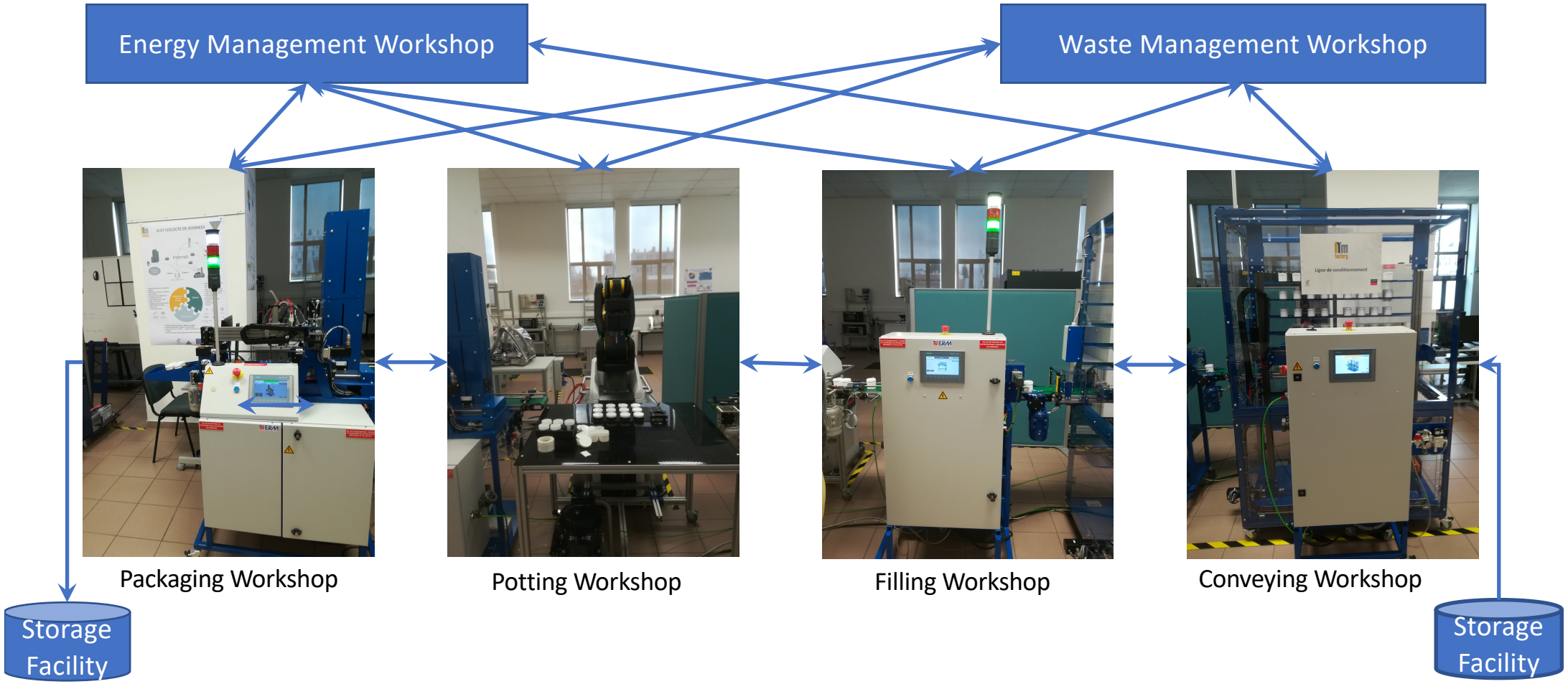
International Project Management Projects

