MOTUS virtualized



With Docker, the MOTUS-application and its dependencies are turned into a package, or a so called Docker-image. This process is also called 'virtualization of software'. A virtual container can run on any Linux server, which is located at the host datacenter.

Multiple docker images can be developed, in numbers but also in content. On the one hand it means that a docker image is available to multiple NSIs with the same possibilities, while on the other hand variation(s) can be supported through Microservices (or Plugins) which can also be dockerized. It is also possible to develop different containers for individual components of an application. An example is the database. The different containers then can communicate with each other via the network. An extra advantage is that developers from different organizations can share their applications, or components, to arrive to a joint application. This supports collaboration between different organizations, while respecting the specific needs of (e.g.) the Members States' specific environment.

Once a docker image is defined, it is easy to distribute. The images are available in a registry which is hosted in the MOTUS datacenter. Due to the Docker software even complex structures (with independent containers) can be linked to function as one application through the Docker-compose function. Through Docker, applications can be properly scaled since more server nodes can be filled with containers when the demand grows.

Architecture C provides the building blocks for the 'industrialization' of the MOTUS-software, and so the flexibility towards the NSIs to choose from the list of virtual containers and at the same time develop solutions of their own that can communicate with each other. In this perspective NSIs can exclusively handle their own surveys.

The work on the governance of MOTUS finishes with ideas on the user governance, and more in detail about the aspect of 'Multi-client capability' and 'Role management'. It is clear that developing a software platform is far more reaching than only having a good User Interface. Also the daily actions and roles within a NSI should be covered. Only then a platform can be stretched out over different phases of the GSBPM architecture.

5.1.4 Recommendations

Recommendations are based on shortcomings, interests and innovative ideas. The entire document is been build up in this way. There is however one general recommendation that needs to be outspoken loudly:

After testing the powerful MOTUS platform, Statbel and Destatis are, from an NSI point of view, of the opinion that based on the long existing strategy of the application and its shown merits like flexibility, adaptability and the most important one: modularity, the platform and the academic researchers behind the platform are well-suited to conduct diary-based surveys on a national and international level.

6 References

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Annexes

(Statbel.1) Description of the data collection architecture in Belgium

Deliverable	Description of the Statbel data collection architecture.

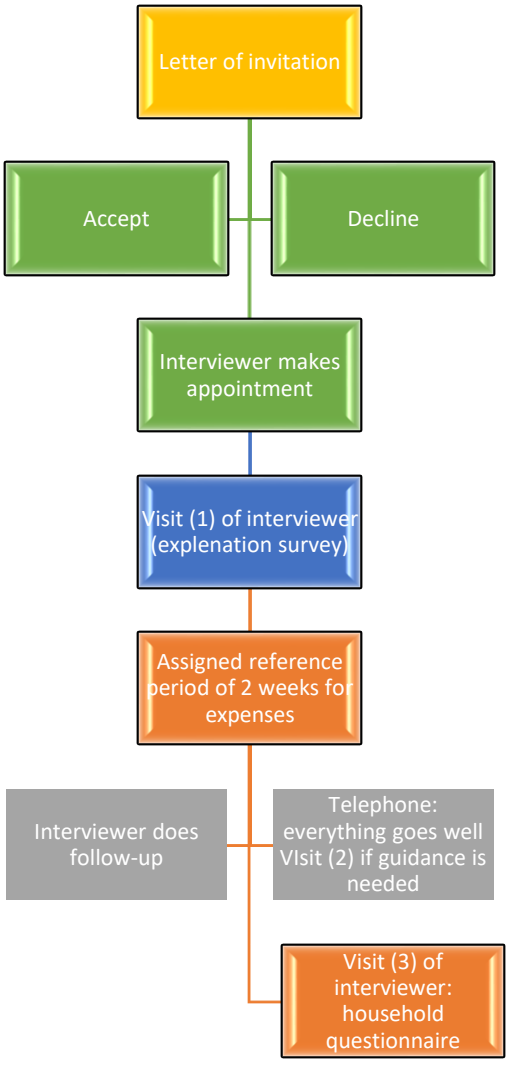
Evaluation of the Statbel data collection architecture, and a functional and technical comparison with the software architecture of MOTUS. This subtask includes steps for implementation through IT.

Research Flow: the respondent journey

There are two ways households are contacted:

1) After the last wave of LFS, the household is asked the question if they would be willing to participate in HBS.
2) All households receives a letter of invitation from Statbel. They can confirm are decline to participate.

Figure 57: Overview of the respondents journey in Belgium



There are some tasks the household need to perform:

1) The small expenses are captured through continuous/daily registration. This is a retrospective registration.
2) The larger expenses are captured through the household questionnaire.

Interaction with households

The NSI: sends letter of invitation.

Afterwards, the interviewer:

1) Calls to make appointment
2) First visit: explanation of survey
3) Second contact: by telephone or visit
4) Last visit: to conduct household questionnaire

Communication between NSI and households

Before survey:

- NSI sends invitation letters
- Letters contain general phone number and email for NSI
- General phone number is answered in general contact centre (first line). Contact centre can forward the call to the data collection unit (back office).
- Email is read by the data collection unit (1 responsible + 1 backup in both languages)

During survey:

- Interviewer will get in contact with households.
- Interviewer gives his personal contact information to households.

After successful survey:

- NSI sends letter.
- This letter contains: thank you – letter + evaluation survey + forms for payment (=”creance”)

Settings of the study

Table 26: Settings of HBS in Belgium

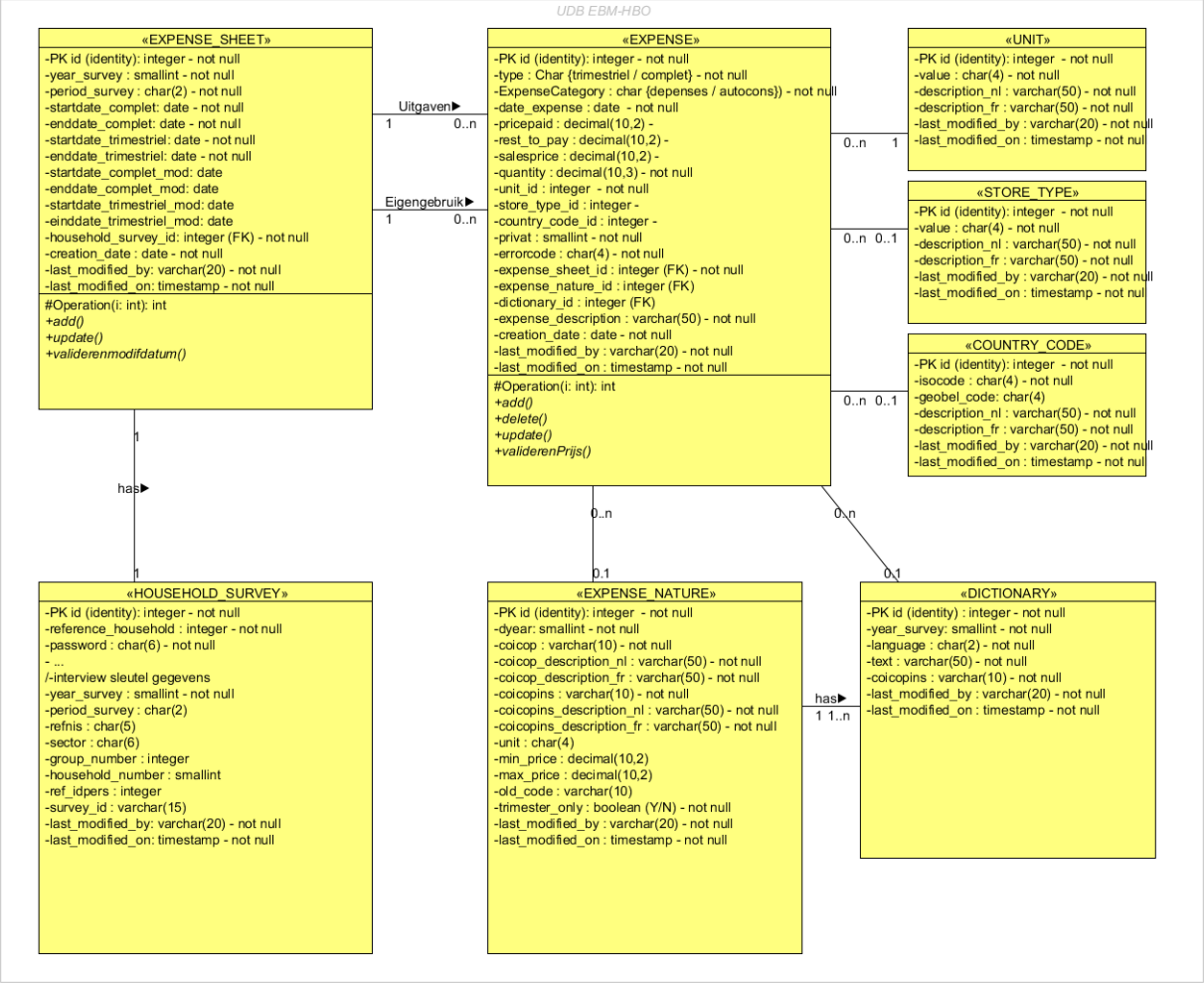
Periodicity	Every even year since 2012 (2014 – 2016 …)
Duration	Assigned15 days reference period Last interview about 45 minutes
Interviewer involvement	Three visits, Interviewer has one month after the end of the reference period to return all the documents to NSI
Expenses	Daily registration and household questionnaire
Cluster	All household members fill in the same book or have the same account Individual: interview with the reference person or other adult

