Education in High Tech Services at ENSIAME

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University of Valenciennes and Hainaut-Cambresis

ENSIAME engineer school

AIP – Primeca: Common Resource Centre in Integrated Design, Manufacturing & Automatic Control

ENSIAME

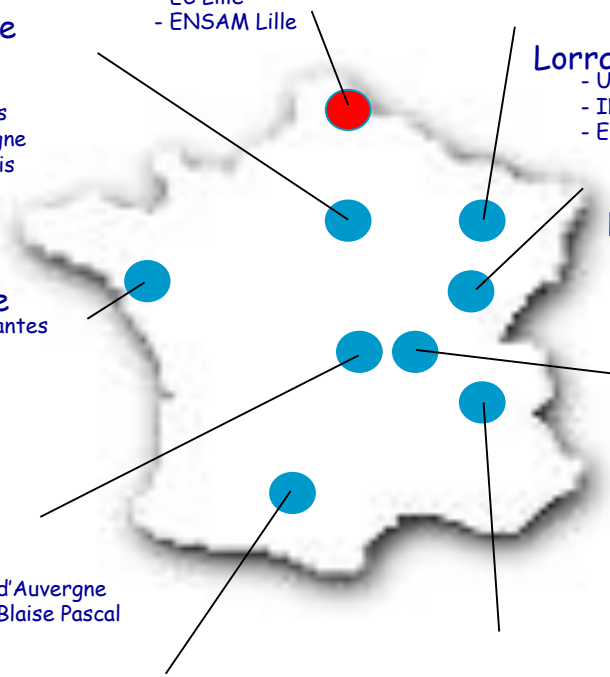
AIP-Priméca Northern Pole

Resource Centre in

Integrated Design, Manufacturing & Automatic Control

aip primeca NORD PAS DE CALAIS

1 of the 9 poles

Nord-Pas-de-Calais
- Université de Valenciennes et du Hainaut Cambrésis
- Université de Lille 1
- EC Lille
- ENSAM Lille

Ile-de-France
- ENS Cachan
- EC Paris
- ENSAM Paris
- UTC Compiègne
- Supmeca Paris

Lorraine
- Université Henri Poincaré-Nancy 1
- INP Lorraine
- ENSAM Metz

Franche-Comté
- ENSMM Besançon
- Université de Franche-Comté
- UTBM Belfort-Montbéliard

Pays de la Loire
- Université de Nantes
- EC Nantes
- ENSAM Angers

Rhône-Alpes Ouest
- INSA Lyon
- EC Lyon
- Université Claude Bernard Lyon 1
- ENI St Etienne
- ECAM Lyon
- École des Mines de St Etienne
- IUT Lumière - Université Lyon 2

Auvergne
- IFMA
- Université d'Auvergne
- Université Blaise Pascal

Toulouse
- Université Paul Sabatier, Toulouse
- INP Toulouse
- INSA Toulouse
- LAAS-CNRS Toulouse

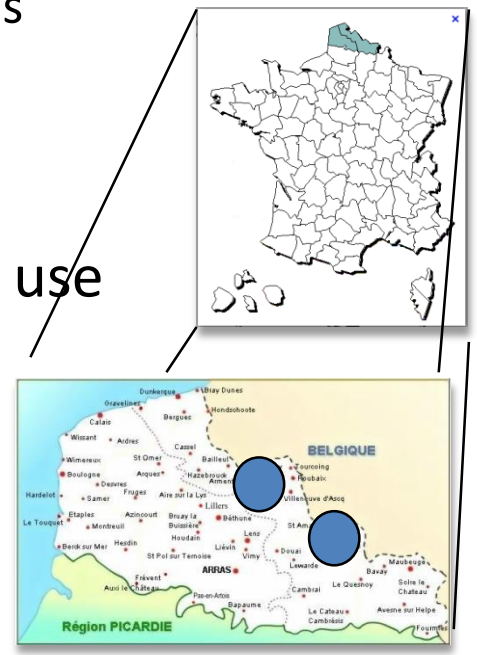
Dauphiné-Savoie
- INP Grenoble
- Université Joseph Fourier
- Université de Savoie

« Northern » POLE



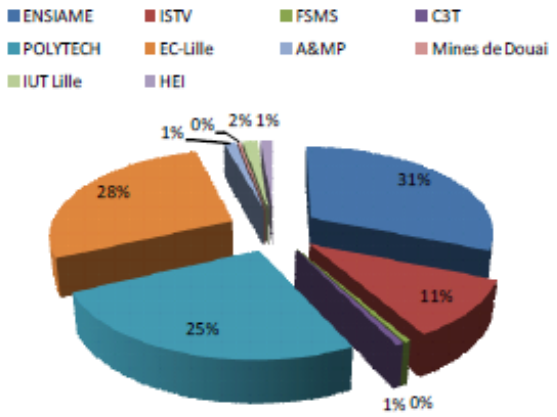

- Cross-organisational Common Service (4 members)
  - UVHC (headquarter) - Centrale Lille
  - University Lille I - A&M Paristech Lille

  2 platforms (resource centres)
  - Valenciennes campus - Lille campus
- Average yearly budget 300 k€
- Contract with Ministry: 2010-14
- Mutual use -> reduced costs & better use
- > 100,000 hours * students / year



Users of the pole

- « users » (Higher Institutes 85 % - University programs 15 %)
  - Levels: Bachelor, Master, Doctorate



- **ENSIAME** Informatics Automatics Mechanics Electronics
- **EC Lille** Generalist + ITEEM + IG2I
- **Polytech'Lille** + **LMD Lille I** Mechanics, Robotics
- **ISTV** Sciences Inst. University Valenciennes
- **HEI** Industrial Engeneering
- **ENSMD** Mines Douai (Ministry of Industry founded)
- **TEMPO-PSI** Research Lab (Production Service Information team)

Lille Platform



- CAD-CAE-CAM resources
  - Software: Catia, NCsimul, ToolSimul, Ansys, Abaqus, Fluent, Virtual Lab, 3D Printer, FDM System, Duplication, Microcasting

Mobile Festo robot float

Automated production resources

- Schneider PLCs, UnityPRO System, robots (**some autonomous**), conveyors, cameras,
- Software: Aphelion (vision), Program Maker (Robotic CAD)
- Research support: real-time tracking - application in surgery (adaptive ray beam focalisation)

Flexible cell:
<- Multi robot env.

