PLM of the future: what place for humans in the digital transformation of companies?

Prof. Dr Eng Frédéric SEGONDS
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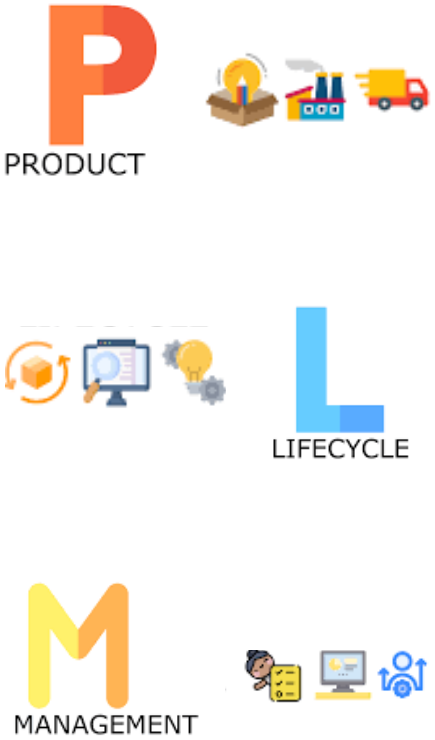

Arts et Métiers Sciences et Technologies

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Arts et Métiers Institute of Technology

Who we are

12
SITES
located all over France dedicated to Teaching & Research

331
PhD STUDENTS
at our Doctoral School "Sciences des Métiers de l'Ingénieur"

1
BACHELOR OF TECHNOLOGY

6000
STUDENTS
all programs included

15
LABORATORIES
and research teams

11
ENGINEERING PROGRAMS
1 broad-based 10 specialized

1110
PERSONNEL
Teachers, Technicians & Administrative Staff

7 MILLIONS
income

+20
RESEARCH MASTERS

15 MILLION
income generated by industry contracts

2000
CONTINUING EDUCATION
auditors

17
EXECUTIVE MASTER PROGRAMS

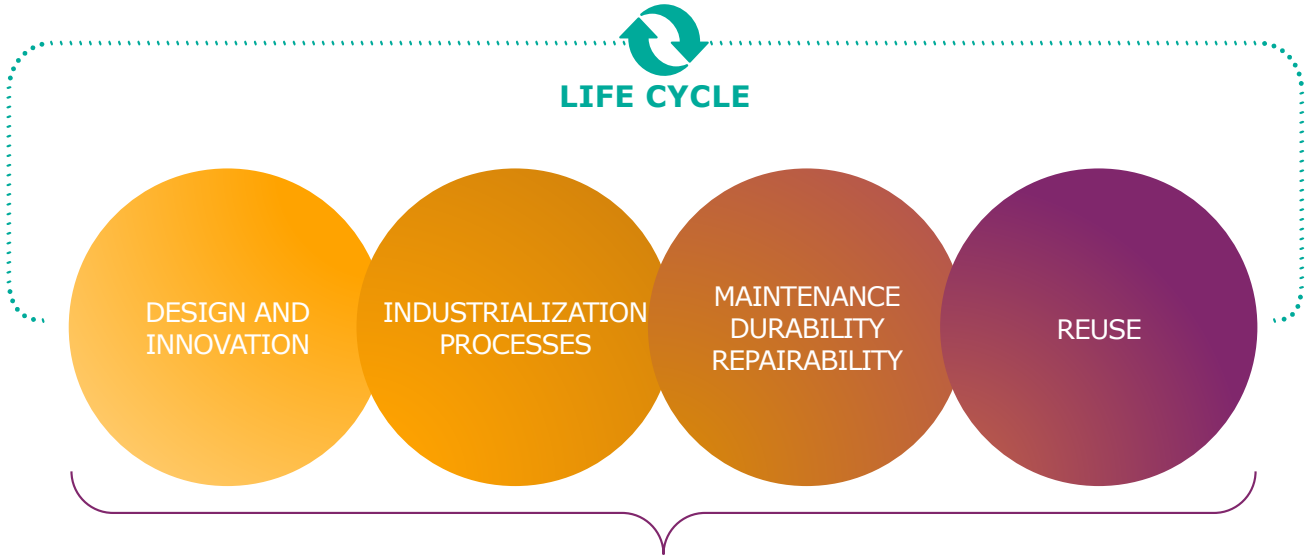
1780
Founded by the Duke Of Rochefoucault-Liancourt

Arts & Métiers ALUMNI

With more than 36 000 alumni registered

Arts Sciences et Technologies et Métiers

Our specialty: research on the full product life cycle from design to reuse, through every intermediate stage