Setup of the infrastructure

Table 27: Front-and back office: mode of data collection in Belgium

Front-office		
	Expenses	**Household questionnaire**
PAPI/CA(P-T-W)I/Online/Connected devices – sensors	Choice between paper&pencil and online 2016: 46% paper and pencil / 54% online	CAPI
Native/Hybrid/Web based application	Web based application	Program installation on umpc
Cross-platform/browser usability	– Computer – Smartphone – Tablet OR paper and pencil, later encoded by survey organisation using web-program	UMPC for the interviewer
Characteristic of the application (download time, memory, load time, …)		
Programming language	JAVA application	Blaise
Framework	JAVA application	.NET framework
User interface/user logic	Webpage	Blaise
Back-office/Back-end server: environment to setup surveys		
Native/Hybrid/Web based application	Tomcat servers linux	Microsoft windows servers
Platform/browser usability		
Programming language	Linux	Windows
Framework		
User interface/user logic (incl. screenshots)		
Database		
Type RDBMS (Relational Database Management System)	DB2 LUW	Fieldwork monitoring: SAS
Characteristics RDBMS	Expenses tables	– DB2 databases are exported to SAS (automatised transfer every night) – Blaise databases are also exported to SAS (via Blaise2DWH programming developed by E8-DWH team) – Production of excel files to monitor fieldwork by group / mailing lists / payment lists
OS	Linux	Windows 7

Figure 58: RDBMS expenses table



Security

- Authentication protocols: https
- Token/UUID: none
- Password encryption: 8 characters
- Household questionnaire password encryption : Public/private encryption
- Transmission of data to/from front and back-office: SFTP – SSH file transfer protocol
- There are no API available.

Figure 59: Schematic overview of expenses collection in Belgium

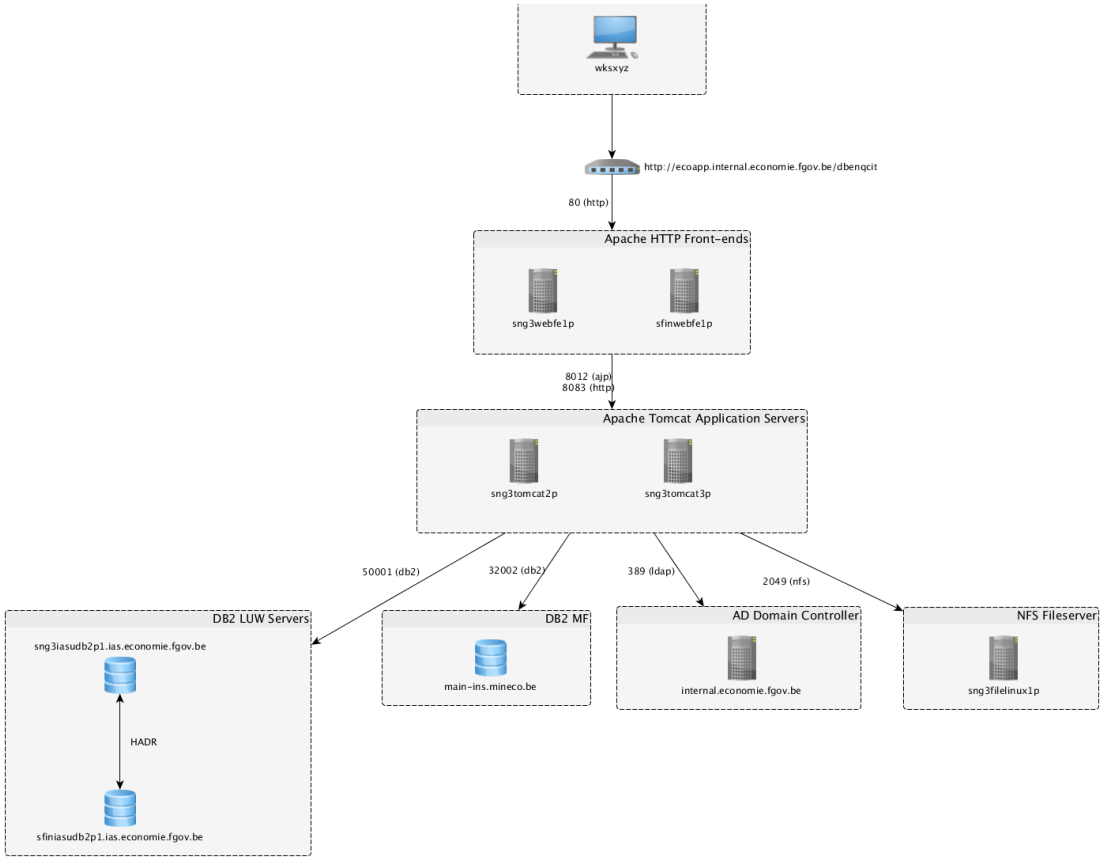
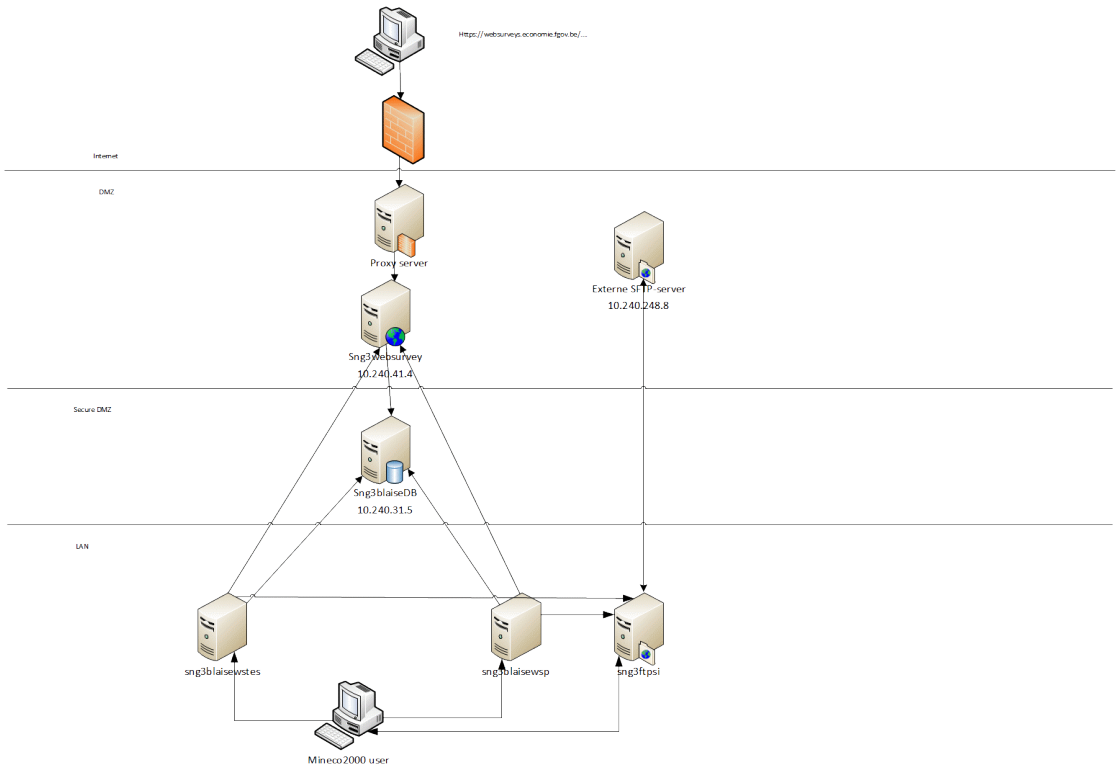