Prototyping:
UV Curing D Printer

Valenciennes Platform

- 1000 m2

  within the University

  Institute of Sciences

- 6 thematic rooms
  - CAD, CAM, Control IT, Logistics, Maintenance, Electrical Eng.
- 2 workshop areas (500 m2)
  - Manufacturing (metal working, forming, soldering, measuring…)
  - Automated Production Systems (Montech + Kuka Robots)

Valenciennes Platform

- Equipment
  - IDM: 1 NClathe, 1*5 axis NCmill, 1*4 axes NCmill, 1 3DMM, 1*injection press, 1*press 150 t, 1 * induction soldering, …
  - PS: 3 conveyors, 5 robots, heterogeneous PLCs, supervision systems…
- Software
  - Catia, Delmia, NCSimul, Traceparts, Metrolog, Arena, Cognex, PCVue, Aidiag, E-magim, Kukasim, Ortems, UnityPro, …

For mechanics

For automatic control

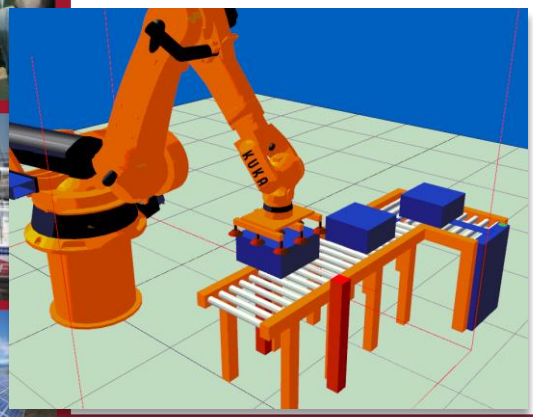
For teamwork

PLM activities

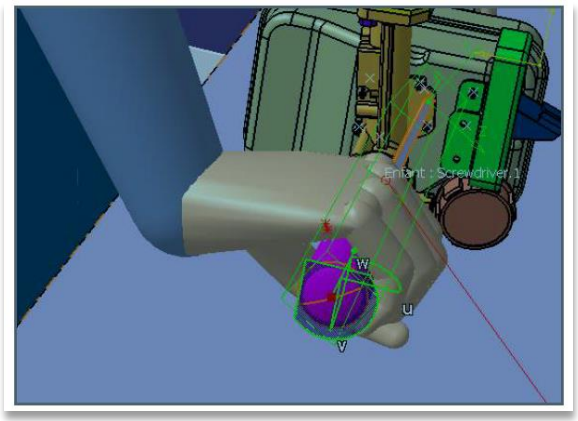
NC machining preparation

Prototyping

Real manufacturing



Manufacturing cell layout

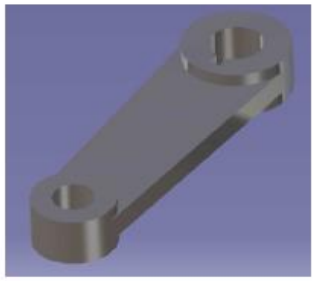
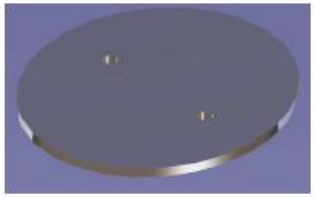
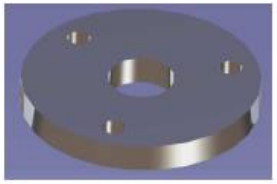