Environmental and societal impact approach

Development of groundbreaking digital tools with real world applications

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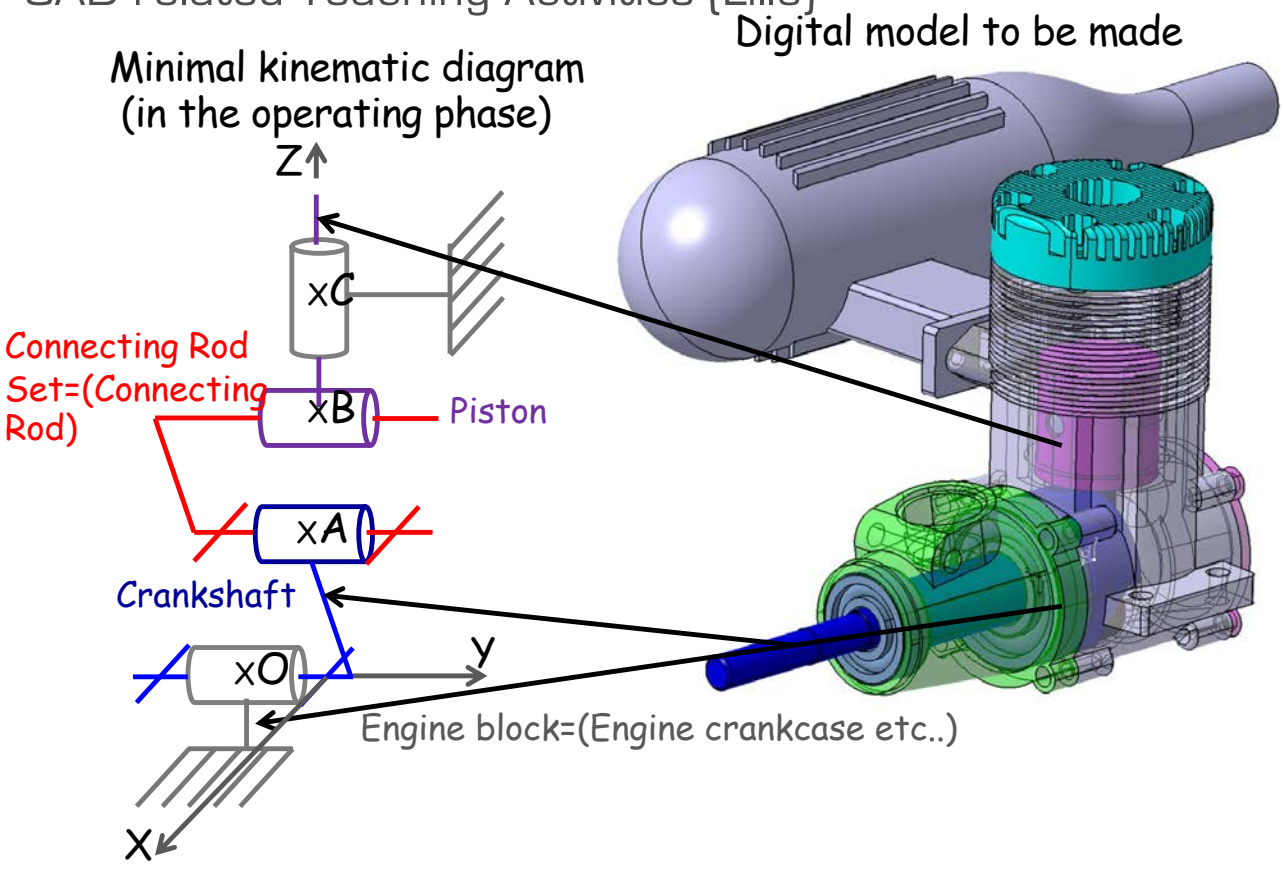
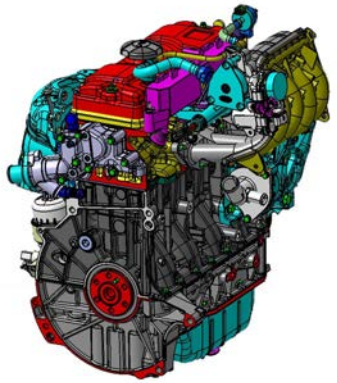
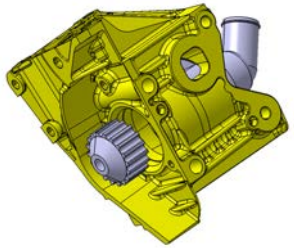
CAD related Teaching Activities (Lille)



1rst year : Design: One Engine Water Pump for Automobile
Choice of bearings, shaft design, cover, implementation of dynamic sealing





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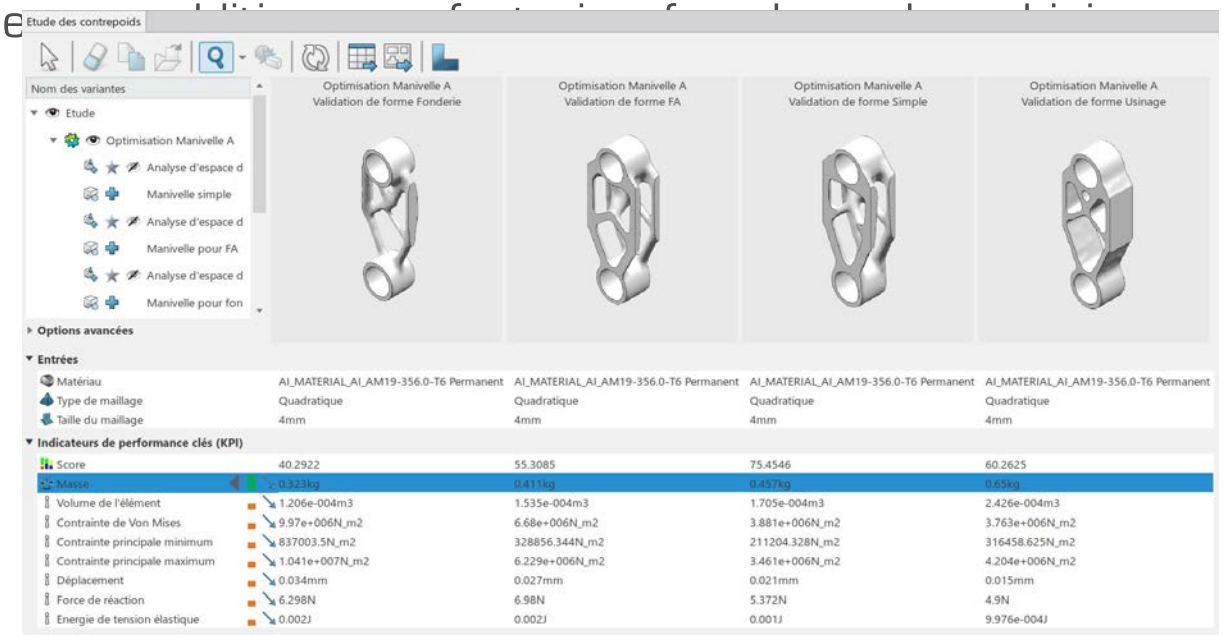
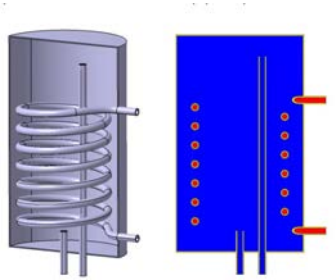
Teaching Activities (Bordeaux)

The goal is to optimize the crank in order to obtain the lightest possible crank. To do this, students select the most suitable material and optimize the geometry according to three proce

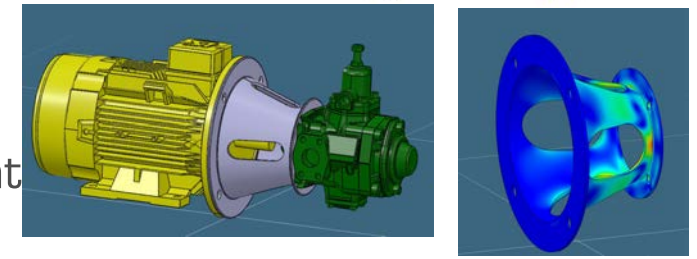


Related Teaching Activities (Lille&Paris)

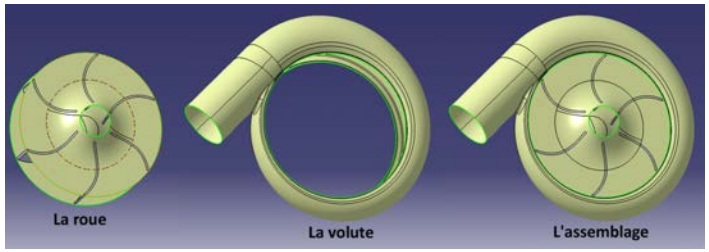
1st year project : Design of an exchanger, the thermal simulation is done c CCM+