Figure 60: schematic overview of the household questionnaire data collection in Belgium



Other data sources

	Expenses	Household questionnaire
Population Register	Used for sampling Offline	
Content	No	• Name • Gender • Date of birth • Nationality • Reference person / relationship to RP
Tax registry	Used for calibration Offline	
Content	No	Household incomes

Analysis strategy

See GSBPM template, part 6.

Archive

The archive is held by Blaise2DWH program so that information can be recovered.

Table 28: SWOT-analysis of the Belgian and German data collection

Strengths	Weaknesses
Registration tool: • Stable • User friendly • Easy to do yearly adaptation • Harmonised and concerted processes • High security standards	• Fieldwork monitoring not automatized • Lots of paper: does not correspond to respondent's needs • Shortened timelines cannot be met
Opportunities	**Threats**
Modern techniques in smartphones can lead to easy ways to collect data, for example scanning will be possible for every household. Modernisation of techniques: by this: • decrease of respondent burden and • increase response rates, data quality and actuality	Survey climate and concern for privacy can lead to lower response rates as people do not want to share their information. • Timing and costs of developing a new application (encapsulation of an additional mode) • Risk of failing: becoming outdated in a fast moving development of market; no/bad acceptance due to concern of privacy/data security, usability

(Destatis.1) Description of the data collection architecture in Germany

Deliverable	Description of the Destatis data collection architecture.

Because of the similarity between the EVS and ZVE in the following description the collection architecture is described for both studies. A crucial fact, that has influence on the respondent journey, is that for EVS and ZVE not a probability sample, but **quota sampling** is used. Furthermore Germany does **no**t make use of **interviewers** – in contrast to many other countries in the EU. This means, that households/respondents fill in questionnaires by themselves. Certainly, if requested, they get assistance by contact persons in the RSIs, i. e. the 14 regional statistical institutes (for 16 federal states). Participation in ZVE and EVS is voluntary.

Both studies, ZVE and EVS, are organised as decentralised studies, that means that data collection (incl. recruitment of households) is conducted by the RSIs. Data processing and all phases afterwards are centrally executed in the office of Destatis (National Statistical Office).

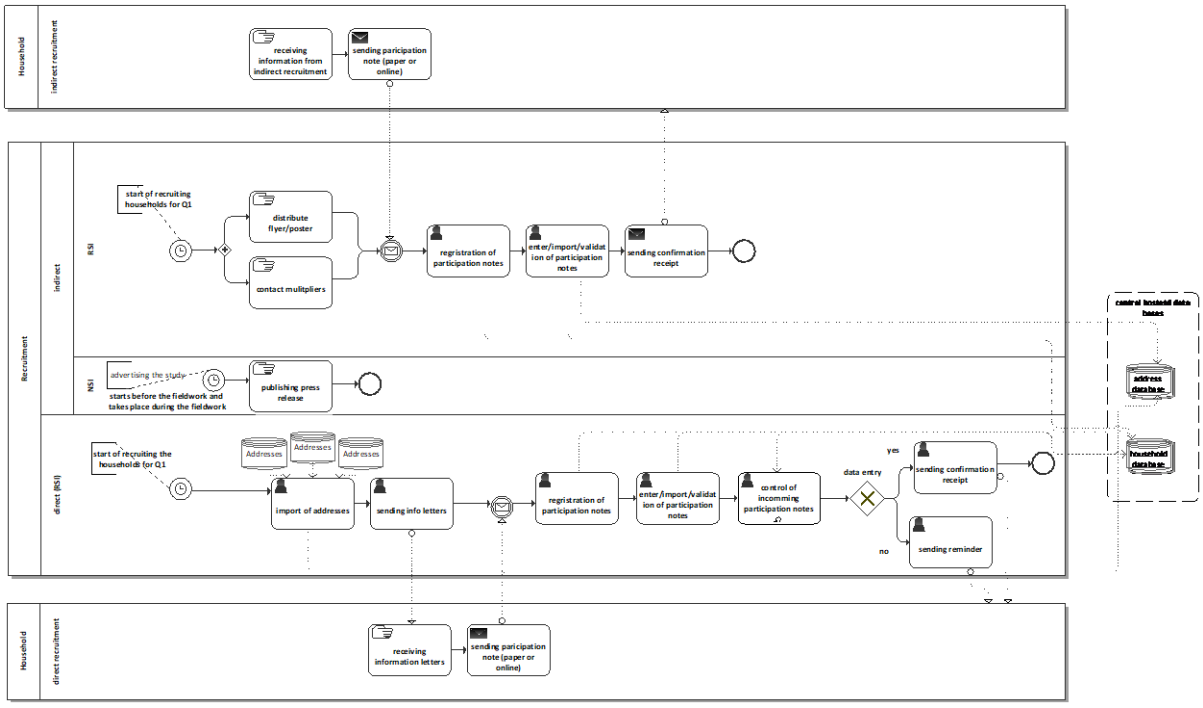
Phases of the survey

The following descriptions refer to current as well as future processes. This is due to the fact that processes simply need to be improved (e.g. confirmation receipt after sending in registration), but also need to be adapted according to the new offer of a mobile app (e.g. push notifications in mobile application, additional interfaces due to mobile app, intensification of communication between RSIs and respondents, ...).