Human tasks validation

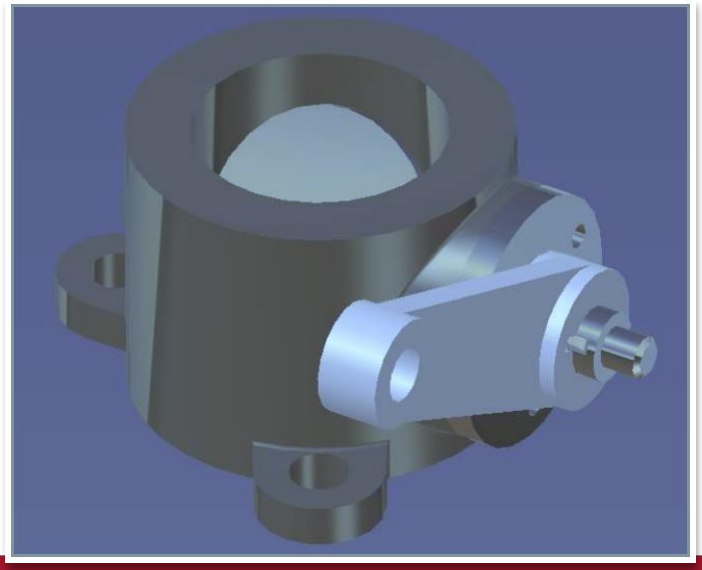
Solid Modeling

Part Design



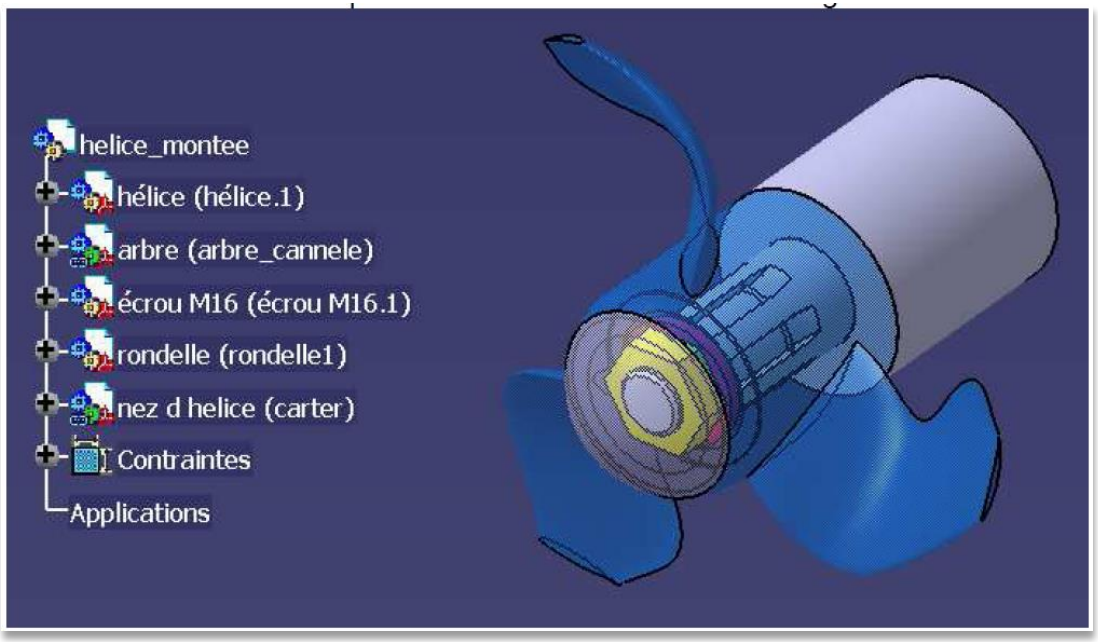
Assembly Design



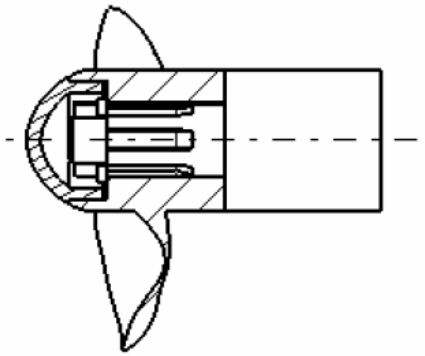
Based on tutorials

Discovery Lab: 3 h

Mechanical design



6 hours



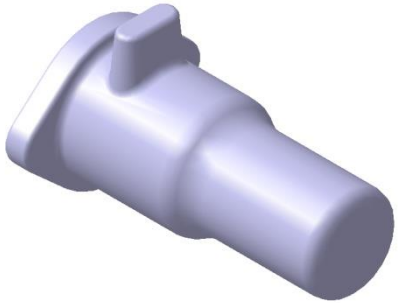
This model is to be controled by a short list of driving parameters (dimensions, number of slots, …). Students must also implement the technology for the joint, taking care of functional gaps and mounting possibilities. They finally design the nose, check the absence of interferences and produce a drawing.

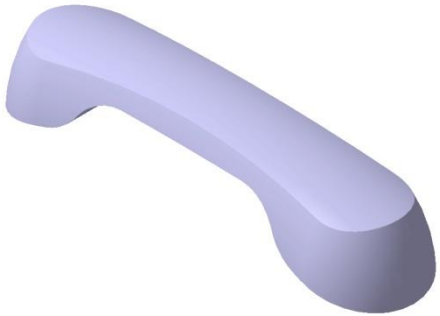
Surface modeling

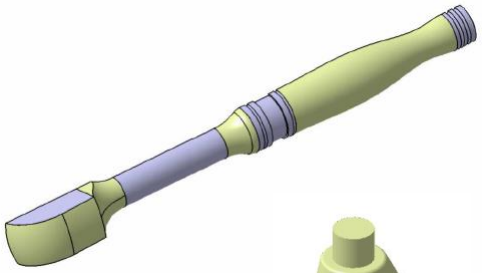
$$S(u,v) = \sum_{i=1}^{k} \sum_{j=1}^{l} R_{i,j}(u,v)\mathbf{P}_{i,j}$$

with

$$R_{i,j}(u,v) = \frac{N_{i,n}(u)N_{j,m}(v)w_{i,j}}{\sum_{p=1}^{k}\sum_{q=1}^{l} N_{p,n}(u)N_{q,m}(v)w_{p,q}}$$



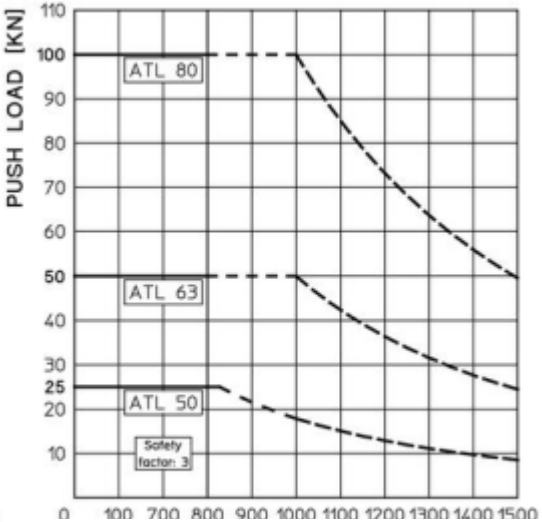




6 hours labs

Knowledge Based Engineering

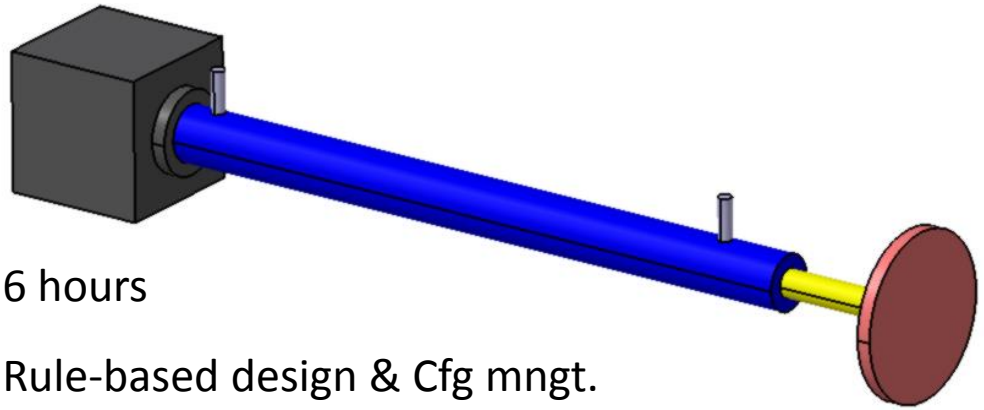


Editeur de règle : Règle.2 Active

Ligne :

```
/*Règle créé(e) par DD1_6 20/02/2012*/

if (Charge <= 25kN and Stroke <= 820mm)
{
        Corps = 600mm
}
else if (Charge <= 50kN and Stroke <= 1000mm)
{
        Corps = 730mm
}
else if (Charge <= 100kN and Stroke <= 1000mm)
{
        Corps = 900mm
}

else if (Stroke > 1000mm or Charge > 100kN)
{
        Message("Aucun type de verin adapté")
}
```



6 hours

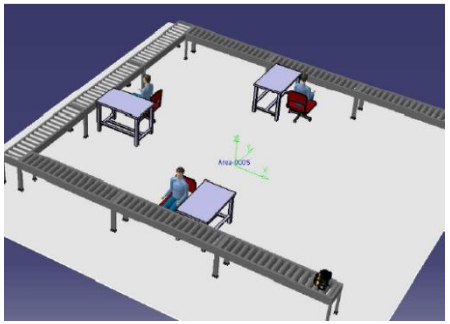
Rule-based design & Cfg mngt.