January 2020

Global View of the production line



Global Use Case

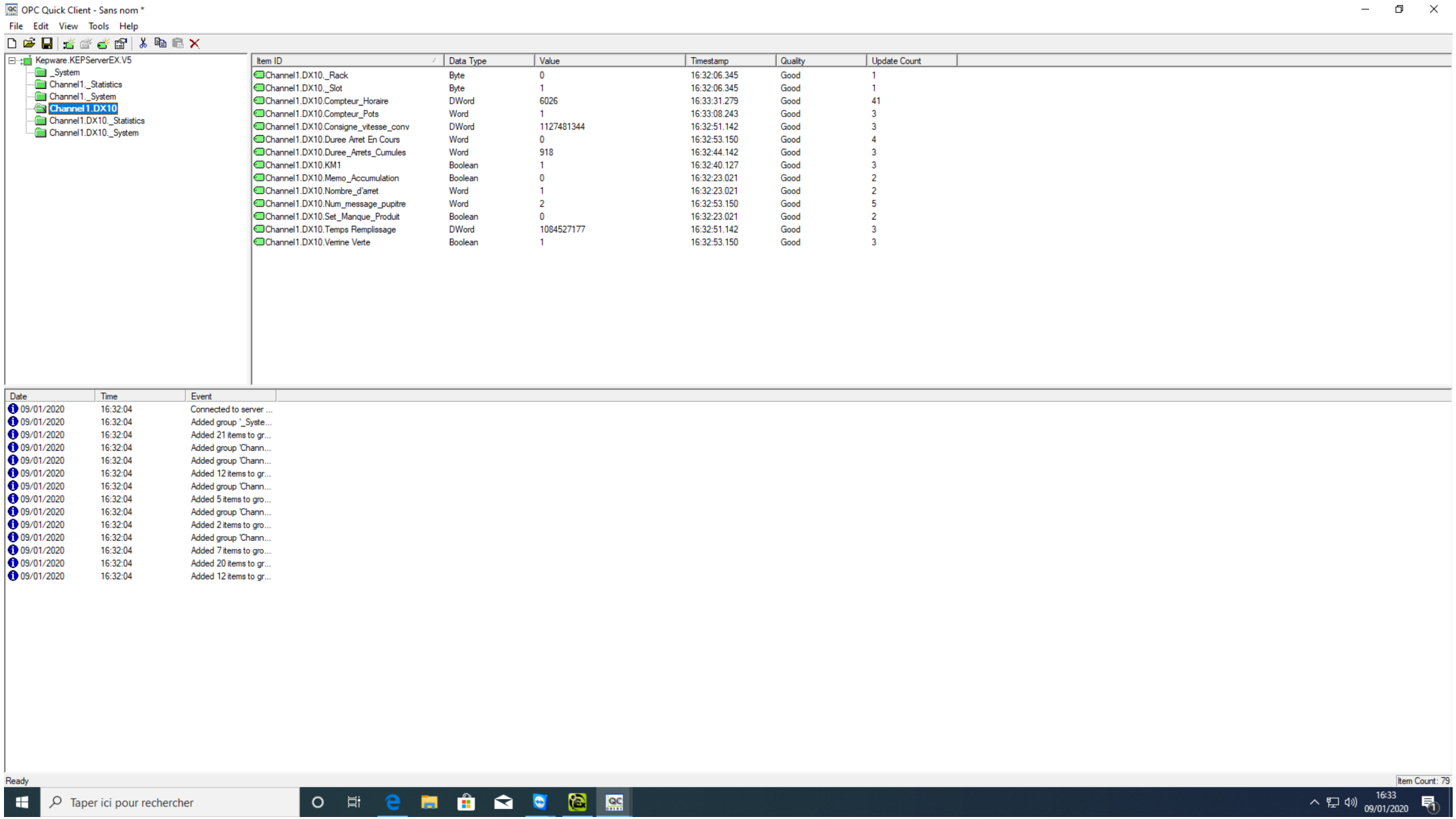
- A production line, composed of four workshops, produces pots. It is supported by two management systems: waste transformation and energy production.
- In sequence the production line collects empty containers from a storage facility (Conveying Workshop), fills them with a product (Filling Workshop), closes the containers (Potting workshop) and packages them in boxes (Packaging Workshop).
- Each workshop consumes energy (provided by the energy management system) and produces wastes (processed by the waste management system).
- Each workshop of the production line is equiped with an automaton that respectively picks one container after the other from the shelf where they are stored, fills it with a product (liquid or powder), closes the container with a robot arm that picks a container, covers it with a lid and closes it, packages the different containers in a box. When the box is full, it is sent to a quality control workshop that checks manually the quality.

