Water -M Project

D1.5 Catalogue of Requirements

Readers acknowledgment

This document mainly shows 2 sections:

1. Presentation of requirements management inside water-M;
2. Master Requirements lists updates.

To maximize efficiency in project follow-up you can directly read the 2nd chapter

Content

History

Date	Version & Status	Author	Modifications
10/11/2017	V 1.0	JJ. Busson	Initial master requirement list
15/03/2017	V.1.1.1	JJ. Busson, S. Dedeystere	Requirements according to project specifications (first release)

1 Presentation of requirements management inside Water-M

1.1 RM introduction inside the Water-M project

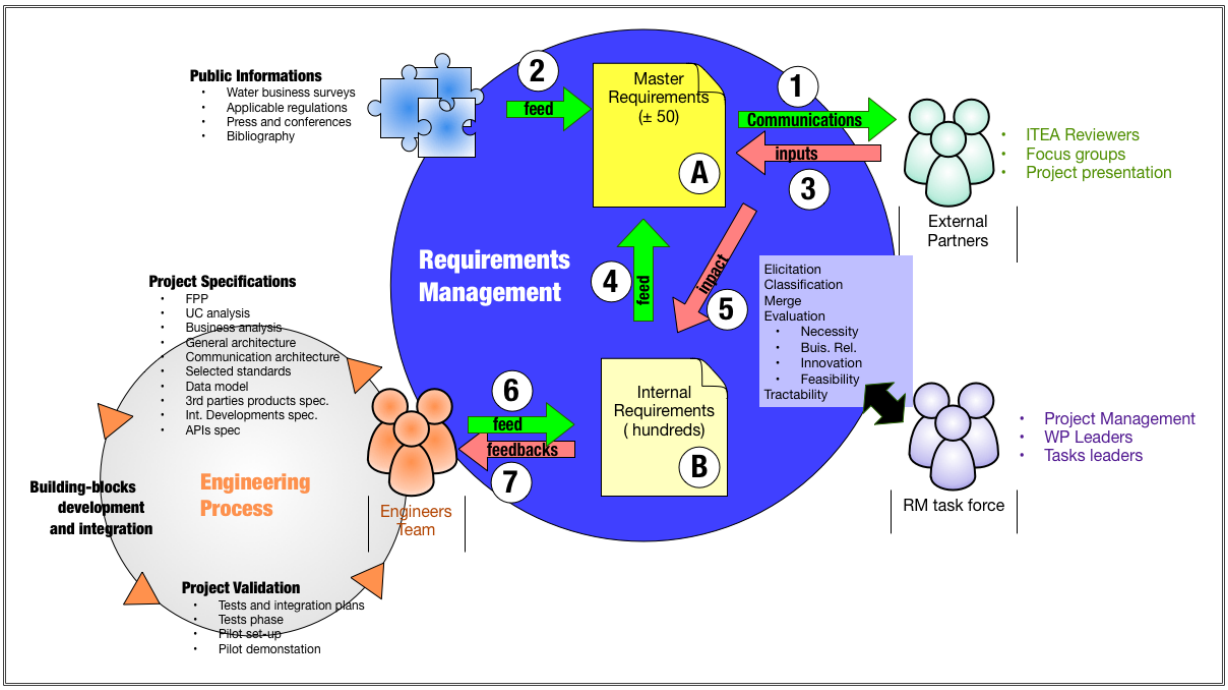
Requirements design (RD) and requirements management (RM) in ITC projects is widely discussed in the literature. There are endless discussions on pros and cons in regard of project creativity and efficiency and about how to comply RM with agile development or extreme programming.

Now, considering Water-M project shifts, its project management alongside with ITEA reviewers, have decided to resort this method to assist:

- The project outlining: scope and limit;
- The specification Water-M building blocks;
- The control the project outputs after the integration and pilot phase;
- The communication with 3rd parties;
- The project construction and follow-up.

Furthermore, the use of RM method, with Water-M engineering team, shall support the coherence of project outputs and documentation.

1.2 Requirements lists choreography



Water-M maintains 2 levels of requirement lists.

1. Water-M master requirements list, at system level, ≃ 50 high level requirements (mark A on schema);
2. Water-M internal & compressive requirements list, which may have several hundred items (mark on B schema).