Editeur de règle : Règle.1 Active

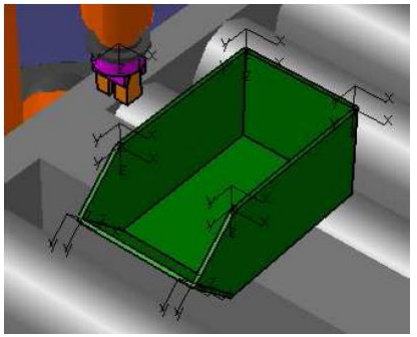
```
/*Règle créé(e) par DD1_6 17/02/2012*/

if (Embout == "BA")
{
        `Corps principal\BA\Activité` = true
        `Corps principal\TF\Activité` = false
        `Corps principal\TS\Activité` = false
        `Corps principal\FL\Activité` = false
}
else if (Embout == "TF")
{
        `Corps principal\BA\Activité` = false
        `Corps principal\TF\Activité` = true
        `Corps principal\TS\Activité` = false
        `Corps principal\FL\Activité` = false
}
else if (Embout == "TS")
{
        `Corps principal\BA\Activité` = false
        `Corps principal\TF\Activité` = false
        `Corps principal\TS\Activité` = true
        `Corps principal\FL\Activité` = false
}
else if (Embout == "FL")
{
        `Corps principal\BA\Activité` = false
        `Corps principal\TF\Activité` = false
        `Corps principal\TS\Activité` = false
        `Corps principal\FL\Activité` = true
}
else if (Embout == "AUCUN")
{
        `Corps principal\BA\Activité` = false
        `Corps principal\TF\Activité` = false
        `Corps principal\TS\Activité` = false
        `Corps principal\FL\Activité` = false
}
```

Digital Factory

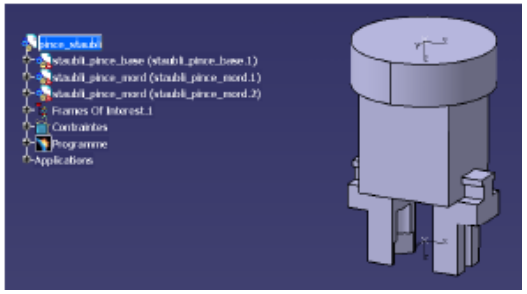
(Dis-)Assembly process modeling



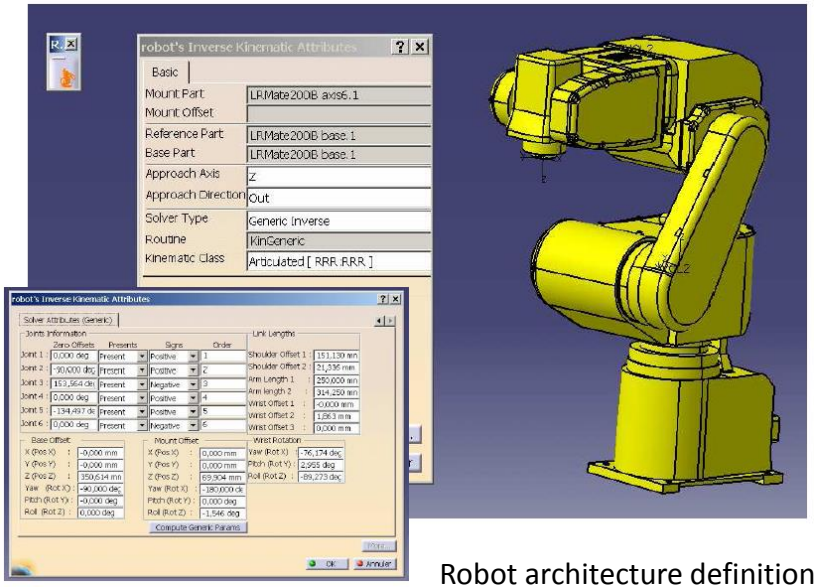
Flow simulation



Robot task simulation



Controled device definition



Robot architecture definition

Human tasks analysis

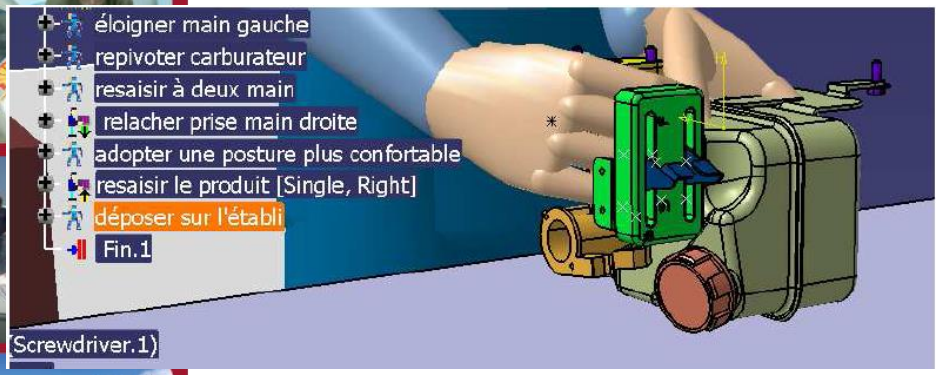
RULA Details Sun Nov 29 16:12:25 2009 [4b128f59]	Manikin2 Report3	Global Score	3	Investigate further
		Upper Arm Score	3	
		ForeArm Score	2	
		Wrist Score	1	
		Wrist Twist Score	1	
		Posture A Score	3	
		Muscle Score	1	
		Force Load Score	0	
		Wrist And Arm Score	4	
		Neck Score	1	
		Trunk Score	1	
		Leg Score	1	
		Posture B Score	1	
		Neck Trunk And Leg Score	2	

(RULA) scoring

Carry Sun Nov 29 16:24:24 2009 [4b129228]	Manikin2 Report5	Maximum acceptable weight (N)	186,83

PUSH-PULL Sun Nov 29 16:24:24 2009 [4b129228]	Manikin2 Report6	Max. initial force for push (N)	324,61
		Max. initial force for pull (N)	0,00
		Max. sustained force for push (N)	172,53
		Max. sustained force for pull (N)	0,00