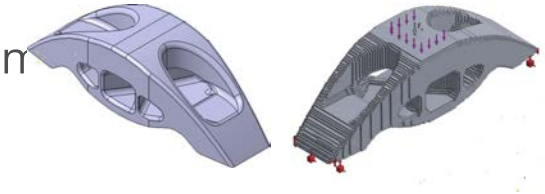
2nd year project : Design of an interface part + Finite Element



2nd year project : pump design



3rd year project : topological optim



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Arts et Métiers Institute of Technology

Specialized Master's Degree "Digital Transformation Manager of Industries ar Construction"

CONFÉRENCE DES GRANDES ÉCOLES

A 12-month work-study program

ACADEMIC SEQUENCE: 2 weeks per month

Approx. 400 hours of courses structured in 5 modulesrelated to Digital Transformation, PLM, BIM etc..., Teaching by specialists in the industrial environment among our partners and by teachers from Arts et Métiers,

INDUSTRIAL SEQUENCE: 2 weeks per month+ 4 months full time

Mission in a company managed in project mode in dual supervision (academic / industrial),

Some references

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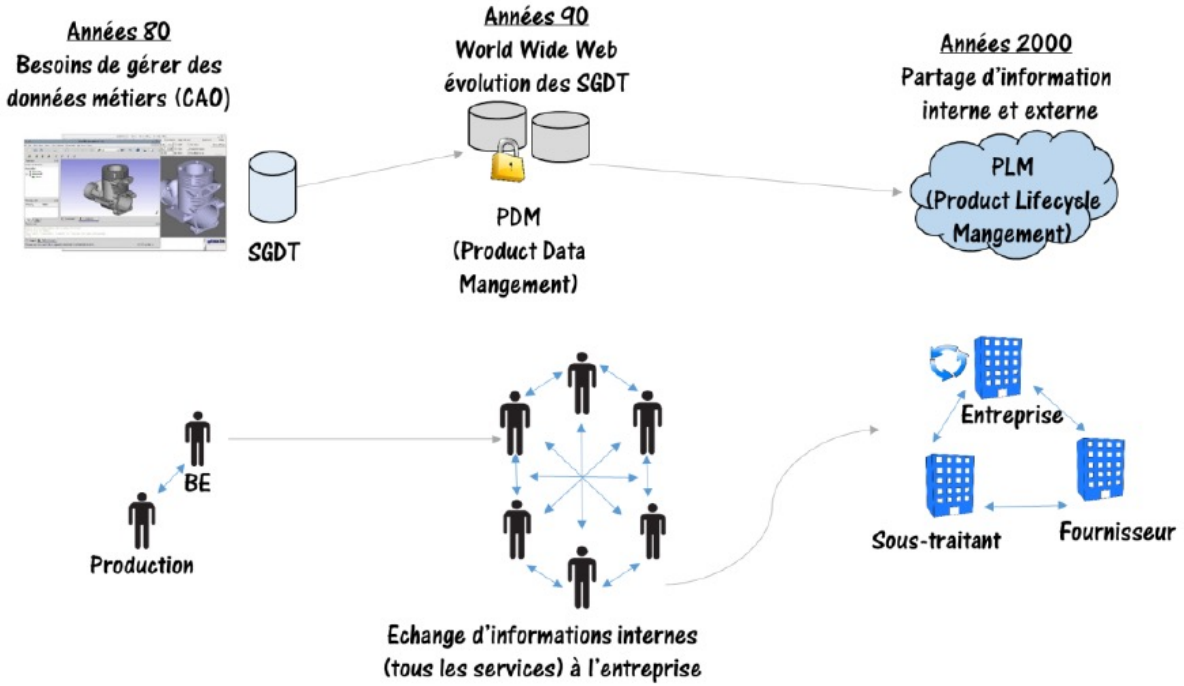
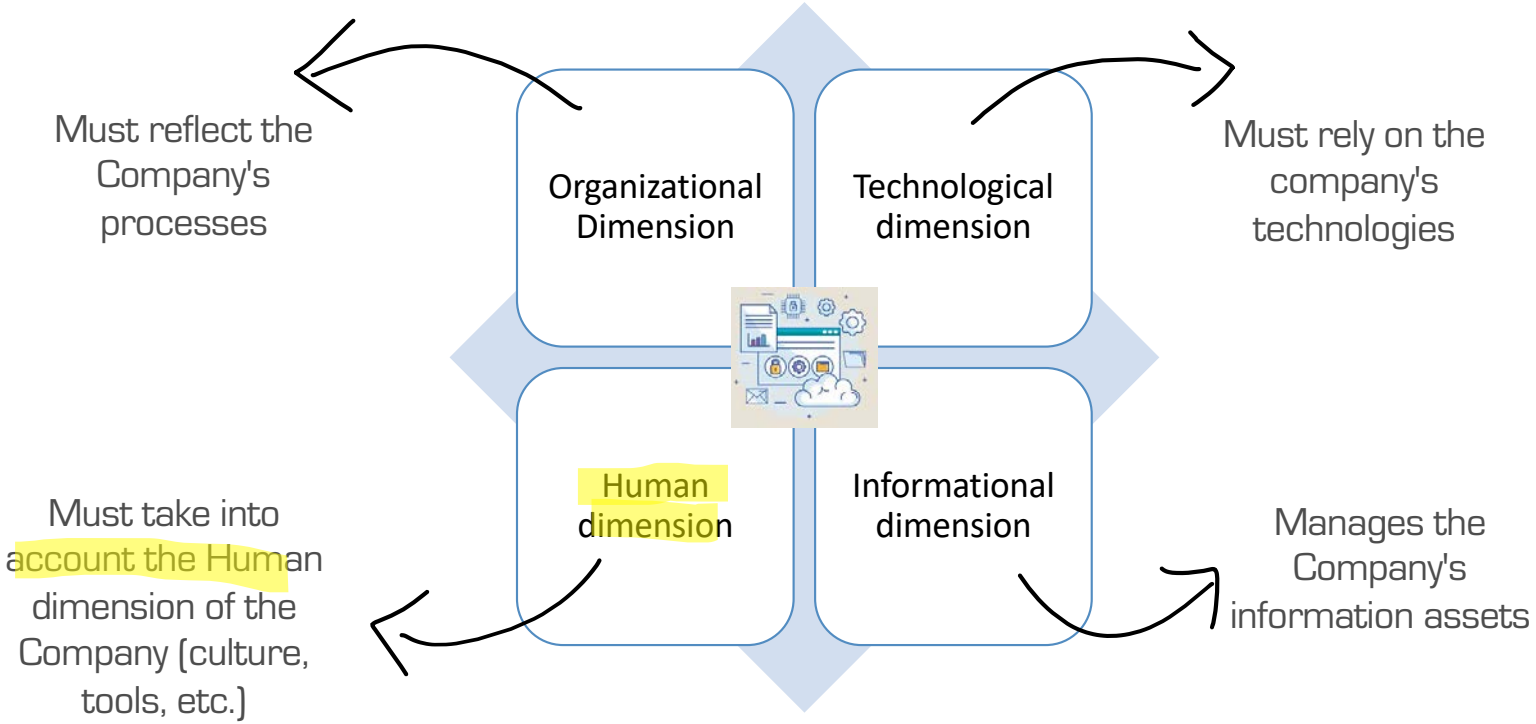
From the individual to the collective



