The Role Of Statistics In Addressing The Level Of Maturity Of SMEs In Terms Of PLM Collaboration

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OUTLINES

- BENEFITS project
- PLM definition
- PLM adoption
- First results
- Future work

BENEFITS PROJECT

- **Duration :** July 2012 – June 2015
- **Budget :** m€ 2.3
- **Partners:** University of Greenwich, CESI Rouen, Exeter
- Keeping high skilled competences within the France-Channel area
- Three main objectives :
  - Structuring the network of stakeholders and establishing exchange programmes on a transnational basis
  - Ensuring innovation fitness of people and companies to innovation
  - Maintening and developing the industrial and manufacturing fabric

Problem Statement

- If you go back 10 years, software solutions, PLM, accounted for very high costs and long and costly internal resources deployments. This is one of the reasons that many SMEs are struggling to adopt these technologies [Andrieu, 2013].

- BENEFITS project aims to offer SMEs a quantified analysis of their situation and a vision of the steps required to determine the "GO" or "NO GO" to PLM.
  - Understand the barriers that discourage SMEs from taking advantage of PLM
  - Review indicators that impact, positively or negatively, the SME's adoption of such technologies.

PLM definition

PLM Definitions

- PLM is an integrated approach including a consistent set of methods, models and IT tools for managing product information, engineering processes and applications along the different phases of the product lifecycle. PLM addresses not only one company but a globally distributed, interdisciplinary collaboration between producers, suppliers, partners and customers **(Abramovici, 2005)**.

- For the analyst **(CIMdata)**, PLM is defined as: “a strategic business approach that applies a consistent set of business solutions in support of the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise from concept to end of life – integrating people, processes, business systems, and information.”

- **(IBM)** defines PLM as “…a strategic approach to creating and managing a company's product-related intellectual capital, from its initial conception to retirement”

- For the PLM Interest Group **(PLMIG)**, PLM includes research, management of customer requirements, product development CAD, CAM, simulation, rapid prototyping and virtual concurrent engineering, product / process design, sourcing of components, machining digital control, collaboration via the web with customers and suppliers. PDM is the IT Platform for PLM, the terms 'PLM System' and 'PDM System' mean the same thing, and are interchangeable