Carry & Push-pull analysis

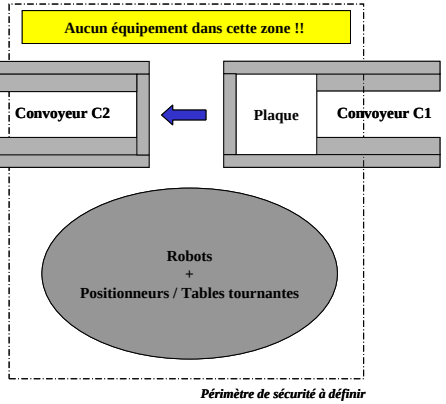


Human task definition

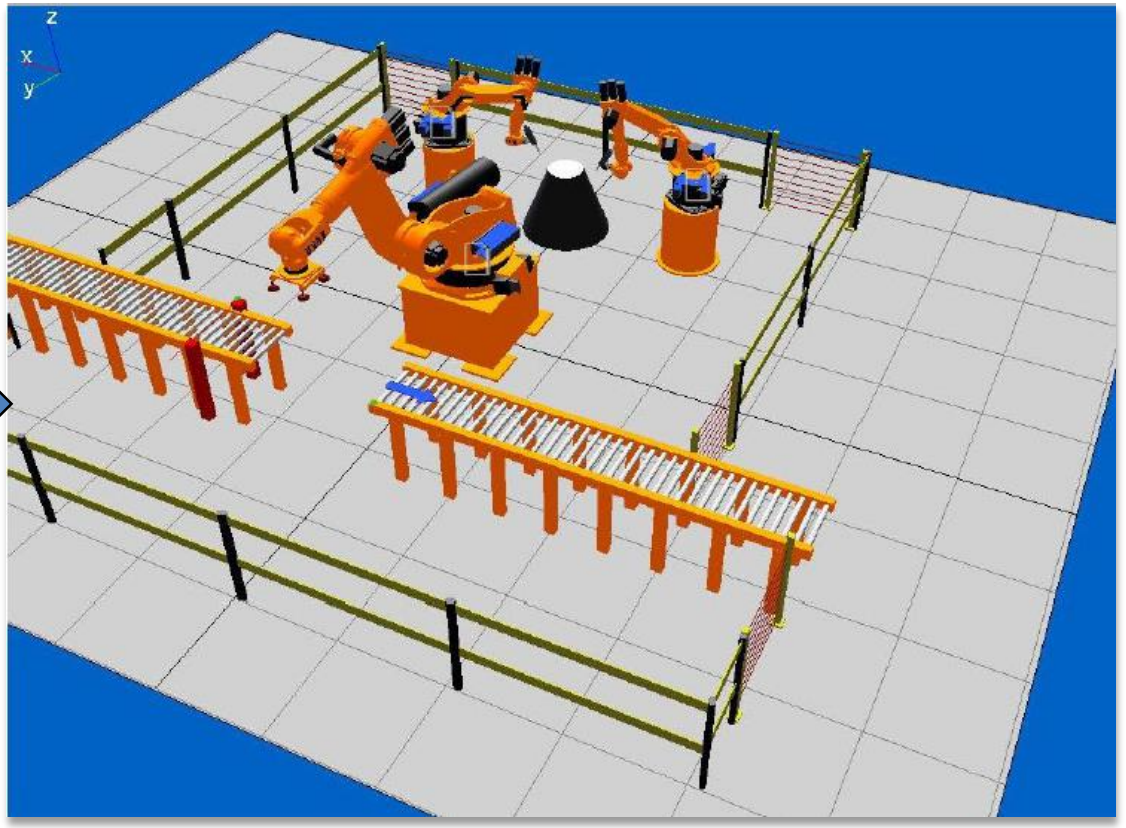
Human task simulation

Flexible cell layout design

Specifications

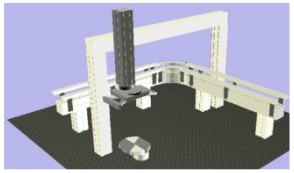


Acceptable layout



Automated Production Control

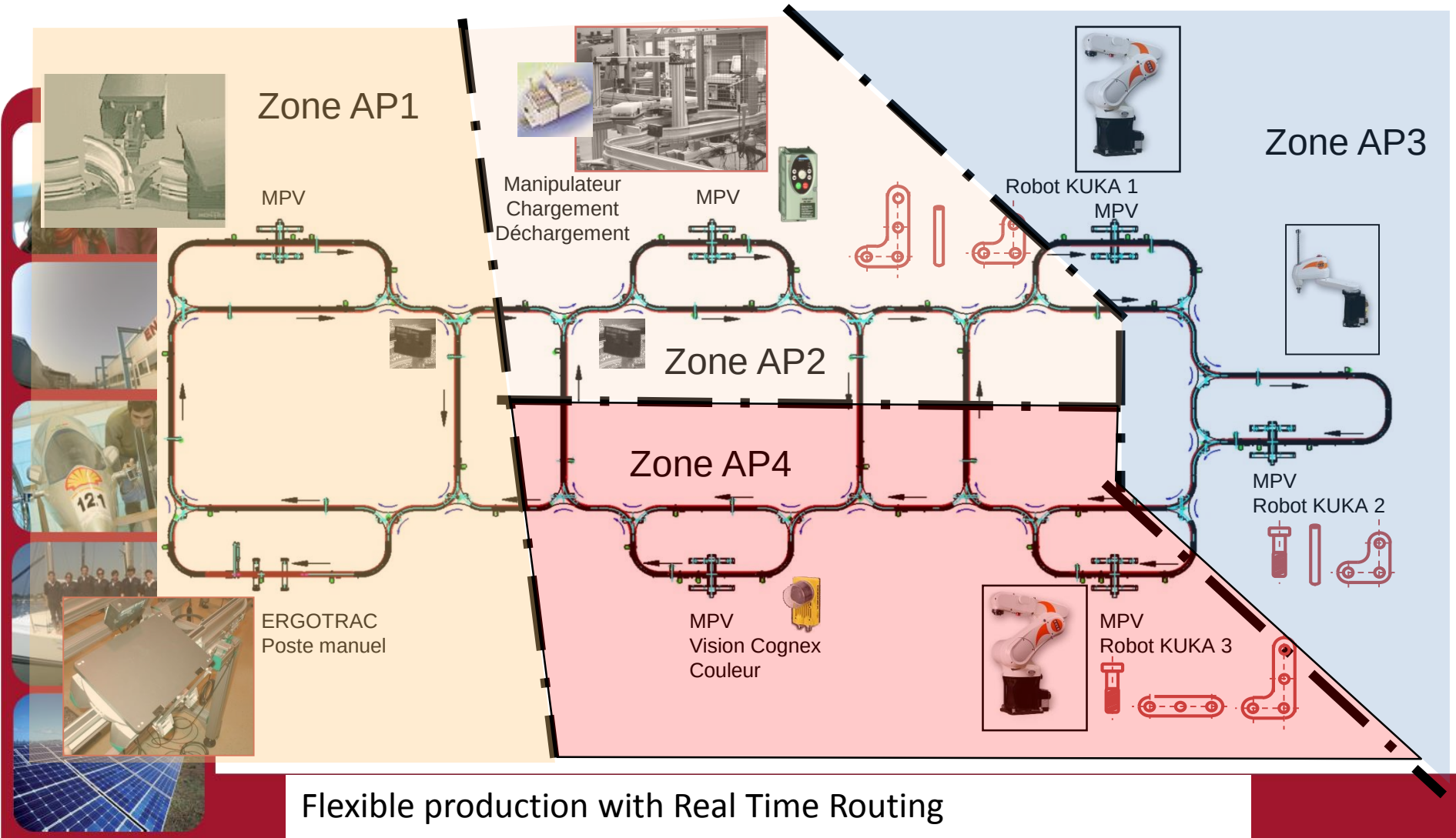
Real production



This cell produces nothing.
Products and resources are virtual.