The 3 main phases of the origin of PLM [Yildiz, 2015]

PLM as a method and support tool for a company's Information System



The 4 dimensions of Enterprise PLM

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The Risks of PLM Project Failure

Table 1
Risk factors identified for implementation of PLM systems.

	Dimension	Factors	Description of Risk Factors for PLM systems implementation
1	Human-related risks	Ignored cultural changes	• Underestimating the need of cultural change • Lack of collaborative environment • Lack of communication • Lack of management support
2		Lack of user acceptance	• Lack of user participation • Change-resistant user • Improper user understanding of technology and its use
3		Lack of technological skills	• User learning and technical skills • User may need additional hands-on training to proceed their working
4	Process-related risks	Lack of technology-process alignment	• Mismatch of process requirements of PLM • Lack of PLM technology alignment with an organization's process
5		Improper data migration	• Underestimating the data consolidation challenge from various other information systems such as from CAD, CAM, etc. to PLM
6		Inadequate resources estimation	• Poor anticipation of budget needed to deliver the full PLM implementation • Compelled executives from the software suppliers/internal management team
7		Lack of technology-business alignment	• Mismatch between the systems' requirements & the organization's business strategy
8		Inappropriate choice of PLM system	• PLM systems evaluation and selection for implementation
9	Technology-related risks	Lack of infrastructure	• Lack of adequate technology infrastructure
10		Lack of systems integration	• Lack of integration among other enterprise systems such as ERP, CAD, CAM, etc.
11		Mismatch in required data formats	• Alterations in data format during migration
12		Threat to data security	• Misuse of product-related data • Unauthorized changes in the product designs/processes

[Singh et al.,2020]

Digital adoption platforms (DAPs) are software that integrates with business applications to help users master the application.

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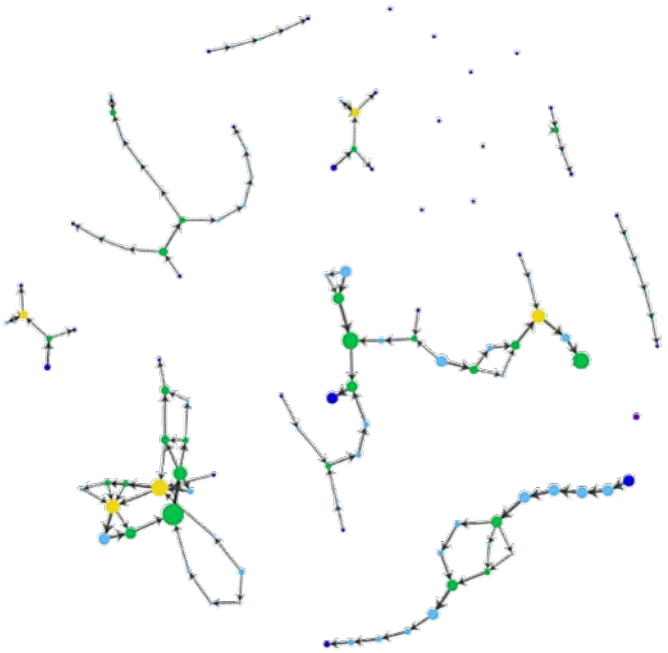
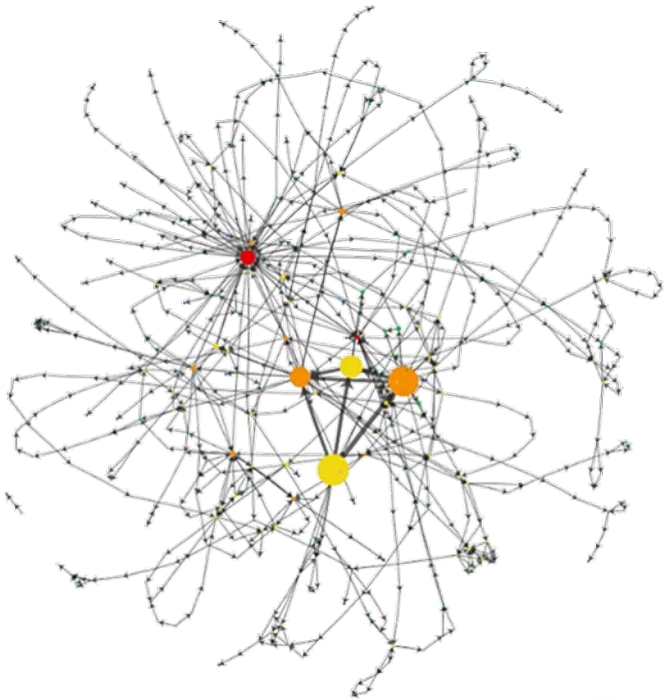
Tooled process graphs