Collect

Select Sample

Figure 61: Recruitment

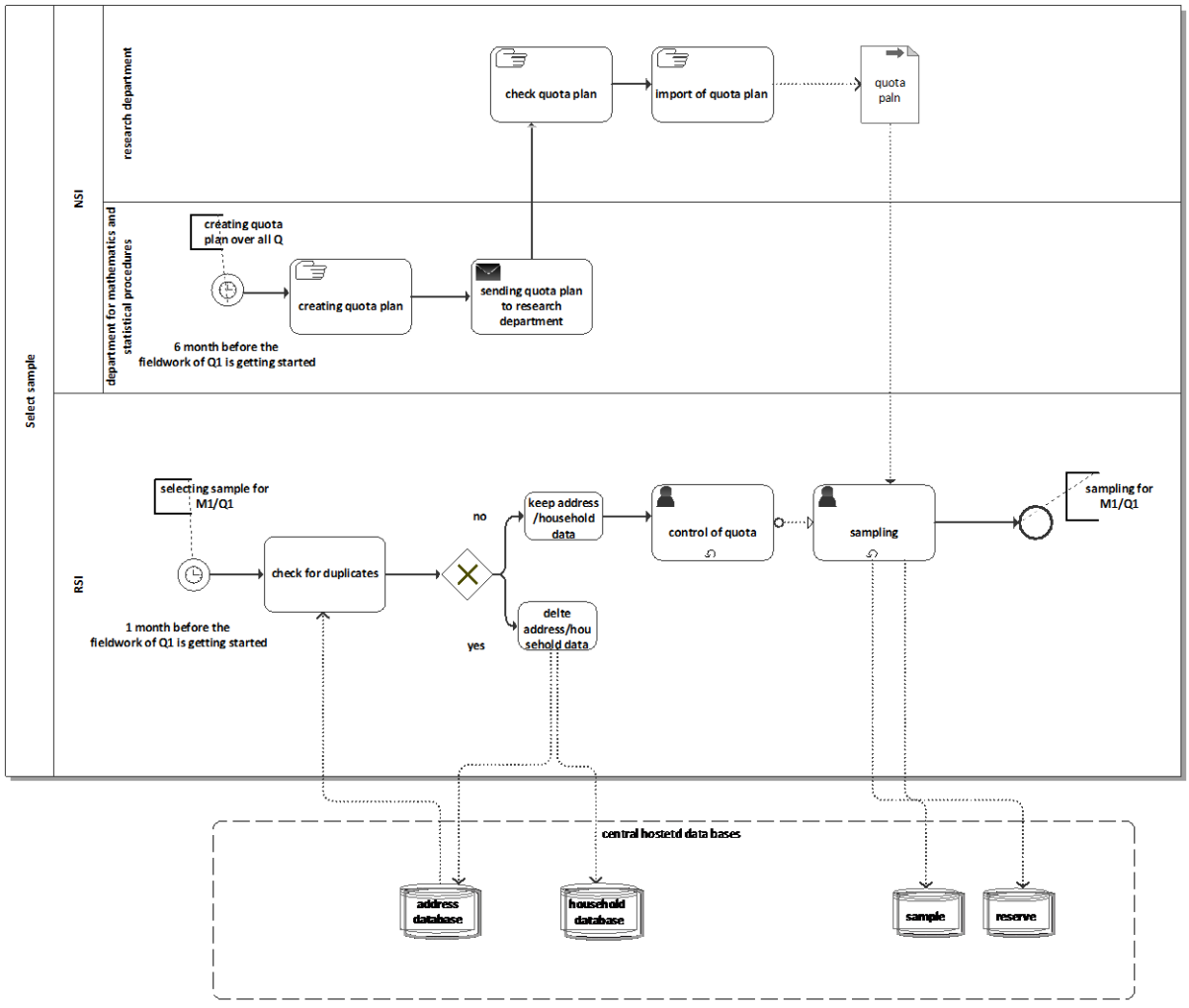


In Germany RSIs start with direct and indirect recruitment (approx. 5 months before fieldwork). There are two ways of recruitment. In case of direct recruitment they send letters to known households (import address) and invite them to the study (by sending out info letters). In case of indirect recruitment they distribute flyers, posters and other material at places like supermarkets or kindergarten. Additionally they contact multipliers in different organisations who distribute the information about the survey to their members. The households have the possibility to send their registration, i. e. participation note via online form or on paper.

In the further steps the RSIs register the incoming participation notes. The paper forms will be entered and validated by RSIs in the administration program (AP). The online forms will be automatically imported to the administration program and also validated. For direct recruited households it is possible to remind them if they didn't send their registration.

After participation notes are validated, the household gets a confirmation receipt (if email address is available per email, otherwise per letter). All registered addresses will be checked for duplicates before the sampling procedure will be started. Before the sampling starts the RSIs control the quota based on the quota plan. The sampling procedure takes place four times (4 quarters). For each quarter of the year (I to IV) based on the sampling source a sample is drawn. Addresses of households with participation interest, that cannot be considered in the sample of quarter I, get assigned to the next quarter(s) (i.e. reserve sample). The sampling procedure should be done by the RSIs. For the assignment of the households in sample and reserve no im- or exports should be necessary.

Figure 62: Select sample

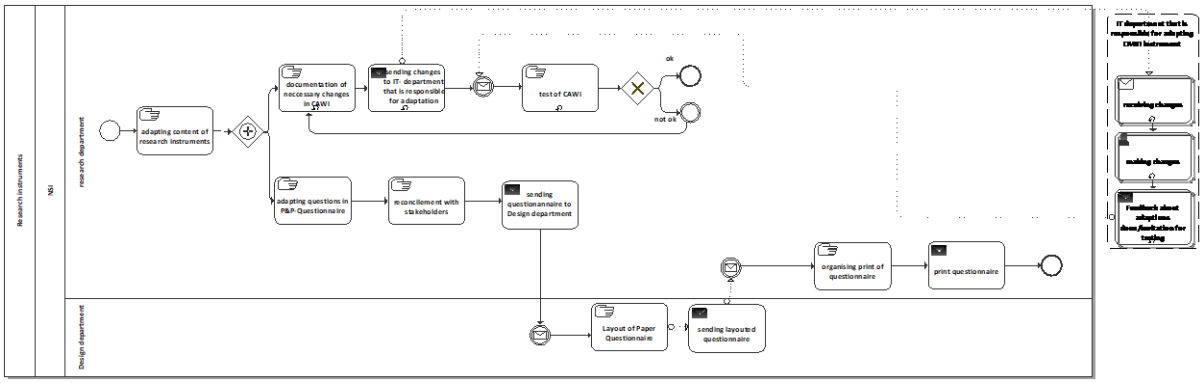


Set up collection

Also for Germany an important step is the preparation of the research instruments. Central to HBS and TUS are the diaries to be completed by the households. In comparison to Belgium, respondents need to fulfill a higher effort: for HBS households track their expenditures for 3 months. For TUS there is the need to fill out the diary for 2 weekdays and 1 weekend day. For HBS one person gathers all information, while in TUS all persons 10 years and older from the household are invited to participate. Also survey questionnaires are part of HBS and TUS.

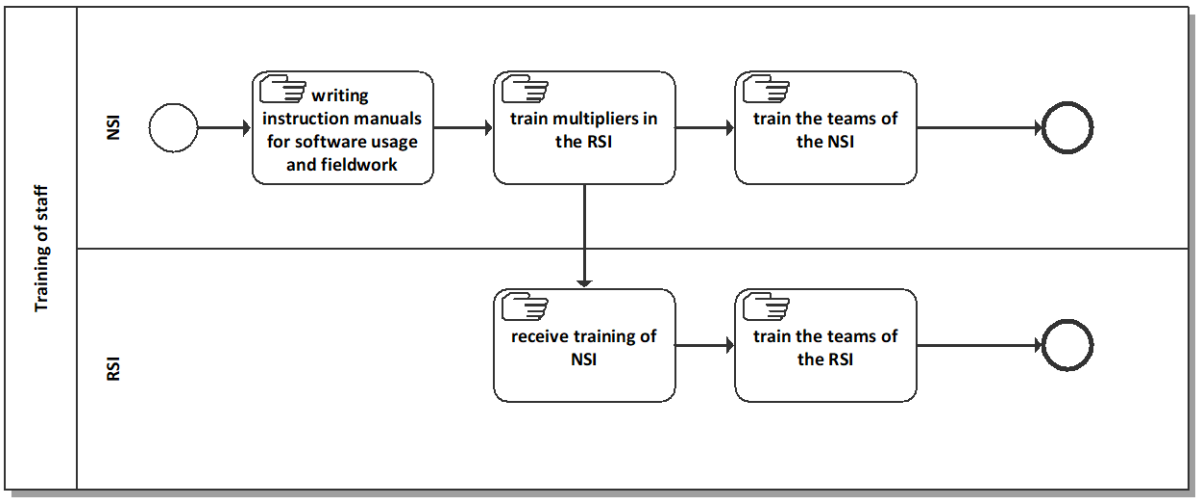
Most of the research instruments are - at the moment - paper based. Design of the paper questionnaires are made by Destatis and have to follow standardized designs. The same will apply for future IT-based research instruments.

Figure 63: Research instruments



In preparation of the data collection process the staff will be trained for their tasks by Destatis' central team members. They get to know how the software, i. e. the administration program as well as the mobile app is to use and how they have to support the households during their reference period. Additionally Destatis provides instruction manuals for software usage (AP, app) and regarding the assistance towards the households.