Students establish communications among heterogeneous equipments.

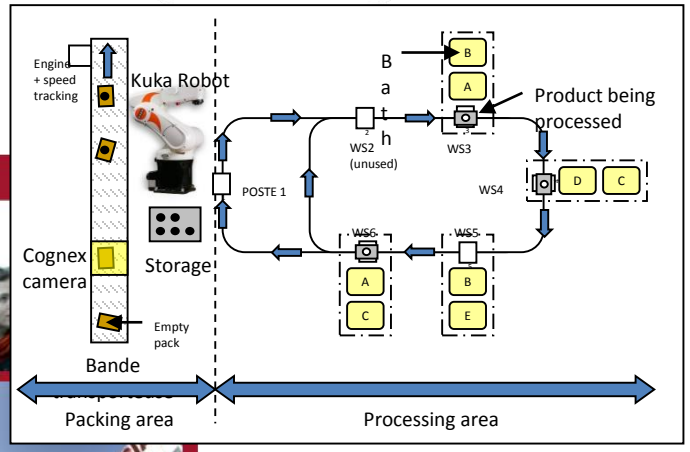
This cell produces assembly configurations.
Student groups are competing for reaching optimized production performance (time / quality)

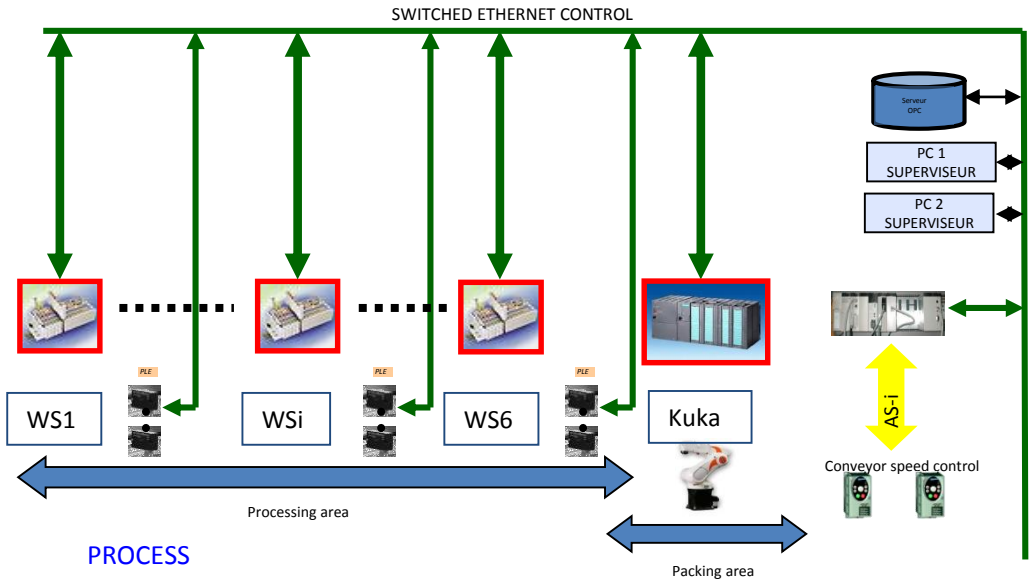
Industrial Engeneering

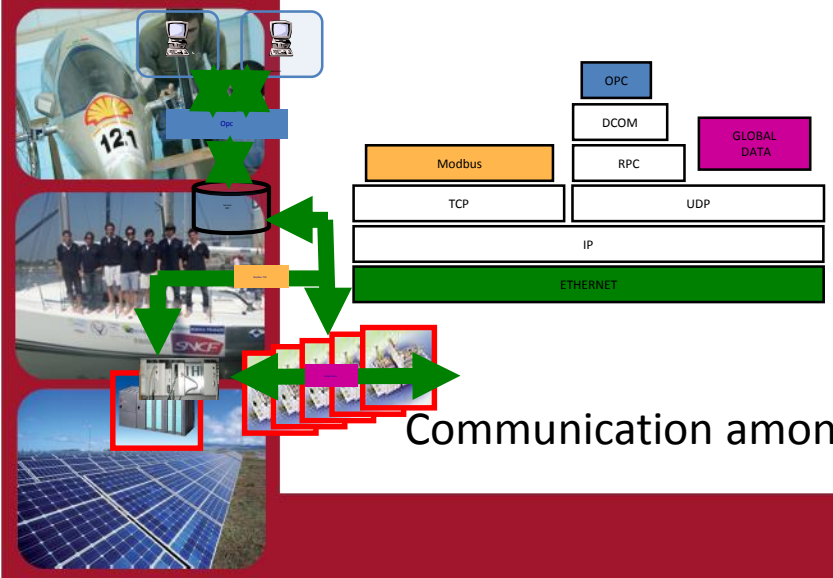


Flexible production with Real Time Routing

Electrical & IT Eng.