1.2.1 Master requirements

Master list aims the communication with external organizations (mark 1 on schema). They express Water-M commitments

- to targeted water-business partners;
- to potential ITC technological partners and
- ITC innovation community;
- and thus, to ITEA reviewers.

Master list is built upon:

1. Information from outside the project team: business trends, market surveys, technological news, regulations and standards, press, bibliography, conferences (mark 2 on schema).;
2. Inputs from third parties: focus group or reference users' communication, dissemination actions feedbacks, parallel projects and other trusted parties including ITEA reviewers (mark 3 on schema).;
3. Synthesis of most significant internal requirements, promoted to the master requirements list (mark 4 on schema).

1.2.2 Internal requirements

Internal requirements mainly serve the engineering process. Internal requirements are sourced from

1. Heritage from master requirement updates: additions, changes, deletions (mark 5 on schema). ;
2. Newly available or updated engineering documents compiled into requirements (mark 6 on schema). .

In return, the collection and the elicitation of internal requirements help the engineering process (mark 7 on schema). .

- Through careful readings and interpretation of engineering documents, questions are raised. In this matter, this enhance quality control of water-M outputs.
- Requirement management facilitates major steps of the engineering process such as data model , break down into building blocks, etc.

The detailed requirements are also a major source of tests plans

1. tests phase, integration phase shall prove the fulfilment of requirements;
2. field -tests shall demonstrate a relevant subset of requirements, in real world conditions;
3. The list of fulfilled requirements is a major part of the project's final assessment.

1.3 Requirements management work organization

A dedicated task force (RM task force) will perform the requirements management which consist in:

1. Eliciting, classifying and merging requirements from the different sources;
2. Providing feedbacks to the engineering team;
3. Organizing requirement evaluation sessions: with the project management, WP leaders and task leaders, where each requirement is evaluated in regard of its necessity, its business relevance, innovation criteria, and its feasibly within the project timeframe and budgets;
4. While maintaining requirements quality, traceability and consistency;
5. Takes into account external feedbacks and external context changes (e.g.: regulations, standards, Water business or ITC game changing);
6. Monitor requirements fulfilment during and after the testing and validation phases.

In engineering teams, technical document authors, will be involved

1. in answering RM task force questions；
2. in rectifying their documents when necessary.

1.4 Requirement updates and requirements list deliverables

Requirement management, at both detailed and master levels, is obviously a continuous process.

Now there are major milestones in this process. These somehow correspond to WP breakdown:

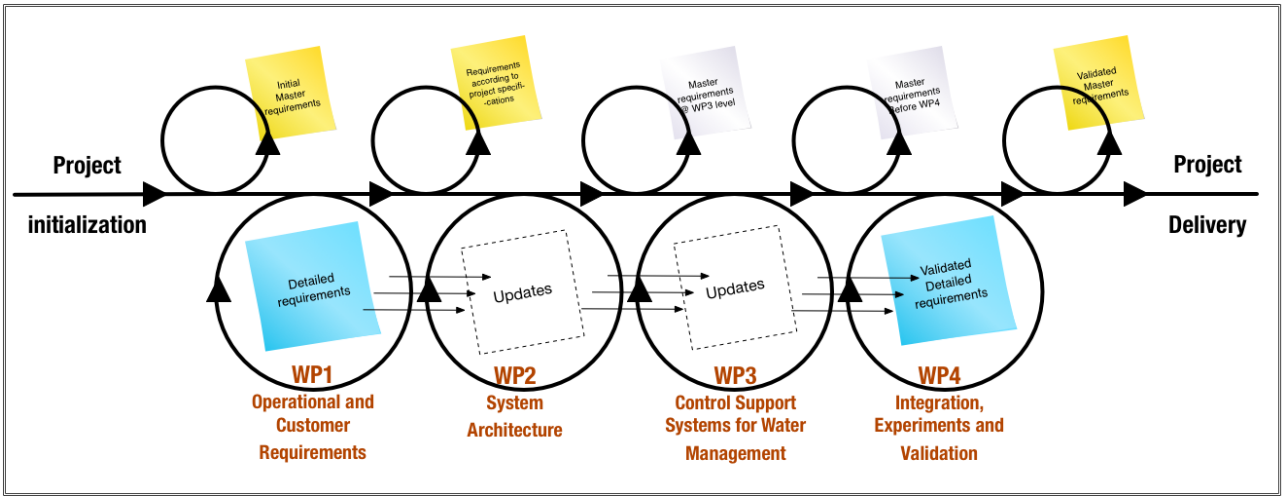
- At FPP level, in our case at FFPV3 change request level: **Initial Requirements**
- Once general project outlines are stated ==> end of WP1: **Requirements according to project specifications;**
- Once architecture and building blocks are specified, which corresponds to end of WP2
- To feed the tests and integration plans, parallel to WP3;
- After the Integration and testing phase ==> **Fulfilled Water-M requirements.**