Figure 64: Training

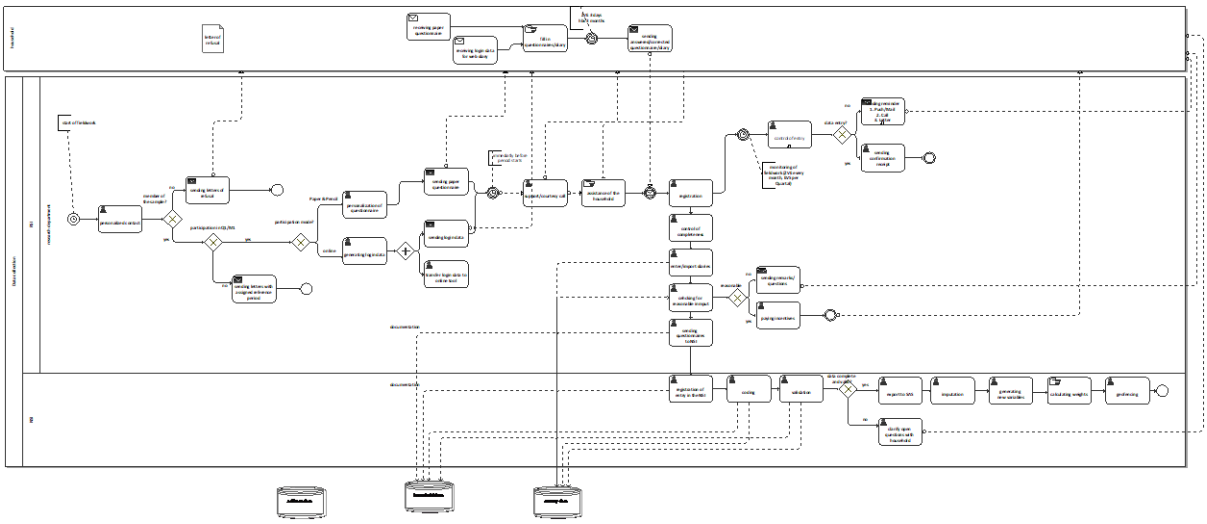


For the selected households in the sample that indicated to use the PAPI-mode the questionnaires will be personalized with an ID, for those who prefer to take part in the study per mobile app, the login data will be generated by the RSIs. At the moment the household gets an ID in the AP when he is assigned to the sample. To generate the login data a separate software is used. In the future it should be possible to generate the login data in the AP. Afterwards the necessary data will be transmitted in the online-tool (Login data, ID, reference period).

Run collection

During this step the RSIs send out either letters of refusal (for households that are not included in the sample(s)) or information letters about assigned reference period, login credentials or paper-questionnaires/diaries. Close to the assigned reference period households get reminded via email/push-notification and a support/courtesy call will be made within the next 1-2 weeks in order to clarify open questions. For ZVE the reference period will be 3 days and for HBS 3 month. The RSIs offer assistance throughout the survey: for technical questions as well as questions regarding contents of the study. Approx. 1 weeks after the reference period (depending on mode) households receive a first reminder if mobile app data/paper documents are not sent in (e. g. email/push-notification, 2nd by phone, 3rd by letter). Households using the mobile app additionally should get reminder not only at the end of the reference period, but also shortly after the reference period and no data entry is done. Especially for the 3 months period in EVS, households should have the possibility, to send in data in partial deliveries, e.g. 1 months. The incoming documents will be registered and checked for completeness. Approx. 6 weeks after the end of reference period RSIs start paying the monetary incentives for households that have delivered reasonable input (questionnaires and diaries). For this reason, the households send their bank information in a separate letter to the RSIs who enter and validate them in the AP.

Figure 65: Data collection



Finalise collection

The online data that are transmitted by the household will be integrated automatically in our input database and from there in the DAP. The further steps like classification, coding and further validation take place in process 5.

Process

The following steps will be done centrally by Destatis.

Integrate data

In this step the paper questionnaires will be entered by the RSIs. During the data entry process first validations for extremely high values take place.

Classify and code

Households using the app have the possibility to code their activities or expenses to the correct categories with the aid of a search function integrated in the app. For this purpose, the users record the

activity or expense in plain text and then, if possible, code it using the suggestions selected by the search algorithm. Activities/Expenses that haven't been coded by the households get coded by the RSIs. For the paper diaries the RSIs code the activities or expenses in this step in the DAP.

Review and validate

After data entry is completed the validation of data takes place. In a first step a rough validation will proof if the data is reasonable to pay the incentive. This information is needed in step 4.3. Afterwards a detailed validation is executed. The validation will be done in the DAP. The validation checks are defined in the PL-editor (SteP-tool). Once defined, the code can be exported and imported to the DAP.

Edit and impute

The households with implausible entries will be called by Destatis/RSIs and the data will be corrected in the DAP. In case of EVS, missing or implausible values will be imputed in the DAP and SAS, if possible.

Derive new variables

In this step new variables will be generated like age in groups or status of education. After data entry is completed and the validation is done the generation of new variables can be started in the DAP. The new variables will be specified in the DAP and the same variables will be generated for each household.

Calculate weights

To calculate the weights the data will be exported (csv). The csv will be imported into SAS, where the weights will be calculated. The weights/extrapolation factors will be calculated using the micro census as frame. The weights are getting merged to the final data set, they are not getting imported into the DAP.

Calculate aggregates

In EVS and ZVE in step 5.7 no aggregates will be calculated. In this step the error calculation takes place. It will be calculated in SAS. In step 6.1 first outputs on aggregate level will be calculated.

Finalise data files

The validated datasets are exported from the DAP (csv-format). Further processing of the data is done in SAS. In case of EVS currently three datasets get exported (Allgemeine Angaben, i.e. sociodemographic data and consumer durables, Geld- und Sachvermögen, i.e. monetary and tangible assets, Haushaltsbuch, i.e. diary of expenses). For ZVE there are currently four datasets (Household questionnaire, individual questionnaire, Activities/diary, Dataset where activities are summed up). The finalized data sets can be used for further analysis and a scientific use file/public use file will be provided (step 6).

Tasks of the household

Details of tasks of household are already described above. In the following the tasks of the households are summarised.

1) Households **register** to take part in the study and send in a participation note, either **via paper form or online**. If directly contacted households do not register within a given time, they receive a reminder letter)
2) If household gets selected in the sampling, household has to **take part in the study** in the assigned time slot (EVS: quartal, ZVE: 2 weekdays/1 weekend day)

3) Households resp. household members fill in all parts of the study (**household questionnaire, personal questionnaire, diary**). There will be one household administrator, who is responsible for household members making their entries. Diary requests for daily/continuous registration. Participation is possible either via paper or via mobile app. Mixed participation within a household should be avoided, but must be possible (e.g. for households with elderly people)
4) Once households have filled in all parts of the study (incl. all household members 10 years and older for ZVE) households **send in paper questionnaires/diaries or** send **finalised data to Destatis** via the application. In EVS households obtain the possibility to send in data per months.
5) If needed: In case of any questions regarding the contents or mobile app the households have the possibility to **contact the RSIs**.

Destatis/RSIs -interaction with households

Details of interaction between Destatis/RSIs and households are already described in section 1.2. In the following interactions are summarised. Interactions of households are based on different ways of communication. These ways are described in section 1.5.

1) RSIs: Active/passive recruitment
2) HH: registration, RSIs: reminder
3) RSIs: receipt of confirmation
4) Destatis: sampling
5) RSIs: letters of refusal or letter of information to households (incl. study material, login credentials)
6) HH: completion of study contents (diaries, questionnaires) and sending in data
7) Destatis/RSIs: contact (by telephone) of households in case of implausible/missing entries
8) RSIs: paying monetary incentive
9) Destatis/RSIs: support (by telephone) of households throughout the study

Communication channel between Destatis/RSIs and households

Communication between households and Destatis/RSIs can be divided into different ways.