Path processes through application objects

Banking application project



PLM Project



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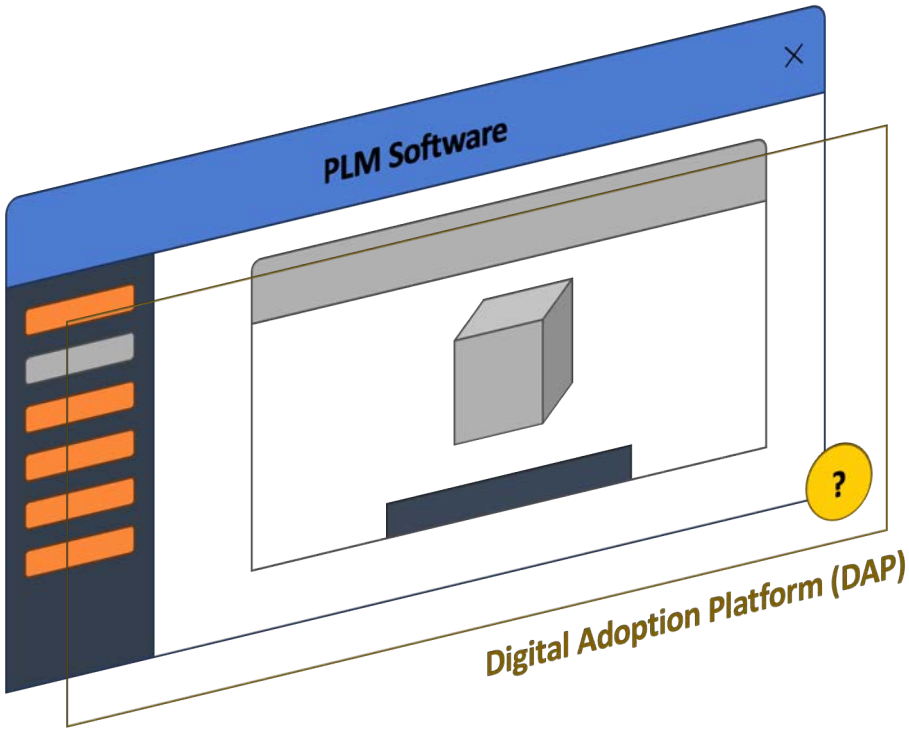
Guide users to facilitate digital transformation

The role of Digital Adoption Platforms



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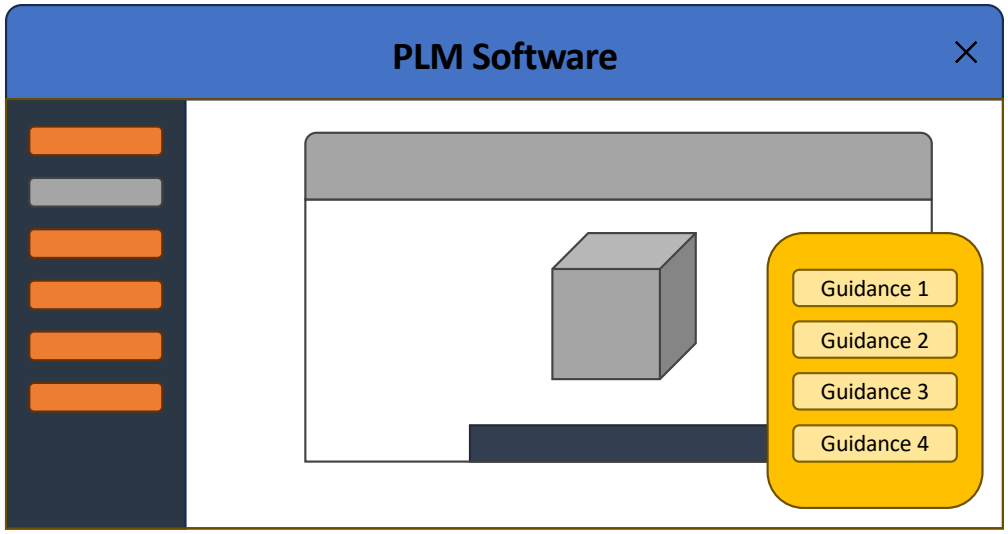
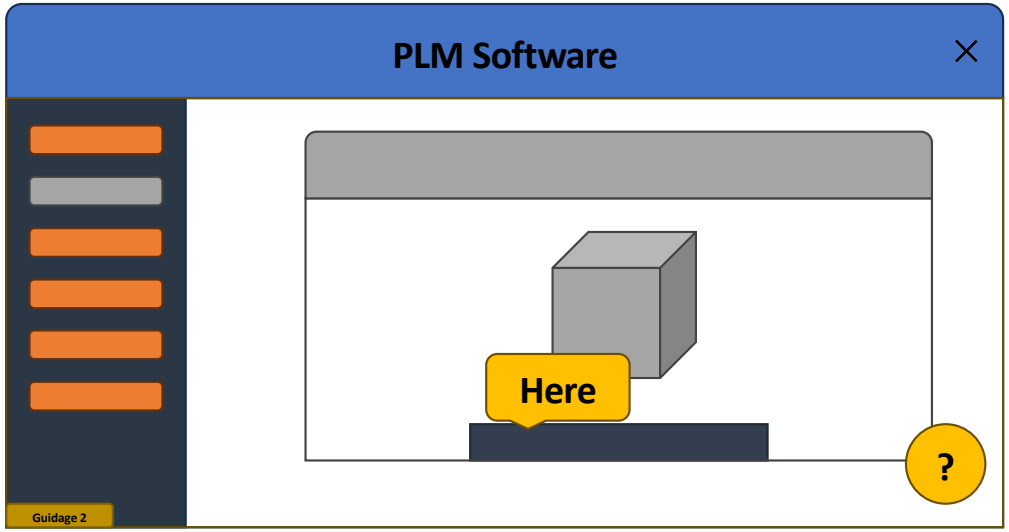
Guide users to facilitate digital transformation

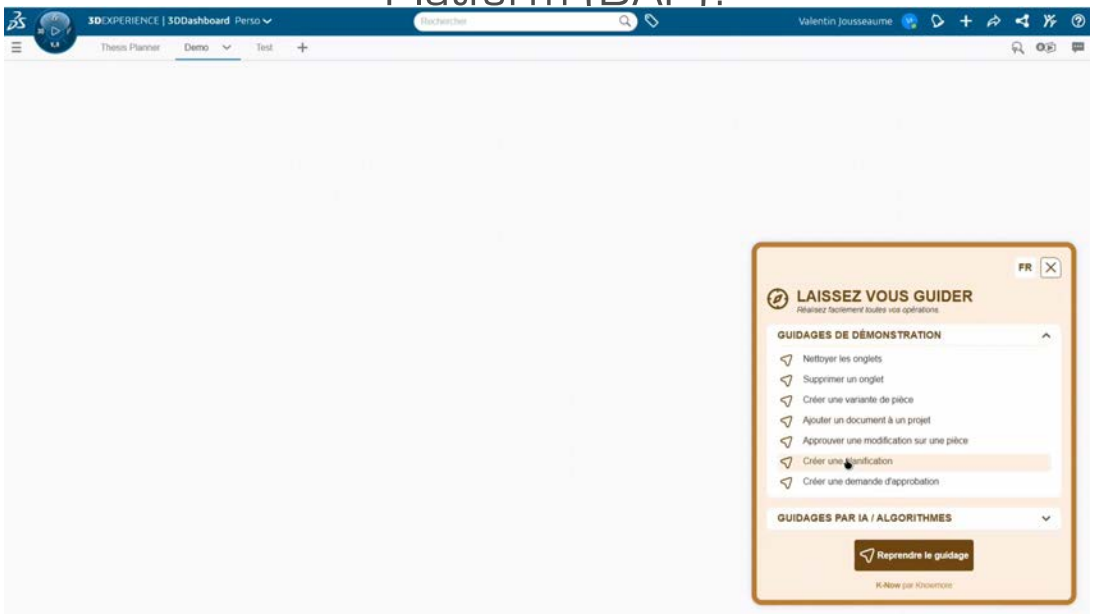


Digital Adoption Platform (DAP)



Guide users to facilitate digital transformation

How to improve users' business practice in a Product Lifecycle Management (PLM) framework using a Digital Adoption Platform (DAP)?