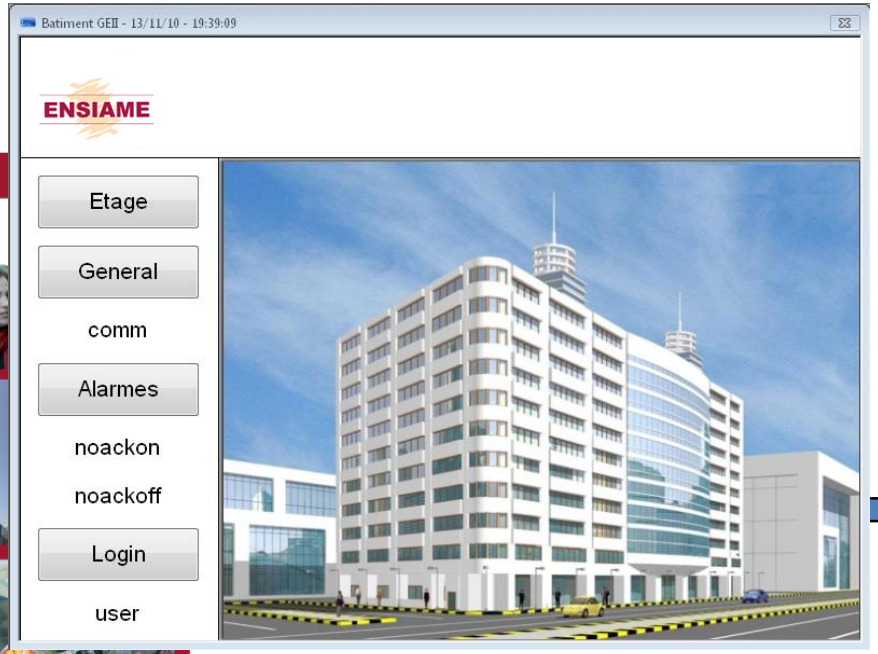




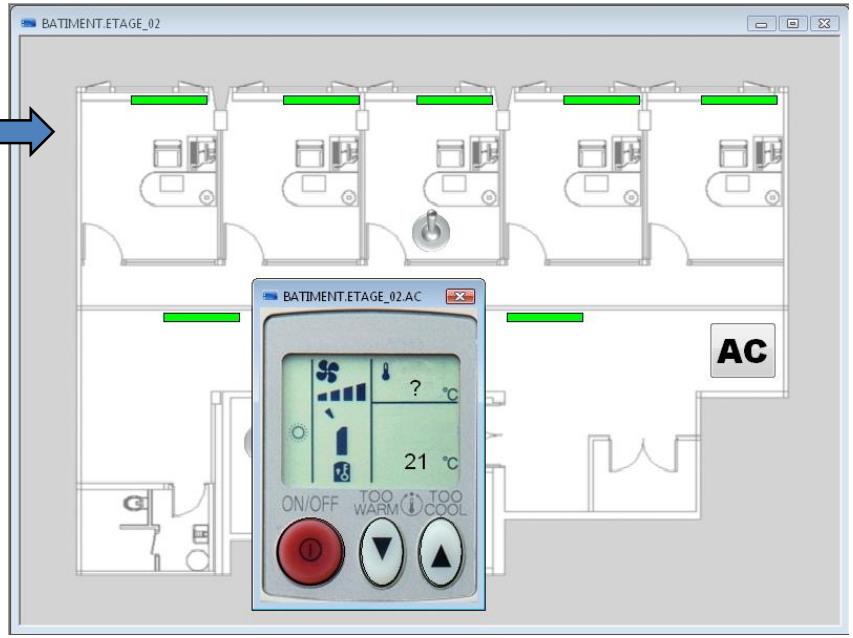


Communication among heterogeneous control systems

Supervision

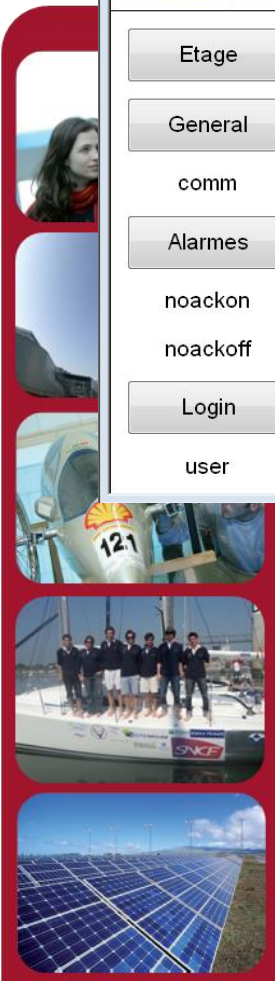


HMI – Scada
&
Manufacturing Execution Systems
(supervision profiles, data collection, recipe, resource management, maintenance, alarm & events, history and traceability,…)



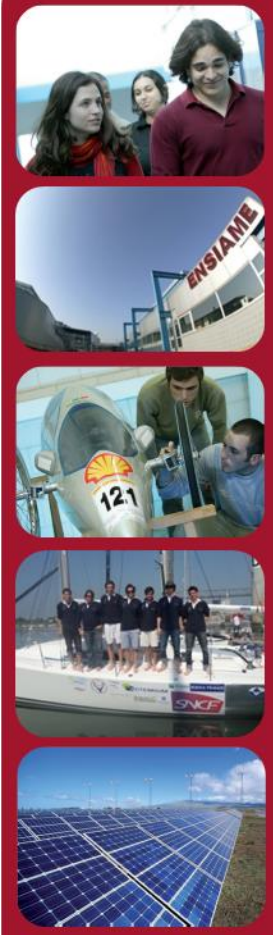
Example:

AC & Lighting control in
« intelligent » buildings



Research support

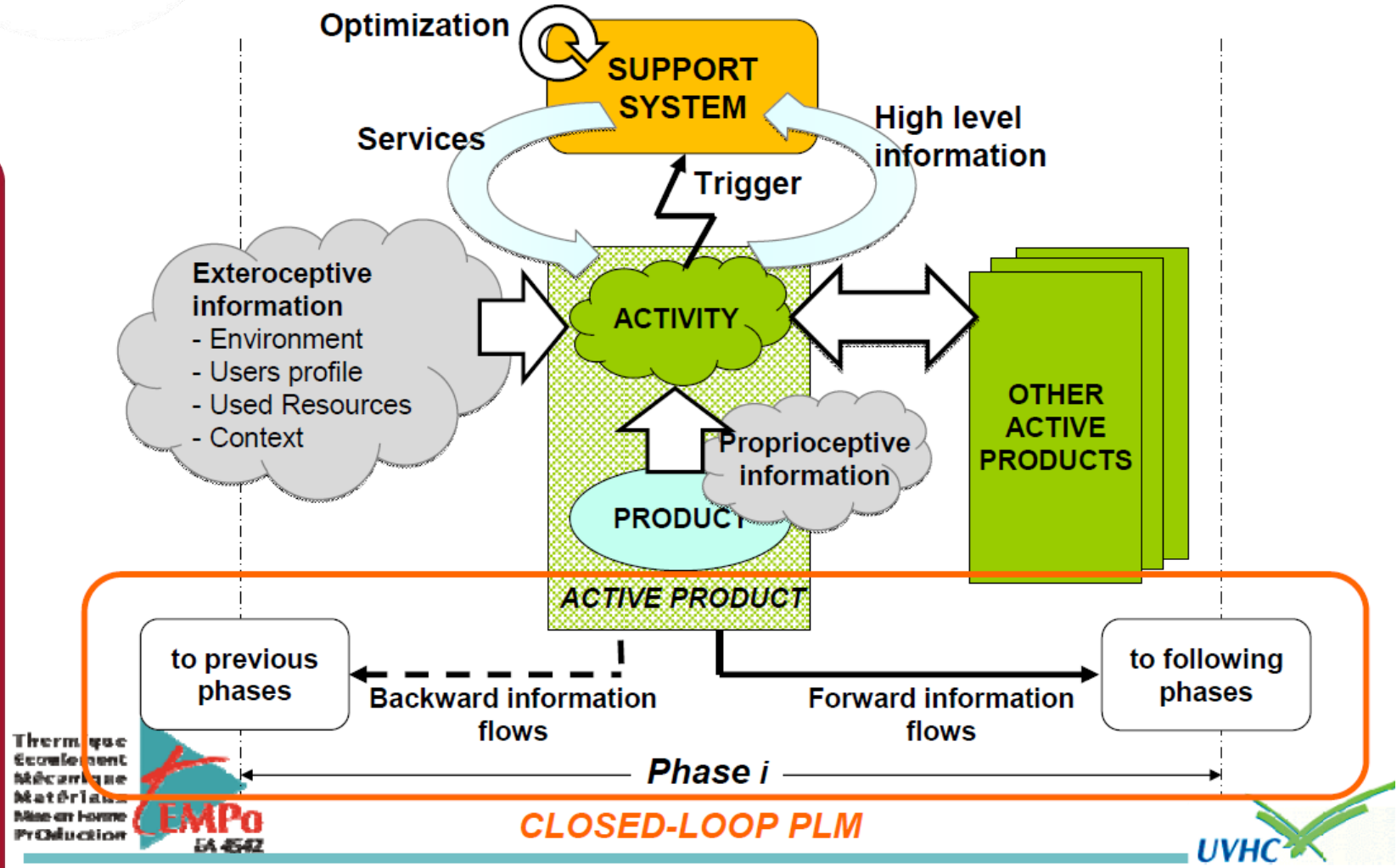
- TEMPO-PSI team
- Concept of active product (vs passive product)
- Active products ?
  - At use time (familiar) : machine claims for descaling, car claims for oil change, …
  - At manufacturing time : (under experiment) product skeletton may request component, configuration, resource (routing variant), test…
  - At design time (prospective work): product digital mock-up may request evaluation, dimensioning, optimizing, validation, conversion, adaptation, …
- Passive products can be « augmented » to become decision makers, during various phases of their own lifecycle.



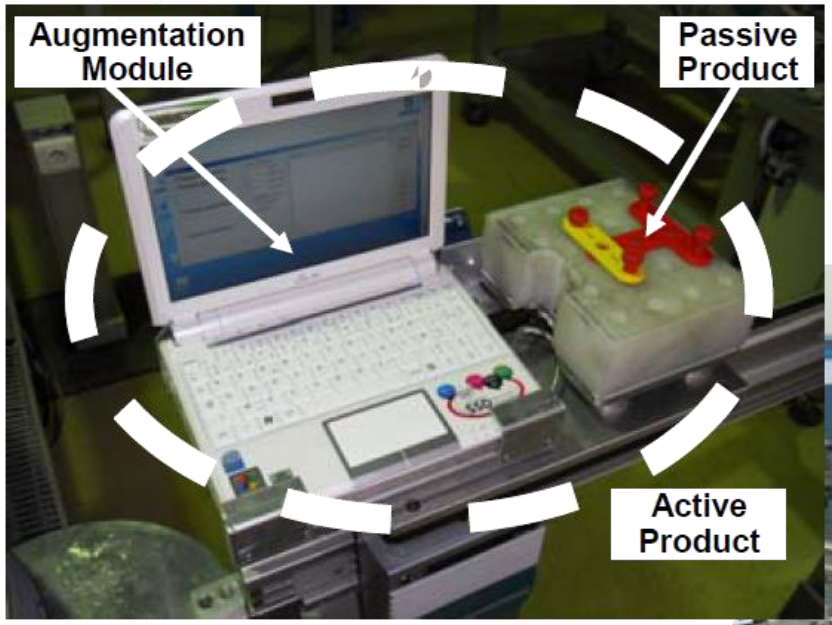
Notion of « Activeness »







"Active" Product implementation



EEEPC

Thermique Ecoulement Mécanique Matériaux Mise en forme Production EMPo EA 4542

UVHC

Intra and Inter-poles communication



Regional Pôle: local events (50 to 100 participants)

Once a yeay: Advisory Committee (Oct). – Executive Committee (Dec.)

Thematic days (each pole organizes 1 or 2 every year)

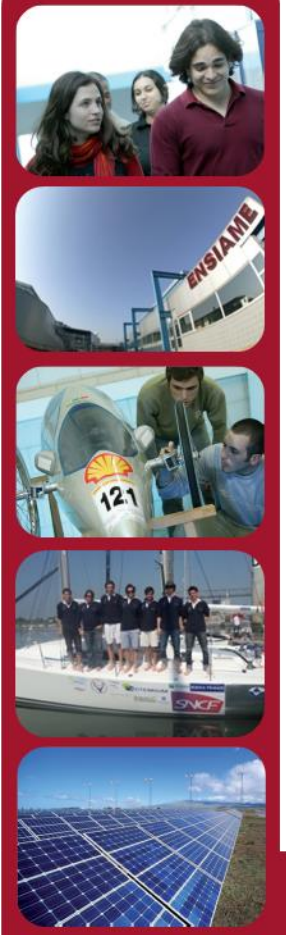
Northern pole: 2011 (prototyping), 2010 (mechatronics), 2009 (CAD-CAE loops)

National Network: (200 to 300 participants)

Prev. 27-30 march 2012 : AIP PRIMECA National Colloquium – Le Mont-Dore
4 research communications from Nord Pas de Calais Pole

Next. IDMME (International Congress) Toulouse , oct. 2013

Conclusion



- A resource centre connected to a national network
- Practical situations of engineering
  - Training on realistic equipment / software
  - Team based labs
  - Also a support for research experiments
- The strenght of a network
  - 400 teachers exchanging and sharing experiences
  - Avg 90.000 student.hour / year in NPdC
  - Nearly 1.5 million student.hour / year in France (2011-12)
- International Relations (Asia, America, North Afr.)