1) Personal, paper vs. electronic communication
   RSIs communicate in different ways with households. There are no interviewers (in field) for conducting HBS and ZVE. However, in RSIs there are assigned persons to recruit, motivate and support households throughout the study. At the beginning – while registration – households are asked about their preferred way to be contacted:
   - By email
   - By phone
   - By letter

   As we aim in having a high share of online participation (approx. 60%), we will accordingly emphasise online advantages (e.g. in letters, …), but still households have the opportunity to take part or get contacted in traditional manner (by phone, letter).

2) Destatis vs. RSIs:
   Most of the communication between households and the statistical office is currently done by RSIs. However, Destatis is planning for future studies to contact the households directly if data is inconsistent or important data is missing.

Settings of the studies

Table 29: Settings of the studies in Germany

Issue	EVS	ZVE
Periodicity	Every 5 years, the next one in 2023	Every 10 years, the next one in 2022
Duration of fieldwork	1 year	1 year
Duration of the diaries	houeshold diary: 3 month food, beverages, tobacco: 1 month	Diary: 3 days
Questionnaires	Allgemeine Angaben Geld- und Sachvermögen Only subsample 20%: food, beverages, tobacco (Individual) Expenses and consumption/diary	Household questionnaire Individual questionnaire (10 years and older) Activities/diary (10 years and older)
Cluster	Allgemeine Angaben: Household administrator Geld- und Sachvermögen: Household administrator Only subsample 20%: food, beverages, tobacco: Household administrator / optional: individual household member (Individual) Expenses and consumption/diary: Household administrator / optional: individual household member	Household questionnaire: Household administrator Individual questionnaire (10 years and older): Individual household member Activities/diary (10 years and older): Individual household member

Setup of the Infrastructure

The following Information is the same for both studies. In the past it was not possible to answer the ZVE online. In the EVS only for the Allgemeine Angaben a CAWI-tool was used. Thus the following information describes sometimes the future requirements instead of the status quo. The different questionnaires should be merged in one online questionnaire with different modules. The following requirements mostly relate to the Expenses/Activities and the household questionnaire.

Table 30: Setup of data collection architecture Germany

Front-office		
	Expenses/Activities	**Household questionnaire**
PAPI/CA(P-T-W)I/ Online/Connected devices – sensors	Choice between paper&pencil and online LWR 2017: 43% online (only rough orientation, as LWR households are sort of a panel)	Choice between paper&pencil and online LWR 2017: 49% online
Native/Hybrid/Web based application	Destatis is seeking for at least a hybrid application or a cross-platform application (e.g. Xamarin, Native Script).	
Cross-platform/browser usability	• Computer • Smartphone • Tablet OR paper and pencil, later encoded by survey organisation using web-program	
Characteristic of the application (download time, memory, load time, …)	The application must run without significantly perceptible loading times during all phases of the survey (from downloading and logging in through to entering incomes/expenditures respectively activities including coding, the search function, saving and transmitting the data). This applies to both online and offline usage.	
Programming language	There is no clear preference regarding programming language.	
Framework	Java Web / EE, Spring under evaluation	
User interface/user logic	The design of the user interface must be user-friendly. This means: • A native look & feel may be of significant interest to the user; the guidelines for the various platforms must therefore also be considered. • All the available buttons and fields must be arranged so that they are clearly visible and easily clicked (keyword: "touchability"). • A navigation tree must enable the respondents to find their way in each section, whereby each section can be edited separately. • Households must be able at all times to cancel an operation and return to the main menu or the previous input mask. • All information must be displayed in a sufficient size (on all end-user devices). • Pop-up windows should be used for error messages and notices.	
Back-office/Back-end server: environment to setup surveys		
Native/Hybrid/Web based application	Tomcat/Wildfly servers on linux (Windows also possible) Microsoft windows servers	
Platform/browser usability	Windows: Internet Explorer, Edge, Firefox ESR, maybe also Chrome in the future	
Programming language	JAVA	
Framework	N/A	
User interface/user logic (incl. screenshots)		N/A
Database		
Type RDBMS (Relational Database Management System)		MySQL EE
Characteristics RDBMS		N/A
OS		Linux, Windows

Security

BSI IT Grundschutz (National IT security standard like ISO 27000) compliance, security measures according to defined data protection level

- Authentication protocols: https with at least TLS 1.2
- Token/UUID: none
- Password encryption: Password length: At least 14 characters with at least one number, one lower case letter, one upper case letter and one special character as a general recommendation from Destatis IT security.
  The password guideline has to be applied. The password has to be saved with current and secure cryptographic methods (hash and salt) (please see the current BSI TR-02102; English translation at https://www.bsi.bund.de/EN/Publications/TechnicalGuidelines/tr02102/tr02102_node.html)
  Household questionnaire password encryption : Public/private encryption
- Transmission of data to/from front and back-office: SFTP – SSH file transfer protocol possible between internal servers or otherwise https transfer
- Protection SLL, DDoS: According to BSI

API

CORE interface for incoming data in XStatistik XML format (or maybe CSV) from participants or maybe intermediate server.

Other data sources

In contrast to the other European countries, in Germany EVS and ZVE are based on a quota sample (disproportionate distribution). The net sample size for the EVS covers approx. 60,000 households, LWR approx. 8,000 households and in the ZVE to date approx. 5,000 households (in 2022 probably approx. 10,000 households). The quota plan for all three surveys splits up the population set of the households into groups by combining the following characteristics: federal state, household type, social status of the main income earner, and household net income (in 5/6 categories).

Within the scope of the recruitment (done by RSIs for each region separately), various measures are undertaken to recruit households for each group until the defined quota target is attained. Each RSIs uses different data sources for **recruiting**:

- Addresses of households, that have indicated their consent to take part in studies of official statistics
- Addresses from national register (only in some regions)
- Addresses from organizations, associations, companies (e.g. email list)
- Indirect advertisement: e.g. flyer, social media such as youtube-video, facebook, twitter, ads in newspaper, online ads, press releases, etc.),

Depending on the source RSIs compile address lists with a standard format and import them (manually) into the administration program. In case contacted households - directly or through indirect advertisement - intend to take part in ZVE/EVS, they may register via printed form or online (via IDEV[1]). Data from participation interests via paper or online get recorded in the administration program, where data get checked towards doublets. Remaining households automatically receive a confirmation of receipt and serve as **sampling source**.

The quota plan is compiled centrally by Destatis for all RSIs and gets imported by Destatis to the administration program. The sample is drawn based on the quotaplan.

[1] Internally developed online registration procedure used by the Statistical Offices in Germany, https://www-idev.Destatis.de/idev/OnlineMeldung

In EVS for each quarter (of the year: I to IV) based on the sampling source a sample is drawn (regarding the above mentioned criteria). Addresses of households with participation interest, that cannot be considered in the sample of quarter I, get assigned to the next quarter(s).

In ZVE the households selected in quarter I will be randomly distributed to the days in that quarter. For this reason the first day of the reference period will be selected by random and the second and third day will be selected by using an algorithm.

Table 31: Other data sources

Other data sources		
	Expenses/Activities	**Household questionnaire**
Population Register	As in Germany there doesn't exist a central national register, some of the RSIs use addresses of the population register. These addresses are delivered offline in different forms (csv/excel).	
Content	• First and last name • Address	
Administration data	For reasons of regionalization data of communities (i.e. classification number and community size) get imported. These information will be uploaded in the AP to assign this information already while entering/input the address. To validate the bank information a list of possible combinations of bank code number and financial institute will be uploaded in the AP at the beginning of the study. In the further data processing the survey data will be matched with geo coordinates.	
Content	• Postal code • Classification number • Community size • Bank code number • Financial institute	

Analysis strategy

Currently within Destatis SAS is used for data processing. As most of the procedures are already available and reusable with SAS code, a switch to another tool for data analyses is not reasonable. Additionally a Destatis specific standard tool (StatSpez) for tabulating is used: tables are predefined and get filled automatically with data.

In future R might also come more important within Destatis. At this moment Destatis does not seek for analyses from MOTUS.

(Statbel.2) Translation support Belgium

Deliverable	Translations of documents.

This deliverable contains the translation of all necessary documents in Dutch and French, including the preparation and support of the translation service that will be responsible for the translation of the requirements.