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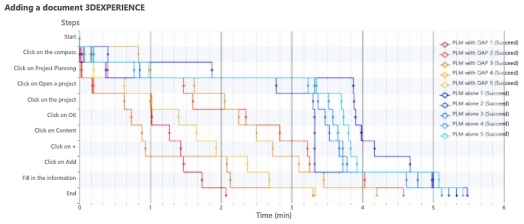
Experience on the usability of the PLM tool with/without DAP

5 Tasks
[Skovholt & Svennevig, 2006; Stark, 2020; Wasiak et al, 2010]

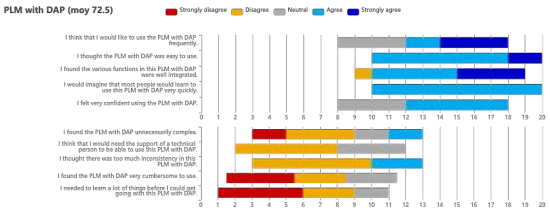
- Approve a change
- Add a document
- Create a new variant
- Create a schedule
- Create an approval request

Validations



Timelines

Quality of the task performed



System Usability Scale

Semi-structured interviews

Statistics

Kolmogorov-Smirnov test (distribution)
Student's test (difference)
Mann-Whitney test (rank)

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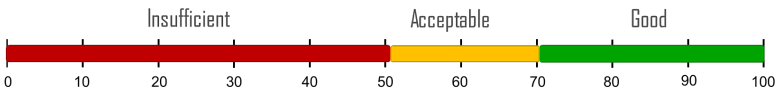
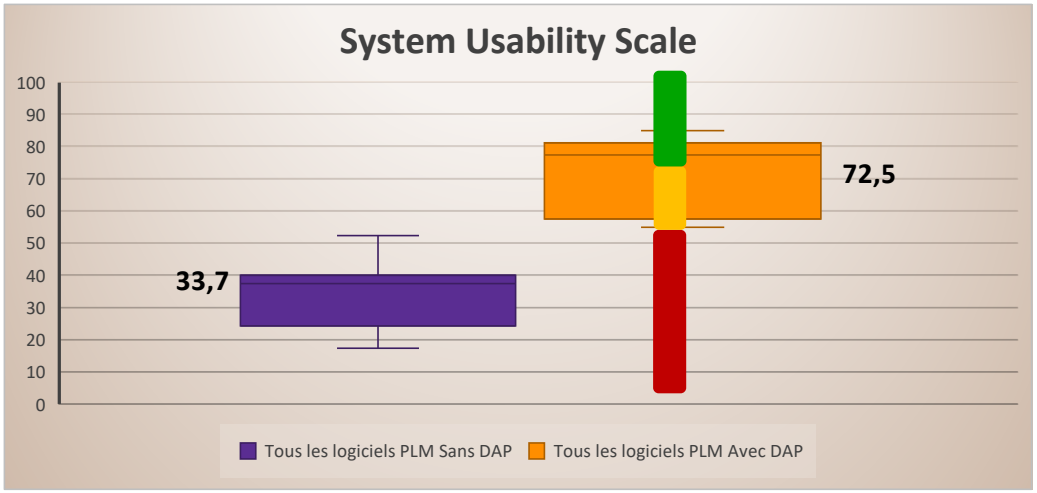
Insights on Usability

System Usability Scale [Brook, 1986]

I think I will use this service frequently
I find this service unnecessarily complex
I think this service is easy to use
I think I'll need the help of a technician to be able to use this service
I need to learn a lot before I can use this service…