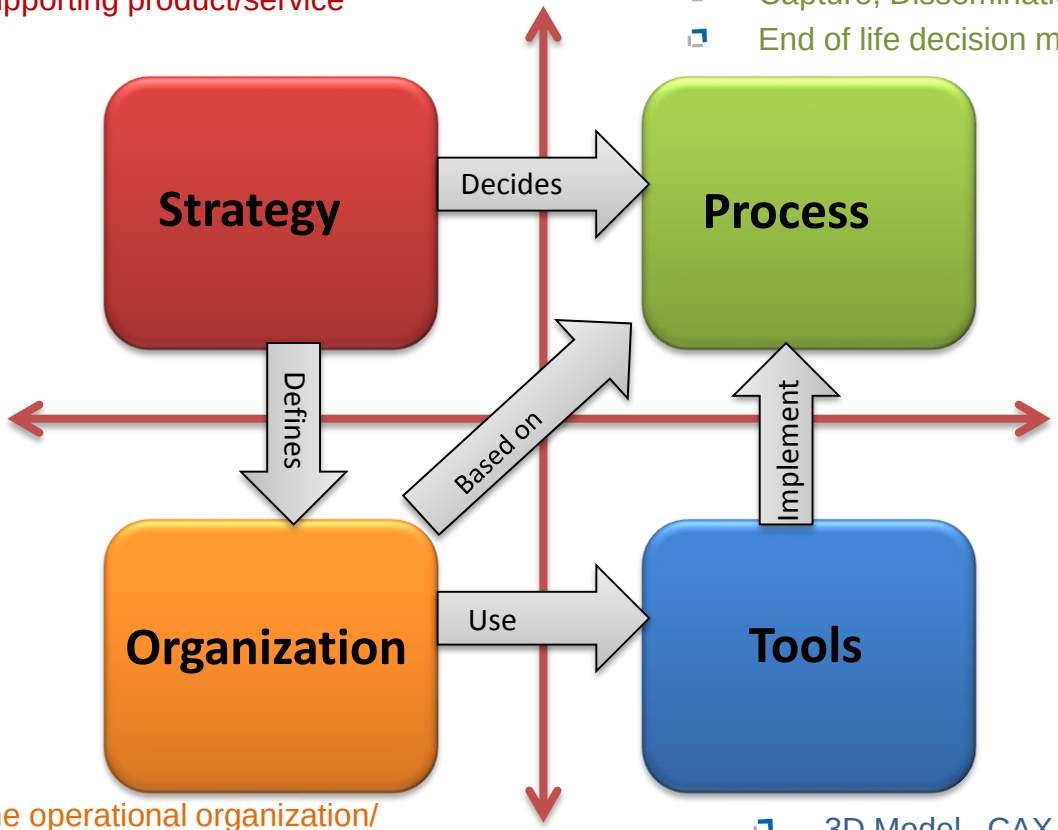
PLM Key Words

Terms related to PLM	Author
Collaborative Mode	[18], [48], [38], [3]
Strategic approach	(CIMData), (IBM) [2], [57], [5]
Requirement management	(PLM Interst Group)
PLM Process	(PLM Interst Group) (CIMData) [57], [29], [58]
PLM Architecture (IT tools)	(CIMData) [57], [29], [48], [1]
Integrated Business approach	(CIMData) [48], [1]
Integrated management	[58]
Product structure	(PLM Interst Group) [38]
Concurrent Engineering	(PLM Interst Group)
……..	

PLM axes

- Defining general guidelines
- External/internal Evaluation STEEP, SWOT
- Business model supporting product/service
- Product portfolio

- Change management : CR, ECR, ECO
- Standards, Data mining
- Capture, Dissemination, Transformation, sharing
- End of life decision making



- Specification of the operational organization/ Strategy
- Skills, motivation, turnover management
- People and culture management

- 3D Model, CAX (CAD, CAM, …)
- Requirements tools (Doors, etc.)
- PDM, ERP, CRM, SCM, MES, … tools
- Product models

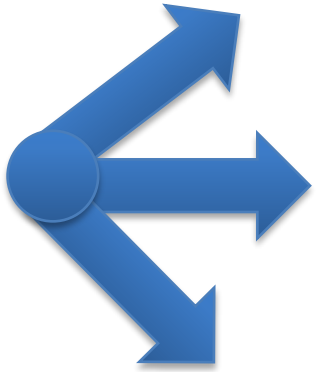
Strategy is the highest level, where important decisions are taking and in this level we define the kind of organization and processes. The **organizational** level describes the shape of structure based on processes. **Tools** level is the implementation of processes and the support for the organization.

PLM deployment

- The deployment of a PLM system for SME's organization requires :

PLM

More than one tool, impact processes and habits related to the organization, and the ability to change, the involvement of stakeholders



- Functional / Business processes
- Data migration
- Global integration with other ICTs (such ERP)
- Change driving
- Training and support.

PLM adoption

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The European Union, investing in your future
Fonds européen de développement régional
L'Union européenne investit dans votre avenir

Strategy

- SMEs with **greater financial capacity** will be more likely to adopt ICTs technologies [Lal, 1999].
- Enterprises that have a **capacity of self-financing** will easier adopt new technology [Stoneman, 2001].
- Enterprise which has a **large R&D budget** and implements a **strategy of acquisitions and fusion** promotes the adoption of new technologies [Bocquet, 2008].
- The **role of leader** is crucial in the development of a strategy for the use of information technology. The introduction of information technology depends on the **knowledge** that had managers and their ability to understand the potential of these technologies [Brown, 1992]. The introduction of information technologies requires the development of new forms of organization and only leaders can effectively carry out these **organizational changes** over time [Mansell, 1998].
- Enterprises that operate in **highly competitive markets** are likely to **adopt an innovation** may be necessary to maintain their market position and can enable for maintaining of “barriers to entry” [Robertson, 1986].