Workshop View

- Each workshop is equipped with automatons that have a number of sensors (e.g. presence sensors, temperature, humidity, weight, etc.) and actuators (e.g. robot arm, cylinder, etc.).
- Each workshop is independent of the other , and communicates its data via a specific terminal for each of them.
- The accessible variables are numerous: e.g. the state of the sensors and actuators, the operating state of a given process (running, requires intervention, error, etc.).

Parameter examples for Conveying Workshop

Nom	Type de données	Adresse	Rémanence	Accessible depuis IHM/OPC UA	Ecriture autorisée à partir de IHM/OPC UA	Visible dans l'ingénierie IHM
Axe sous puissance	Bool	%I0.1	False	True	True	True
Came de prise d'origine	Bool	%I0.4	False	True	True	True
Axe_Remplissage_Impulsion	Bool	%Q0.0	False	True	True	True
Axe_Remplissage_Sens	Bool	%Q0.1	False	True	True	True
Mise sous puissance	Bool	%Q0.2	False	True	True	True
Acquit Défaut	Bool	%Q0.3	False	True	True	True
Stop	Bool	%M2.0	False	True	True	True
Presence pot	Bool	%I0.3	False	True	True	True
Visu_BP_Marche	Bool	%M6.0	False	True	True	True
Visu_Mesures	Bool	%M6.1	False	True	True	True
Etape Initialisation	Word	%MW12	False	True	True	True
BP Initialisaton	Bool	%M5.2	False	True	True	True
Etape conduite	Word	%MW10	False	True	True	True
BP Marche	Bool	%M5.0	False	True	True	True
Visu_BP_Initialisation	Bool	%M6.2	False	True	True	True
Visu_BP_Manu	Bool	%M6.3	False	True	True	True
BP Manu	Bool	%M5.3	False	True	True	True
BP_Sortie_Manu	Bool	%M5.1	False	True	True	True
BP Arrêt	Bool	%M5.4	False	True	True	True
Visu_BP_Arrêt	Bool	%M6.4	False	True	True	True
Visu_BP_Paramètre	Bool	%M6.5	False	True	True	True
Temps Remplissage	Real	%MD100	False	True	True	True
FirstScan	Bool	%M50.0	False	True	True	True
Alarme V90	Bool	%I0.2	False	True	True	True
KM1	Bool	%I0.0	False	True	True	True
Etape Marche	Bool	%M3.0	False	True	True	True
Etape Arrêt AU	Bool	%M3.1	False	True	True	True
System_Byte	Byte	%MB50	False	True	True	True
DiagStatusUpdate	Bool	%M50.1	False	True	True	True
AlwaysTRUE	Bool	%M50.2	False	True	True	True
AlwaysFALSE	Bool	%M50.3	False	True	True	True
Réferencement init	Bool	%M1.1	False	True	True	True
Memo Stop	Bool	%M14.0	False	True	True	True
Memo distance remplissage	Real	%MD40	False	True	True	True
Accumulation Aval B5	Bool	%I0.6	False	True	True	True
Memo_Accumulation	Bool	%M3.4	False	True	True	True
Front memo accu	Bool	%M310.1	False	True	True	True
Pause	Bool	%M310.2	False	True	True	True
Front pause	Bool	%M310.3	False	True	True	True
Front arret pause	Bool	%M310.4	False	True	True	True
Verine Verte	Bool	%Q0.4	False	True	True	True
Clock_Byte	Byte	%MB20	False	True	True	True
Clock_10Hz	Bool	%M20.0	False	True	True	True
Clock_5Hz	Bool	%M20.1	False	True	True	True
Clock_2.5Hz	Bool	%M20.2	False	True	True	True
Clock_2Hz	Bool	%M20.3	False	True	True	True
Clock_1.25Hz	Bool	%M20.4	False	True	True	True
Clock_1Hz	Bool	%M20.5	False	True	True	True
Clock_0.625Hz	Bool	%M20.6	False	True	True	True
Clock_0.5Hz	Bool	%M20.7	False	True	True	True
Font_Defaut_V90	Bool	%M310.6	False	True	True	True
Set_Manque_Produit	Bool	%M6.6	False	True	True	True
Front_Absence_Produit	Bool	%M6.7	False	True	True	True