The documents in need of translation were provided by the subcontractor, the VUB In English in .csv format. The time needed to translate these documents was about two weeks. The translation was only a forward translation from English to Dutch and French.

Documents:

- Household questionnaire
- Individual questionnaire
- End questionnaire
- Activity list

In the columns of the questionnaires, following Items were provided:

  - Sequence
  - Variable name
  - Description
  - Private question info
  - Question type
  - Default value
  - Minimum
  - Maximum
  - Options Code
  - Logic

In addition to these documents, the automatic mail flow and the evaluation questionnaire for the pilot test also needed to be translated. This took about 2 weeks as well.

The automatic mail flow contained also information screens.

Hereby an overview of the mailflow (which Is already a preparation for TUS 2021):

- MOTUS Invitation to participate
- MOTUS Reminder 1 to participate
- MOTUS Reminder 2 to participate
- Unfinished profile questionnaire
- Communication of the start date of the preliminary questionnaire
- Starting the preliminary questionnaire
- Reminder 1 to start preliminary questionnaire
- Reminder 2 to start preliminary questionnaire
- Unfinished preliminary questionnaire 1
- Unfinished preliminary questionnaire 2
- Reminder 1 to start registering time use
- Reminder 2 to start registering time use
- Progress - nothing registered after 24 hours
- Progress - nothing registered after 72 hours
- Progress - nothing registered after 168 hours
- Progress - nothing registered for 36 hours
- Progress - nothing registered for 72 hours

- Progress - Doing well after 3 days
- Progress - Last day after 6 days
- Reminder 1 to start closing questionnaire
- Reminder 2 to start closing questionnaire
- Unfinished closing questionnaire 1
- Unfinished closing questionnaire 2

Hereby an overview of the Information screens:

- Intermediate screen just before the start of the survey
- MOTUS intermediate screen after profile questionnaire
- MOTUS intermediate screen after preliminary questionnaire and before time use registration
- MOTUS intermediate screen after time use registration and before closing questionnaire
- Final screen: MOTUS survey completed
- Password forgotten
- Short manual time use registration
- Survey description
- Course of the survey
- Time use registration manual
- Privacy
- Contact

The translated documents are provided separately.

(Destatis.2) Translated documents by Germany

This deliverable contains the translation of all necessary documents in German, including the preparation and support of the translation service that will be responsible for the translation of the requirements.

The documents in need of translation were provided by the subcontractor, the VUB In English in .csv format. The time needed to translate these documents was about one week. The translation was only a forward translation from English to German.

Documents:

- Household questionnaire
- Individual questionnaire
- End questionnaire
- (Activity list): *Germany has to meet in addition to the European HETUS-guidelines also national requirements. The activity list and concrete codes are still in the course of preparation for the next round of TUS in 2022. As soon as this task is finished, activity list for Germany will be provided.*

In the columns of the questionnaires, following Items were provided:

  - Sequence
  - Variable name
  - Description
  - Private question info
  - Question type
  - Default value
  - Minimum
  - Maximum
  - Options Code
  - Logic

The translated documents are provided separately.

(Statbel.6) Overall IT Belgium

Deliverable	Overview of the IT-tasks performed.

Within this project, Statbel investigated the possibilities of including the MOTUS environment (back-office) into the IT infrastructure of Statbel. After careful consideration, this would not seem immediately possible and would take a long period of time (estimated between 18 and 30 months).

Because of this fact and the fact that there are other possibilities (see hbits.7 Table 37: MOTUS governance correspondence table), Statbel opted not to pursue the initial idea and to go for one of the proposed governance models.

Therefore, the IT-department involvement was not further involved, except for mapping the Statbel data infrastructure.

(Statbel.7) Follow-up Belgium

(Destatis.5) Follow-up Germany

Deliverable	Update on GANTT-chart, including motivated changes.

Statbel is the coordinator of this project. As coordinator, it evaluated the progress of the project and coordinated tasks between Statbel and hbits as a subcontractor, and with Destatis as a partner. Figure 66 shows the initial planning in a Gantt-chart at the beginning of the project, with a starting date in May (the first three months were conceptual thinking and defining the content of each deliverable).

Figure 66: Gantt-chart overview at the beginning of the project

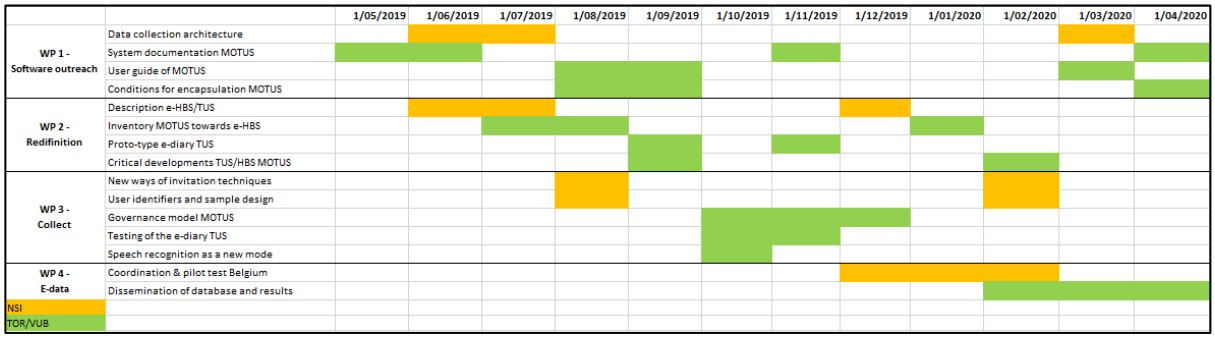
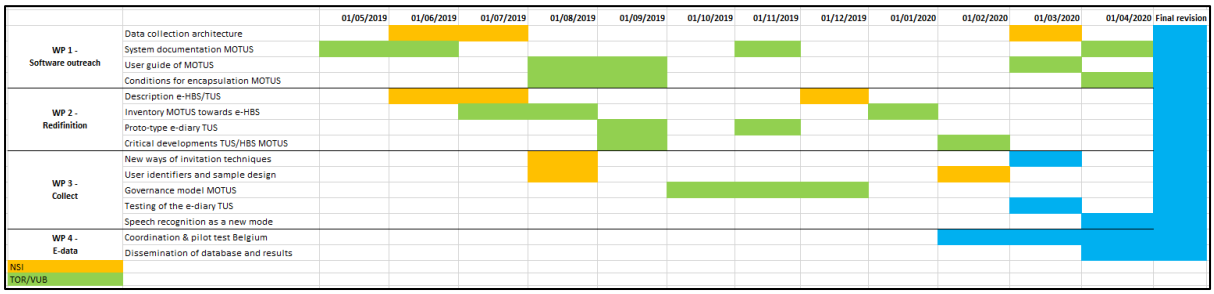


Figure 67 shows the planning changes that happened during the project.

Figure 67: Gantt-chart overview at the end of the project



Because of multiple reasons, some deliverables were reschedules:

- New ways of invitation techniques: because MOTUS will be used for the next official Time Use Survey in Belgium, more departments then initially intended were involved in this deliverable.
- Testing of the e-diary TUS: the actual testing of the survey got a small delay because of delays in translation.
- Speech recognition as a new mode: it became clear soon on the project, that for now speech recognition is something to keep following, but is not yet mature enough to use in official statistics. Therefore, this deliverable became a stand-alone part of the project, as there was no rush.
- Coordination & pilot test Belgium: the setup of the pilot test changed two times during this project. Firstly, a workshop was planned by Eurostat on 18 March, where all the participants of the workshop would be invited to test the front-office of the MOTUS application. Because of COVID-19, the workshop was cancelled. Therefore, we needed to rethink strategy twice and

finally conducted a field test during March and April (see coordination pilot test Belgium and hbits.10: pilot test Belgium).

- Dissemination of database and results: because of the reasons above, this deliverable was delayed, because this deliverable follows the previous one.
- Final revision: during the last two weeks, all deliverables were revised by all the participants in this project to give a consistent overview.