DAP significantly improves the usability of PLM tools

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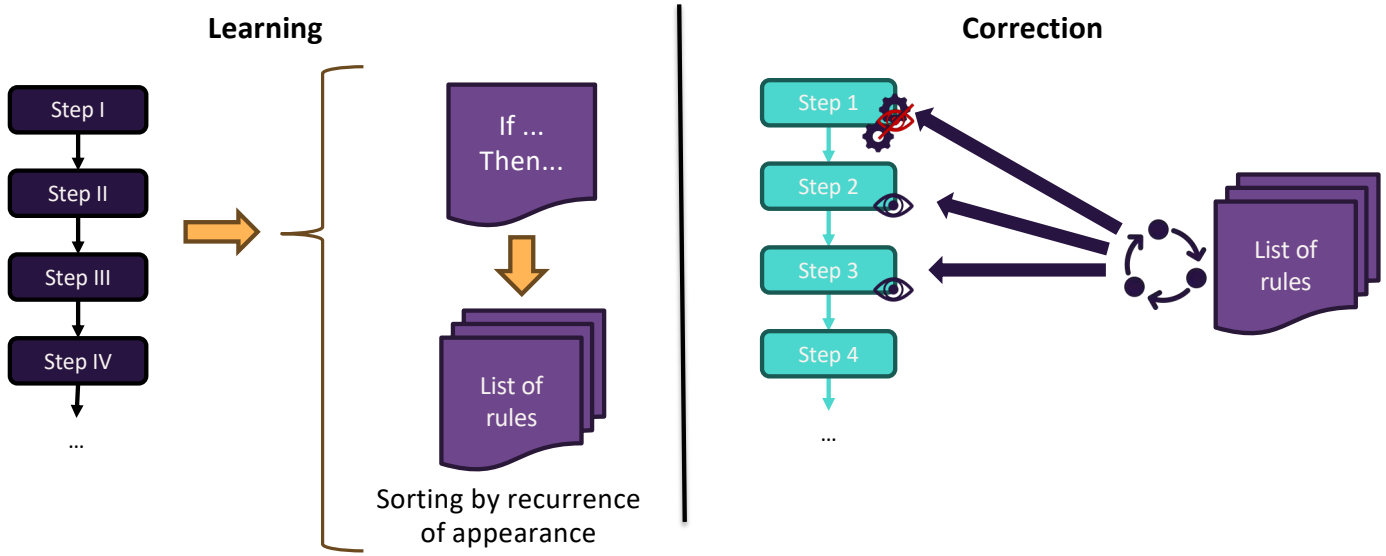
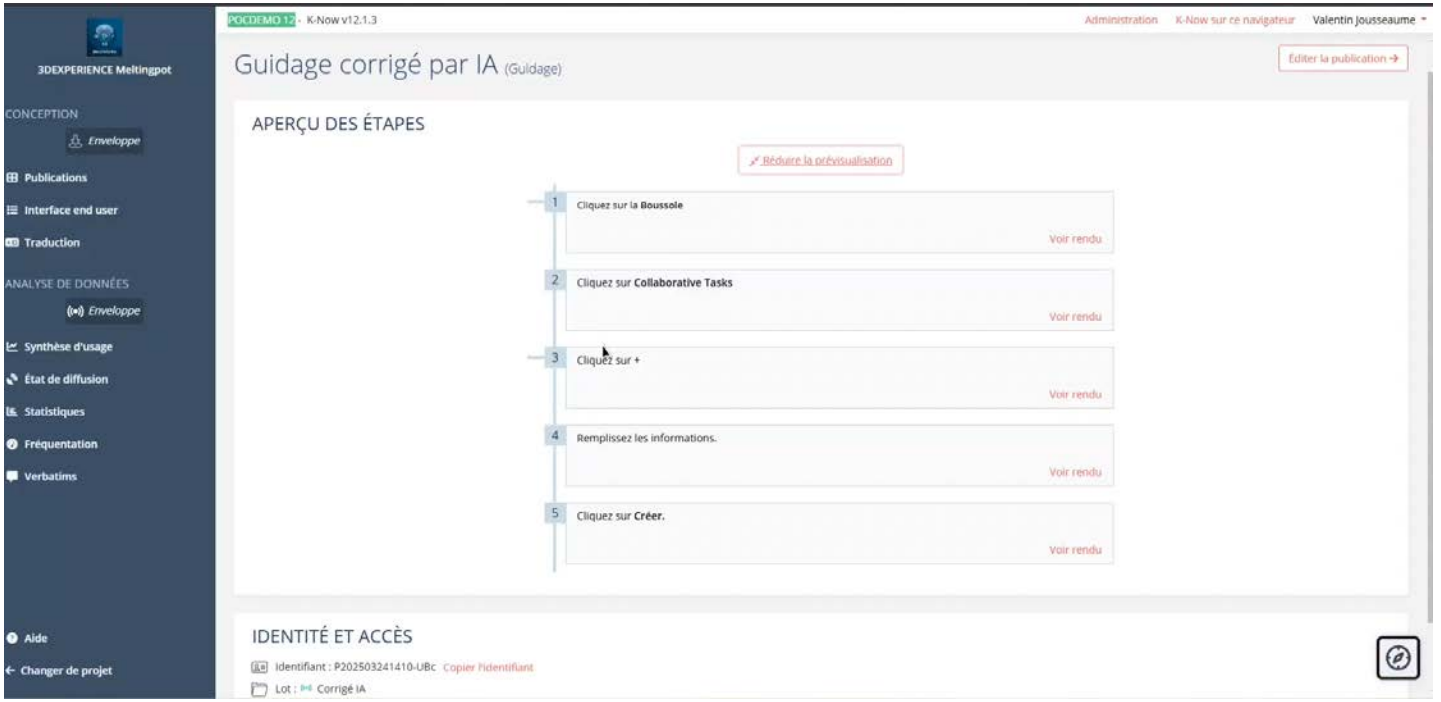
Artificial Intelligence for DAP



Correction of the guidance offered by the DAP by artificial intelligence

Artificial Intelligence for DAP



Correction of the guidance offered by the DAP by artificial intelligence

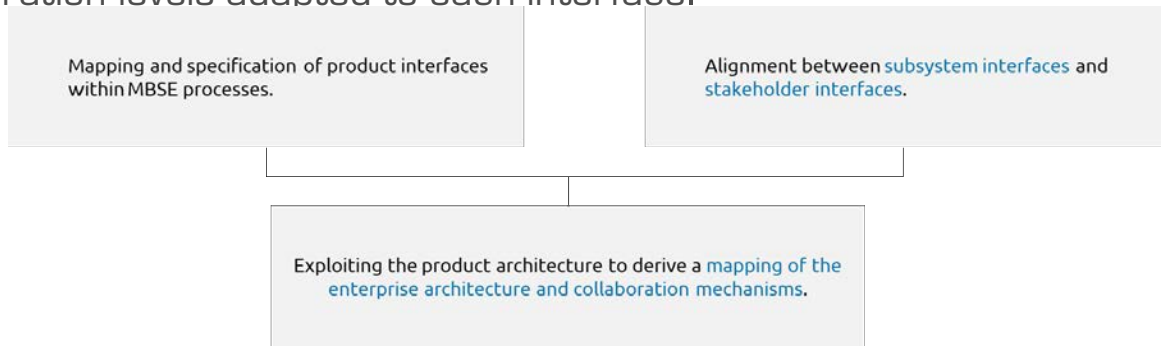
Collaboration and risks assessment in Extended Enterprise

Objectives:

Tooling co-development to **mitigate information-exchange risks between stakeholders** within the extended enterprise.

Identification and mapping of interfaces between stakeholders, and prioritization of associated risks.

Proposal of collaboration levels adapted to each interface.



Collaboration and risks assessment in Extended Enterprise

Specification of the information exchanged at the interfaces between the subsystems.

Important information

- Evaluated by system engineers from enterprises in need of information from their partners.

Evaluation Response	Corresponding numerical value
a/A	0,11
b/B	0,33
c/C	0,55
d/D	0,78
e/E	0,98

Confidential information

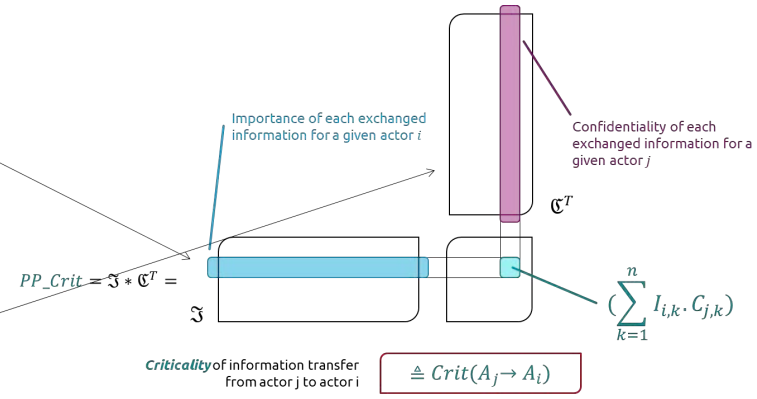
- Evaluated by decision-makers (program directors or equivalent) of the companies holding the information.