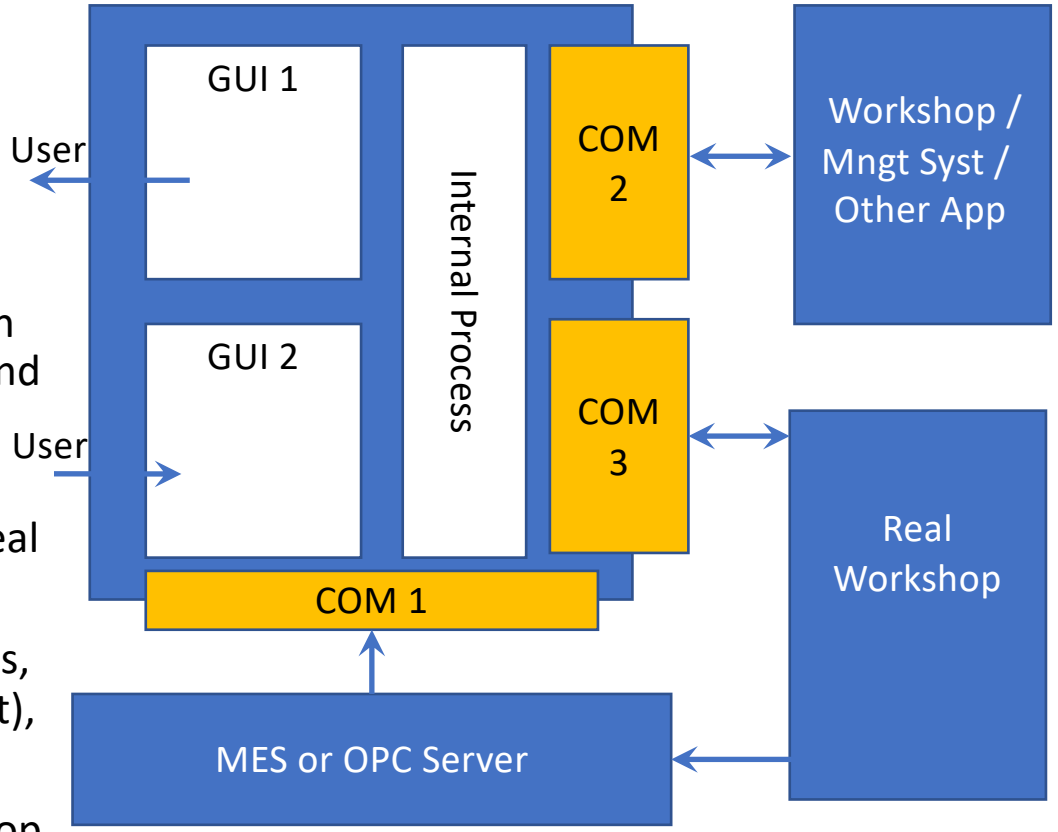

OPC Quick Client - Sans nom *
File Edit View Tools Help
Kepware.KEPServerEX.V5
_System
Channel1._Statistics
Channel1._System
Channel1.DX10
Channel1.DX10._Statistics
Channel1.DX10._System
Item ID | Data Type | Value | Timestamp | Quality | Update Count
Channel1.DX10._Rack | Byte | 0 | 16:32:06.345 | Good | 1
Channel1.DX10._Slot | Byte | 1 | 16:32:06.345 | Good | 1
Channel1.DX10.Compteur_Horaire | DWord | 6026 | 16:33:31.279 | Good | 41
Channel1.DX10.Compteur_Pots | Word | 1 | 16:33:08.243 | Good | 3
Channel1.DX10.Consigne_vitesse_conv | DWord | 1127481344 | 16:32:51.142 | Good | 3
Channel1.DX10.Duree Arret En Cours | Word | 0 | 16:32:53.150 | Good | 4
Channel1.DX10.Duree_Arrets_Cumules | Word | 918 | 16:32:44.142 | Good | 3
Channel1.DX10.KM1 | Boolean | 1 | 16:32:40.127 | Good | 3
Channel1.DX10.Memo_Accumulation | Boolean | 0 | 16:32:23.021 | Good | 2
Channel1.DX10.Nombre_d'arret | Word | 1 | 16:32:23.021 | Good | 2
Channel1.DX10.Num_message_pupitre | Word | 2 | 16:32:53.150 | Good | 5
Channel1.DX10.Set_Manque_Produit | Boolean | 0 | 16:32:23.021 | Good | 2
Channel1.DX10.Temps Remplissage | DWord | 1084527177 | 16:32:51.142 | Good | 3
Channel1.DX10.Verrine Verte | Boolean | 1 | 16:32:53.150 | Good | 3
Date | Time | Event
09/01/2020 | 16:32:04 | Connected to server ...
09/01/2020 | 16:32:04 | Added group '_Syste...
09/01/2020 | 16:32:04 | Added 21 items to gr...
09/01/2020 | 16:32:04 | Added group 'Chann...
09/01/2020 | 16:32:04 | Added group 'Chann...
09/01/2020 | 16:32:04 | Added 12 items to gr...
09/01/2020 | 16:32:04 | Added group 'Chann...
09/01/2020 | 16:32:04 | Added 5 items to gro...
09/01/2020 | 16:32:04 | Added group 'Chann...
09/01/2020 | 16:32:04 | Added 2 items to gro...
09/01/2020 | 16:32:04 | Added group 'Chann...
09/01/2020 | 16:32:04 | Added 7 items to gro...
09/01/2020 | 16:32:04 | Added 20 items to gr...
09/01/2020 | 16:32:04 | Added 12 items to gr...
Ready
Item Count: 79
Taper ici pour rechercher
16:33
09/01/2020

Work to realize

- A group of 4 members will be in charge of developing a limited « digital twin » of two workshops or workshop+management system
- Each workshop will be based on the generic architecture shown in next slide
- The 3 groups will have to collaborate and discuss with each other to make all these « digital twins » cooperate with each other
- Cooperation requires interoperability
- The current allocation is as follows:
  - **ITMWorkshop1:** Conveying Workshop + Waste Management System
  - **ITMWorkshop2:** Filling Workshop + Potting Workshop
  - **ITMWorkshop3:** Packaging Workshop + Energy Management system

Generic Workshop Architecture

- **GUI1**: visualisation of parameters of the process. Parameters are describing the internal state of the workshop, info sent to other workshops, info received from other workshops or external actors
- **GUI2**: actions on the process, setting of parameter values
- **Internal Process**: simulation of the process undertaken by the workshop given the values of the parameters and producing new values of parameters
- **COM1**: communication interface with the MES or OPC server that gather data (parameter values) from the real workshops
- **COM2**: communication interface with other workshops, the management systems (energy, waste management), other App. COM2 is a Web API
- **COM3**: communication interface with the real workshop



Work to realize by each group

- Develop a software application for each workshop and / or management system following the SCRUM Approach along 3 sprints.
  - The Teachers and external actors are the product owners.
  - Be careful about the evaluation of the efforts for each backlog item
  - Definition of the content of each Sprint has to be done by each group, in cooperation with the product owners and the different groups.
- Model the systems and their interactions with UML (actors/sequence/activity/class diagrams)
  - Think about the different operating states of the process
- Develop Swagger specification of each workshops' Web APIs, and for COM2
  - What are the paths, operations, expected responses,
  - What are the query and response messages (defined using JSON Schemas)

Work to realize by each group (contd)

- Code web servers for these APIs that run the logics of each workshop and / or management system
  - Generate classes from the JSON Schemas (you know how to do this)
  - Generate a server skeleton from the Swagger YAML (new)
  - Code a simple logics of the workshop in the server
- Code the GUI1 and GUI2 web clients, that use these APIs
  - Mockup web interfaces, think about the different operating states (many mockup tools out there)
  - Generate the JavaScript client skeleton from the Swagger YAML
  - Code the clients
- Refine and improve the logics of the workshops or management system
- Integration and interoperability with the other workshops