GSBPM template

The USED GSBPM steps to conduct surveys in Belgium.

CD_GSBPM	GSBPM_EN
1	**Specify needs**
1.1	Determine needs for information
1.2	Consult and confirm needs
1.3	Establish output objectives
1.4	Identify concepts
1.5	Check data availability
1.6	Prepare business case
2	**Design**
2.1	Design outputs
2.2	Design variable description
2.3	Design data collection methodology
2.4	Design frame and sample methodology
2.4.1	Define population of interest
2.4.2	Define sampling frame
2.4.3	Determine sampling criteria and methodology (sampling plan)
2.5	Design statistical processing methodology
2.5.1	Define coding routines
2.5.2	Define editing methodology and routines
2.5.3	Define imputation/estimation methodology and routines
2.5.4	Define weighting and calibration methodology
2.5.4.1	Define nonresponse correction methodology
2.5.4.2	Define calibration frame(s)
2.5.4.3	Define calibration model
2.6	Design production systems and workflow
3	**Build**
3.1	Build data collection instrument
3.1.1	Build/review data extraction routines (when gathering data from existing administrative datasets)
3.1.2	Prepare/review data collection instrument (survey questionnaire)
3.1.2.1	Prepare/review introduction letter
3.1.2.2	Prepare/review questionnaire
3.1.2.3	Prepare/review instructions (respondents, interviewers)
3.1.2.4	Prepare/review taxonomy
3.1.3	Test data collection instrument (survey questionnaire)
3.1.4	Establish/review connection to metadata system
3.1.5	Questionnaire translation
3.1.5.1	Translate introduction letter
3.1.5.2	Translate questionnaire
3.1.5.3	Translate instructions (respondents, interviewers)
3.2	Build or enhance process components
3.2.1	Build/review sampling tool

3.2.2	Build/review tools for data collection
3.2.2.1	Build/review tool for user management
3.2.2.2	Build/review tool for fieldwork follow up
3.2.2.3	Build/review tool for data collection
3.2.2.4	Build/review tool for data entry
3.2.3	Build/review calibration tool
3.3	Configure workflows
3.4	Test production systems
3.4.1	Test sampling tool
3.4.2	Test tools for data collection
3.4.2.1	Test tool for user management
3.4.2.2	Test tool for fieldwork follow up
3.4.2.3	Test tool for data collection (e.g. web survey)
3.4.2.4	Test tool for data entry
3.4.3	Test calibration tool
3.5	Test statistical business process
3.6	Finalize production systems
4	**Collect**
4.1	Select sample
4.1.1	Create sampling frame (extraction)
4.1.2	Check sampling frame
4.1.3	Select sample
4.1.4	Check sample
4.2	Set up collection
4.2.1	Preparing a collection strategy
4.2.1.1	Launching an external communication
4.2.1.2	Determine questionnaire version per enterprise
4.2.2	Preparing training manuals (for interviewers or internal staff)
4.2.3	Preparing interviewers
4.2.3.1	Contacting interviewers
4.2.3.2	Attribution of groups to interviewers
4.2.3.3	Organisation of trainings (logistic and administrative issues)
4.2.3.4	Training interviewers
4.2.3.5	Delivering survey material to interviewers
4.2.4	Preparing and training data collection team (internal)
4.2.5	Ensuring all collection resources are available (e.g. laptops, interviewers, green line, website…)
4.2.5.1	Recruitment of new interviewers
4.2.5.2	Creation of login codes and passwords
4.2.5.3	Update website (for data collection)
4.2.6	Configuring collection systems to request and receive the data
4.2.7	Ensuring the security of data to be collected
4.2.8	Preparing collection instruments
4.2.8.1	Printing questionnaires
4.2.8.2	Printing labels

4.2.8.3	Printing (other)
4.2.8.4	Prefilling questionnaires with existing data
4.3	Run collection
4.3.1	Establishing initial contact with respondents
4.3.1.1	Mailing letters/questionnaires
4.3.1.2	Initial interviewer contact
4.3.2	Responding to comments, queries and complaints
4.3.3	Preparing and sending reminders
4.3.3.1	Reminder 1
4.3.3.2	Reminder 2
4.3.3.3	Reminder 3
4.3.4	General fieldwork follow up
4.3.4.1	Follow up response and fieldwork progress
4.3.4.2	Quality monitoring (survey content) and feedback
4.3.4.3	Back checks through households
4.3.5	Implement additional response increasing measures and administrative fines procedure
4.3.5.1	Telephone follow up
4.3.5.2	Contact by statistical correspondents
4.3.5.3	Issue PV's
4.3.5.4	Management and monitoring of administrative fines procedure
4.4	Finalize collection
4.4.1	Data capture and data-entry
4.4.2	Loading collected data and metadata into raw dataset
4.4.3	Launching payment procedure (interviewers / respondents)
4.4.3.1	Produce claims
4.4.3.2	Execute payment
4.5	Administrative data collection
4.5.1	Contact provider
4.5.2	Data reception
5	**Process**
5.1	Integrate data
5.2	Classify & code
5.3	Review, validate and edit
5.3.1	Micro editing / Input data validation
5.3.2	Macro editing
5.4	Imputation and estimations
5.5	Derive new variables and statistical units
5.6	Calculate weights
5.6.1	Calculate nonresponse correction factors
5.6.2	Create calibration frame(s)
5.6.3	Calculate calibration benchmarks (totals)
5.6.4	Adjust for non-response and/or calibrate
5.7	Calculate aggregates
5.8	Finalize data files

6	**Analyse**
6.1	Prepare draft outputs
6.2	Validate outputs
6.2.1	Primary validation
6.2.2	Apply validation procedure
6.2.2.1	Validation procedure for Eurostat delivery
6.2.2.2	Validation procedure for standard products (website update, downloadable tables, brochures)
6.2.2.3	Validation procedure for non-standard products (press release, ad-hoc demand, studies)
6.3	Scrutinize and explain
6.4	Apply disclosure control
6.5	Finalize outputs
7	**Disseminate**
7.1	Update output systems (e.g. be.stat)
7.2	Produce dissemination products
7.2.1	Production of data for Eurostat
7.2.1.1	Production of microdata for Eurostat
7.2.1.2	Production of aggregated data for Eurostat
7.2.2	Production of data to update website
7.2.3	Production of press release
7.2.4	Production of excel tables for download
7.2.5	Production of data for be.Stat (internal)
7.2.6	Production of paper publication (brochure)
7.2.6.1	Content
7.2.6.2	Printing
7.2.7	Production of weekly publication
7.2.8	Production of other dissemination product
7.2.9	Translation of dissemination product(s)
7.3	Manage release of dissemination products
7.3.1	Delivery of data to Eurostat (through eDamis)
7.3.1.1	Delivery of microdata to Eurostat (through eDamis)
7.3.1.2	Delivery of aggregated data to Eurostat (through eDamis)
7.3.2	Update of website
7.3.3	Release of press release
7.3.4	Release of excel tables for download
7.3.5	Release of data on to be.stat (external)
7.3.6	Release of paper publication (brochure)
7.3.7	Release of weekly publication
7.3.8	Release of other dissemination product
7.4	Promote dissemination products
7.5	Manage user support
7.5.1	Production and dissemination of user specific demands (recurrent)
7.5.2	Production and dissemination of user specific demands (non-recurrent, ad-hoc)
7.5.3	Dissemination of encoded microdata to external users

8	**Archive**
8.1	Define archive rules
8.2	Manage archive repository
8.3	Preserve data and associated metadata
8.4	Dispose of data and associated metadata
9	**Evaluate**
9.1	Gather evaluation inputs
9.2	Conduct evaluation
9.3	Agree action plan

Management (quality – metadata – project)

Q	**Quality management**
Q.1	Quality measurement
Q.1.1	Response analysis
Q.1.2	Variance estimation
Q.1.3	User satisfaction measurement
Q.2	Quality reporting
Q.2.1	Producer oriented quality report (Eurostat)
Q.2.2	User oriented quality report
M	**Metadata management**
P	**Project/Production management (general)**