$$\mathfrak{I} = (I_{i,j}) = \begin{matrix} \text{information} \\ \\ \\ \end{matrix} \overset{\text{stakeholders}}{\begin{bmatrix} 0{,}14 & \cdots & 0{,}17 \\ \vdots & \ddots & \vdots \\ 0{,}47 & \cdots & 0{,}58 \end{bmatrix}}$$

Importance of information i for stakeholder j

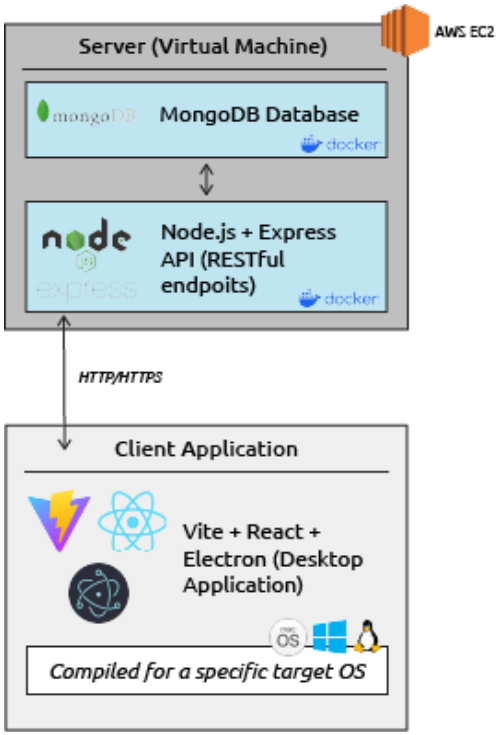
$$\mathfrak{C} = (C_{i,j}) = \begin{matrix} \text{information} \\ \\ \\ \end{matrix} \overset{\text{stakeholders}}{\begin{bmatrix} 0{,}57 & \cdots & 0{,}24 \\ \vdots & \ddots & \vdots \\ 0{,}47 & \cdots & 0{,}89 \end{bmatrix}}$$

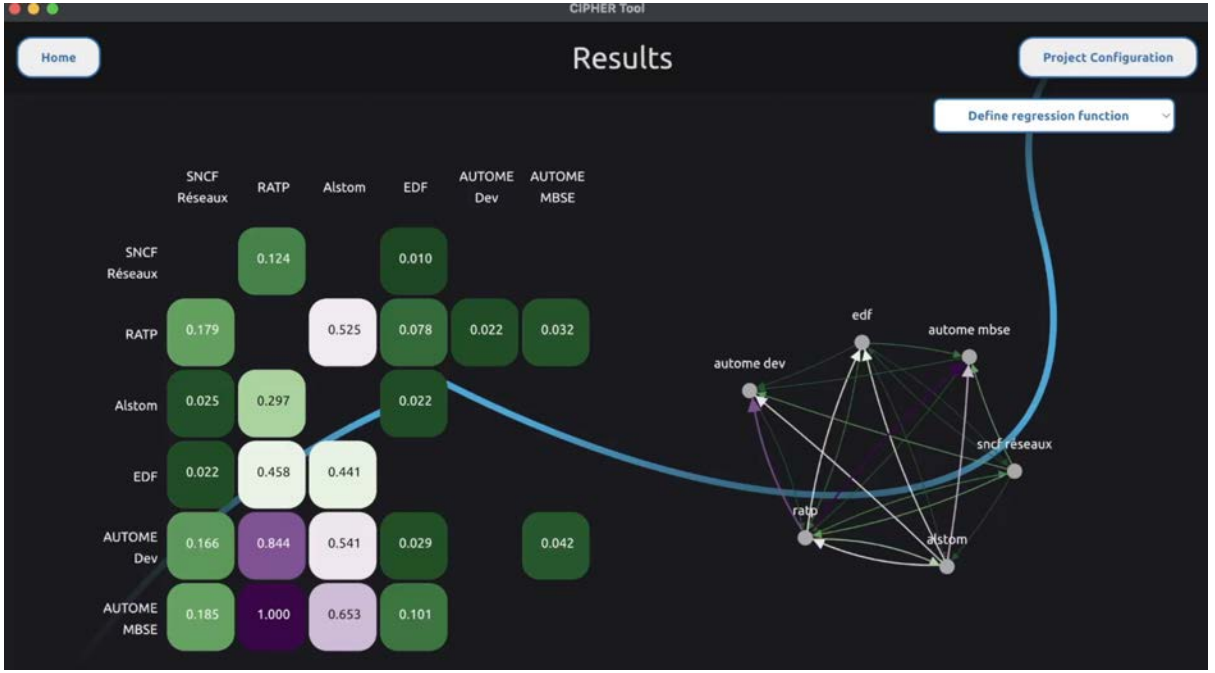
Confidentiality of information i for actor j



Collaboration and risks assessment in Extended Enterprise

Specification of the information exchanged at the interfaces between the subsystems.





The Future of PLM

Digital Adoption is a major challenge in the Digital Transformation of companies > creation of a dedicated chair, bringing together all stakeholders. A strong commitment as a vector of communication.

- **Research axis**: develop innovative research, e.g. in the field of digital engineering, PLM, BIM etc...
- **Dissemination axis**: Dissemination of the work to:
  - the national and international scientific community,
  - of our partners' industrial customers
  - Arts et Métiers students.
- **Formation Axis**: possible training of employees on themes e.g. Digital Transformation, sourcing actions

Join the Innovation/Research ecosystem to promote digital transformation!

PLM of the future: what place for humans in the digital transformation of companies?

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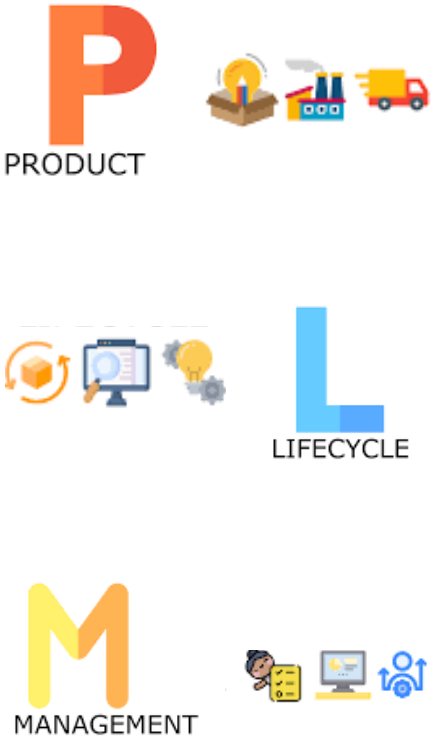

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