The project will officially deliver 3 releases of Master requirements

1. Initial requirements;
2. Requirements according to project specifications;
3. Fulfilled Water-M requirements.

The internal requirement will remain internals to Water-M team.

These are nevertheless, accessible to ITEA reviewers upon request.



1.5 Practical considerations

1.5.1 Tools

As previously mentioned RM, is a recognized discipline and there is a large offer of software package and on-line services around RM. In Water-M, to lighten the process and lower investments we have chosen to rely on spreadsheets plus maximum attention inside RM task force.

1.5.2 Requirement management rules inside Water-M

The following paragraphs state the rules RM task force, engineering team, WP and task leaders are following in Water-M. These are subject to changes along the project progress.

1.5.2.1 Elicitation rules

A requirement is something wanted or needed in the project.

Requirement need to be understandable and are grammatically correct and written in a style that facilitates review by the affected parties.

They are written as “shall” statements using one of the following form:

- [object] shall [verb] [object of verb];
- [object] shall have [property of object].

1.5.2.2 Overall requirement classes

The nature of the object inside the requirement determines level of the requirements. In Water-M we have retained 8 major categories of requirements. Requirements may concern:

1. The whole Water-M system: **System requirements**;
2. A function or group of functions and/or Information transiting between function ➔ **Functional requirements**;
3. Constraints on above functions, data or technical and or technical entities ➔**Unfunctional requirements** (security, performance, Customization, Flexibility…);
4. We also must consider the **implementation requirements**, such as need to implement a category of products on which developments shall be based (OS, SQL data base) use a certain programming language, needs concerning on systems Integration, etc;
5. **Business requirements**: Needs from the Water-Management industry and requirement to insure the final system/product acquires competitive advantage in regard of the competition
6. **Organizational requirements:** Constraints on the users’ organization, work, manual processes (Note: good systems should not impose too many constraints on management);
7. **Project requirements:** constraints on project activities like documentation, project management;
8. **Product life requirements:** needs on the maintenance of products.

1.5.2.3 Additional classification criteria

The project progress will outline necessary additional classifications such as: functions and sub-functions, data categories, sub-systems, etc.

These are validated with WP and task leaders.

1.5.2.4 Requirements sources

RM task force, insure the audit tract between the (internal) requirements and documents.

RM Task force maintain a set of annotated most recent version of engineering documents where sources and consequent requirements are referenced.

The early versions of these annotated engineering documents also raise questions to document authors.

Authors will make their best effort to supply necessary precisions to clarify the documents.

1.5.2.5 Sorting, dupes identification, Merging

RM task force process the necessary sorting to pinpoint requirements duplicates or similarities.

RM task force is responsible to maintain the consistency of requirements within different source documents, while maintaining traceability.

1.5.2.6 RM outputs

As previously mentioned, RM facilitates major steps of the engineering process such a data modelling, the break down into building blocks, etc.

RM task force provides needed extractions, sorting, presentations to serve engineering processes.

1.5.2.7 Requirement importance

RM task force proposes requirements' importance. Requirement importance will be validated during evaluation sessions.

Chosen requirements' importance grades within Water-M are:

- N/A: ➔ When a requirement needs elicitation before its importance is set;
- 0 ➔ Deleted requirement;
- 1 ➔ Must have;
- 2 ➔ Brings competitive advantages to the system, although non-compulsory;
- 3 ➔ Nice to have;
- 4➔ Requirement addition, for comfort

Requirement showing importance level equal to 1 will be developed in water-M.

Requirement showing importance level equal to 2 shall be discussed.

The requirement showing other requirement importance are nevertheless kept in the audit track. These may be used in further ideation sessions.

1.5.2.8 Promotion to Master requirement list

Master requirement can be expressed thought the synthesis of several internal requirements. The Master requirement writing is proposed by the RM task force. RM task force proposes internal requirements promotion.

Each requirement promotion is validated during evaluation sessions.

We also stated the following rules:

1. Only requirement showing importance level equal to 1 or 2 can be reported in the Master List.
2. Master requirement list will only comprise the requirement having the following classes

2.1. Overall Business requirements;
2.2. Synthetic functional and unfunctional requirements;
2.3. Organizational requirement (impacts on final user organisation);
2.4. Project requirements (additional activities compared to FPP).

1.5.2.9 Requirement evaluation sessions

RM task force organise regular requirement evaluation session comprising:

1. RM task force members;
2. Project management;
3. Relevant WP and Task leaders for the given session.

During the sessions:

1. Detailed and master list of requirements are reviewed.
2. Proposed evaluations and promotions are discussed then decided in regard of business relevance, innovation criteria, and feasibly within the project timeframe and budgets.
3. Decisions are logged for traceability purposes.
4. Feedback to engineering team documents are presented and discussed.

2 Master Requirements list

2.1 Initial Master Requirements list

It has been exposed, to ITEA reviewers before FPP version 3 request changes This list was a main source for FPP 3rd version.

2.2 Requirements according to project specifications (current version)

2.2.1 Sources

The proposed version of Master requirement aims at finalizing WP1. It takes mainly into consideration

- FPPV3;
- Evaluation of stakeholder interactions;
- Analysis of current water policies;
- Use cases application scenarios and definition.

2.2.2 Comments

As necessary feedbacks on late use cases analysis are not yet taken into consideration, and as evaluation session are not finalized the current version is not the final one.

Following yellow highlighted paragraphs correspond to level 2 of requirement importance "provides a competitive advantage to the project"

2.2.3 Main outputs

The achievement of the detailed requirement list on which the bellow Master list is based, mainly enabled the proposal of

1. project functional breakdown;
2. needed data concepts;
3. actors dictionary.

To the engineering team. Those are inputs of WP2 and WP3.

2.2.4 Business Requirements

Req. ID		Description
OBR-001	**1**	**Evaluate and improve the performance of a water distribution network**. Water-M provided dashboards are designed, taking in consideration state of the art indicators for water networks managers and owners (most often municipalities) point of view. The conjunction of performance watching and detailed monitoring features provided in Water-M shall permit to • Follow evolution of performance indicators (alerts in case of disruption) • Indicate the localisation points where actions are needed. This will serve as the main operational information which is used to optimise the maintenance: Selection and planning of the most profitable corrective and evaluative maintenance actions.
OBR-002	**1**	**Allow to perform subscribers billing based on water consumption**. Ability to produce the billing information based on water meters' information is nowadays a minimal requirement for water management system. Now, the scalability of Water-M's architecture shall allow the production of any number of subscriber's detailed consumption bills reflecting all available water consumption measurements (e.g.: 1/day). It will also be possible to proceed to detail queries on water-consumption data and therefore provide new services to customers. Note: ERP and billing systems are outside water-scope.
OBR-003	**1**	**Facilitate water distribution network maintenance and reduce associated costs**. As stressed in above business requirements, performance watching and detailed monitoring features participate in the corrective maintenance optimization. Smart alerts triggering through complex event processing (CEP) technologies is one of the most advanced Water-M contribution. This permits early warnings systems and shall reduce intervention time after problem occurrence. This shall reduce aftermath's costs.
OBR-004	**1**	**Reduce the amount of water losses.** Leaks detection, leaks localisation and leaks volume evaluation shall improve the evaluation of the water network loses. Early warning on leaks will contribute to water loss and associate costs reduction. Note: The project shall provide a cost-benefit analysis for water loss reduction taking into consideration: • Monetary values and other evaluation means; • The point of views of water network managers, municipalities (usually network owners), final users and society.
OBR-005	**1**	**Prevent and reduce health risks.** Water-M has conducted a detailed survey on water quality measurements needs. This survey also comprises an evaluation of: • The best available sensing technologies; • The automated methods to operate as accurate as possible measurement of chemical, physical and biologic water content. • Through water quality watching and thanks to CEO based alert Water-M enhance the protection against, direct health risk at consumer level and indirect health risks consequent to environmental hazard • Reduce fertilizers and the phytosanitary treatments in irrigation waters, thanks to smart urban farming monitoring

Req. ID		Description
OBR-006	**1**	**Provide data to different actors.** Water-M is based on IoT architecture state of the art. In such architecture, upper level application can access all network information through platforms. Exogenous data can be accessed through the platforms or at application level. By design, data are available to any user or any application provided the security process in place grants access. The adoption of the IoT platform based architecture allows a better adaptability to the development of new applications service dedicated to new users purposes.
OBR-007	**1**	**Allow new business models for water management** New ideas are emerging to rebuild the economic model by making the remuneration depending on the water distribution performance, therefore, partially detaching the remuneration from the volumes sold. The municipality pays the operator directly based on performance measured through precise evaluations. The remuneration is function of the objectives respected as well as the volumes of water sold Thus, water provider has a monetary interest in control the performance variables of the network.
OBR-008	**2**	**Target energy cost reduction in the water network** In municipalities, after public lighting, water network represents the second most important electricity bill. 1. Thanks, to the constant monitoring and to early warnings Water-M system shall alert water network stakeholders on leaks and transportation ability losses causing unnecessary energy consumption (due to pumping) 2. Provided energy market data are available, Water-M optimization processes shall help the scheduling of energy consuming process accordingly to energy prices. **3.** The advanced remote monitoring of the water system also aims at reducing the number of field interventions (which, nowadays, contributes to the reduction of fossil fuels consumption)
OBR-009	**2**	**Ensure compatibility with European directives on water** Namely 1. Groundwater Directive 2006/118/EC 2. Water Framework Directive 2000/60/EC concerning drinking water (98/83/EC) Through a constant water quality monitoring of 1. water sources and waste water treatment plants outlets, **2.** clear water distribution network.
OBR-010	**1**	**Minimize irrigation water and energy needs in monitored urban farming sites.** Irrigation accounts for more than two-thirds of total water usage abstraction. In northern member states, levels of water use in agriculture are lower, with irrigation being less important but still accounting for more than 30 % in some areas. • In monitored urban farming sites, expert systems will optimize the quantity of water and light (also nutriments) accordingly to: plants species and cultivar, crops development stage and health conditions, seasons & time, current and forecasted weather conditions. • While minimizing water and light, the needs for energy is minimized

2.2.5 Functional Requirements

Req. ID		Description
OFR-001	**1**	**Provide states of water distribution network devices**. A water system consists of a predefined set of devices (Storage reservoir, sectioning valve, zone meter, pump station, pressure regulator, pressure sensor, subscriber meter) that can be modeled as objects. These objects have a state composed by a set of information coming from sensors.
OFR-002	**1**	**Detect and locate leaks in water distribution network**. Leak detection in the network reduces the volume of unbilled water. The location of the leakage can reduce the maintenance cost.
OFR-003	**1**	**Detect and locate overpressure in water distribution network**. Overpressure detection in the pipes prevents leakage and water pipe damages. Overpressure location helps to optimize network and to adjust water distribution network devices.
OFR-004	**1**	**Measure volume of water supplied for each network area.** Water loss can be checked by comparing the total consumption of the subscribers in an area and the volume of water passing through the area sectioning valve.
OFR-005	**1**	**Provide water quality measurement.** Water quality measurement helps to respond to the goal of European norm and is a necessity to prevent and reduce health risks.
OFR-006	**2**	**Measure energy consumption of water network devices.** Some water network devices need energy (fuel, electricity) whose cost should be calculated to optimize OPEX.
OFR-007	**2**	**Measure the pressure available at the subscriber premise.** The pressure at the distribution point (or near) must be greater than a threshold to ensure quality of experience for the subscriber.
OFR-008	**1**	**Measure subscribers water consumption.** Measuring the consumption of the subscriber allows billing.
OFR-009	**1**	**Detect abnormal water consumption at the subscriber premise.** Used to signal to the subscriber an abnormal consumption avoids waste and contributes to the satisfaction of the subscriber.
OFR-010	**1**	**Use and eventually allow to constitute a geospatial database to locate and identify sensor, pipes, water network devices and water distribution points.** It is necessary to have access to a geographic database including network topology. These allow to display the various objects, including sensor and actuators, of the network on a map, to make the link between an object and the data associated with it and what are the upstream and downstream objects on a pipe. This database, will eventually communicate with available Geographical Information Systems (GIS) and building information management (BIM) systems, through standardized APIs. Those APIs shall be designed both ways. This, to be able to use Water-M information in GIS or BIM based GUIs.
OFR-011	**1**	**Use and eventually allow to constitute a water context database.** To calculate the performance indicators that measure the quality of service, it is necessary to provide context data on the network once per year, which may not be directly measurable (Cost of service, Network length, Number of subscriber ...).
OFR-012	**1**	**Filter, add timestamp and store real time data coming from sensors.** Data coming from sensors can be pretreated, are time stamped, stored as time series and accessible by applications through an API.

Req. ID		Description
OFR-013	**1**	**Close the sectioning valve to isolate a water distribution area**. Area sectioning valves can be closed in case of major leakage or contamination.
OFR-014	**1**	**Set the sensors and the various water distribution network devices**. Sensors must be configured remotely (whenever possible) to adjust some settings to use cases (thresholds, sampling period, transmission period).
OFR-015	**1**	**Detect events from standard rules.** Primary as well as complex events that can generate alarms are made from pre-defined rules and allow for example to compare values with thresholds, detect and locate leaks, ...
OFR-016	**1**	**Detect events from user-defined rules.** Events that can generate alarms are made from user-defined rules.
OFR-017	**1**	**Calculate performance indicators to measure the efficiency of the water distribution network.** Each year, some actors demand a set of performance indicators. Some of them are used to compare different services having some similarities, to be able to have references.
OFR-018	**2**	**Forecast Water Demand** Models for predicting the water consumptions in real time and short terms have to be implemented to optimize water network.
OFR-019	**1**	**Provide a man-machine interface for viewing the various measurements in the network as well as faults and indicators.** Water-M provided dashboards are designed, taking in consideration state of the art indicators for water networks managers and owners (most often municipalities) point of view. The conjunction of performance watching and detailed monitoring features provided in Water-M shall permit to • Follow performance indicators evolution (and alert in case of disruption); • Indicate the localisation of needed actions.
OFR-020	**2**	**Imbed 3rd party energy cost optimization routines using 3rd party energy tariff database**. Reducing energy cost mainly consist in organizing a given process in regard of 1. Process constrains 2. Business rules, e.g.: performance indicators to reach 3. Energy consumption functions for each step of the process Using 4. current and forecasted energy tariffs 5. Energy cost optimisation routine
OFR-021	**2**	**Consider instruments and measurement method calibration** **Water-M shall** • Warn users on measurements deviations • Consider a training period to obtain reliable indicators • Allow users to manually set instruments or measurement routines parameters
OFR-022	**2**	**Use weather and climate reference data** Local current and forecasted temperature and precipitation data, are used for several UC. The Water-M project shall, at least, comprise suitable methods to import such context data in its environment

Req. ID		Description
OFR-023	**2**	**Consider obtaining sensor data and commanding actuators via SCADA interfaces** Legacy water network monitoring installations are based on SCADA. To fasten the integration of legacy system, it is necessary to build APIs to mostly used SCADA system
OFR-024	**2**	**Be ready for river monitoring and river flood alerts systems UC** This mainly means integrating, Water depth sensors, water depth calculation derived from pressure, dedicated applications and GUI.

2.2.6 Non-functional Requirements

Req. ID		Description
ONFR-001	**1**	**Adapt to different water distribution network topology.** Water-M must address high population density areas and low population density area as well.
ONFR-002	**1**	**Have open and standardized (whenever possible) interfaces.** Water-M must be modular. Components must have standard interfaces, whenever possible, at all levels of the architecture so that they can be easily replaced.
ONFR-003	**1**	**Have open data model**. Water-M should use a data model based on standardization work allows to have a model as close as possible to next generation standard.
ONFR-004	**1**	**Performance and scalability** The scalability of the Water-M shall be demonstrated simulating the behaviour of a city with at least 1 million inhabitants then evaluating average cost effectiveness per water metering point.
ONFR-005	**1**	**Ready for state of art security mechanisms** Although the implementation of security mechanism in not part of Water-M, the project shall analyse which mechanisms are to be implemented and how.

2.2.7 Project Requirements

Req. ID		Description
OPRJ-001	**1**	**Water-M shall enhance its business analysis** Organization of business canvases session