Organization

- [Hollenstein, 2004] argues that the size of SME is positively correlated with rapid adoption and intensive use of ICT; he suggested an **optimum size (from 50 to 200 employees)**. [Lal, 1999; Ciarli, 2007]

- SMEs have an advantage, according to large company, considering the small number of services and people involved, the implementation of PLM will not face to hard **resistance to change** [Hollenstein, 2004].

- In the other hand, SMEs with **younger employees** is able to have less resistance to changes [Giunta, 2007]. Also, **Age of SME** can have a negative influence on the PLM adoption.

- The presence of **skills** and **accumulated knowledge** within the enterprise is important for the adoption of information technology [Ciarli, 2007].

- **Enterprises exporting** are more likely to adopt new technologies to improve their internal organization and their production processes in order to remain competitive in **international markets** [Hollenstein, 2002].

Process

- The new technologies adoption, such PLM, requires a **standardization of procedures and information**, which penalizes SMEs for which the **exchange**, either internally or externally, stood mostly **informally** [Giunta, 2007].

- Companies are **forced to redesign their products** more frequently to meet the rapidly changing demands.

- **R&D department** is responsible, not only to develop new products, but also to change the information technologies that support the production process to make it more effective, and to develop effective and user-friendly applications to operate the assembly.

- The presence of an **R&D department** facilitates the adoption of new technologies [Lal, 1999] which can be seen as an existing R&D process and an **ability to develop new products**.

Tools

- The adoption of a new ICT depends on its characteristics, but also on the context, especially **technology already present in the company** (such ERP, CAD, etc.).
- They determine the **compatibility of the new technology**, but also the **level of technological experience** acquired through the use of **older versions**.
- [Tornatzky, 1982] shows that the adoption of new technology depends on its **advantage**, **compatibility** and **complexity**.
- The introduction of CAD/CAM, for example, requires suitably **qualified employees** to use it effectively [Lal, 1999] knowing that PLM integrates such tools.
- An enterprise may adopt a new technology only because **other enterprises**, **having relationship with it**, have **already adopted** [Rogers, 1991].

Few SMEs have adopted PLM

Strategy

- Indirect costs (S1) ☹
- Expected profitability (S2) ☺
- M&A Strategy (Merger-acquisition) (S3) ☺
- R&D activity (S4) ☺
- Manager profile:
  - Focus on short-term (S5) ☹
  - Emphasis on new markets (S6) ☺
  - Want to grow (S7) ☺
  - Focuses on innovation (S8) ☺
  - Risk aversion (S9) ☺
  - Emphasis on quality (S10) ☺

Process

- Informal communication mode (P1) ☹
- Knowledge Management (P2) ☹
- Process synchronization (P3) ☹
- Existing R&D process (P4) ☺
- Existing Innovation process (P5) ☺
- Interdependencies Collaboration (P6) ☺
- Existing certified (QM) system (P7) ☺

Organization

- Average size of effective of SME between 50 and 200 (O1) ☺
- Age of SMEs (O2) ☹
- Level of skill and knowledge (O3) ☺
  - With similar technology
- Resistance to change (O4) ☺
- Ability to assess technological opportunities (O5) ☺
- Number of adopters (O6) ☺
- Competitive environment (O7) ☺
- Geographical proximity (O8) ☺
- Rank of SME: 1st and 2nd ☺, 3rd ☹ (O9)

Tools

- Complexity (T1) ☹
  - Ergonomic
  - Interoperability
- Compatibility (T3) ☺
- Relative advantage (T4) ☺
- Existing software ☺
  - PDM (T5)
  - CAD/CAM (T6)
  - ERP (T7)

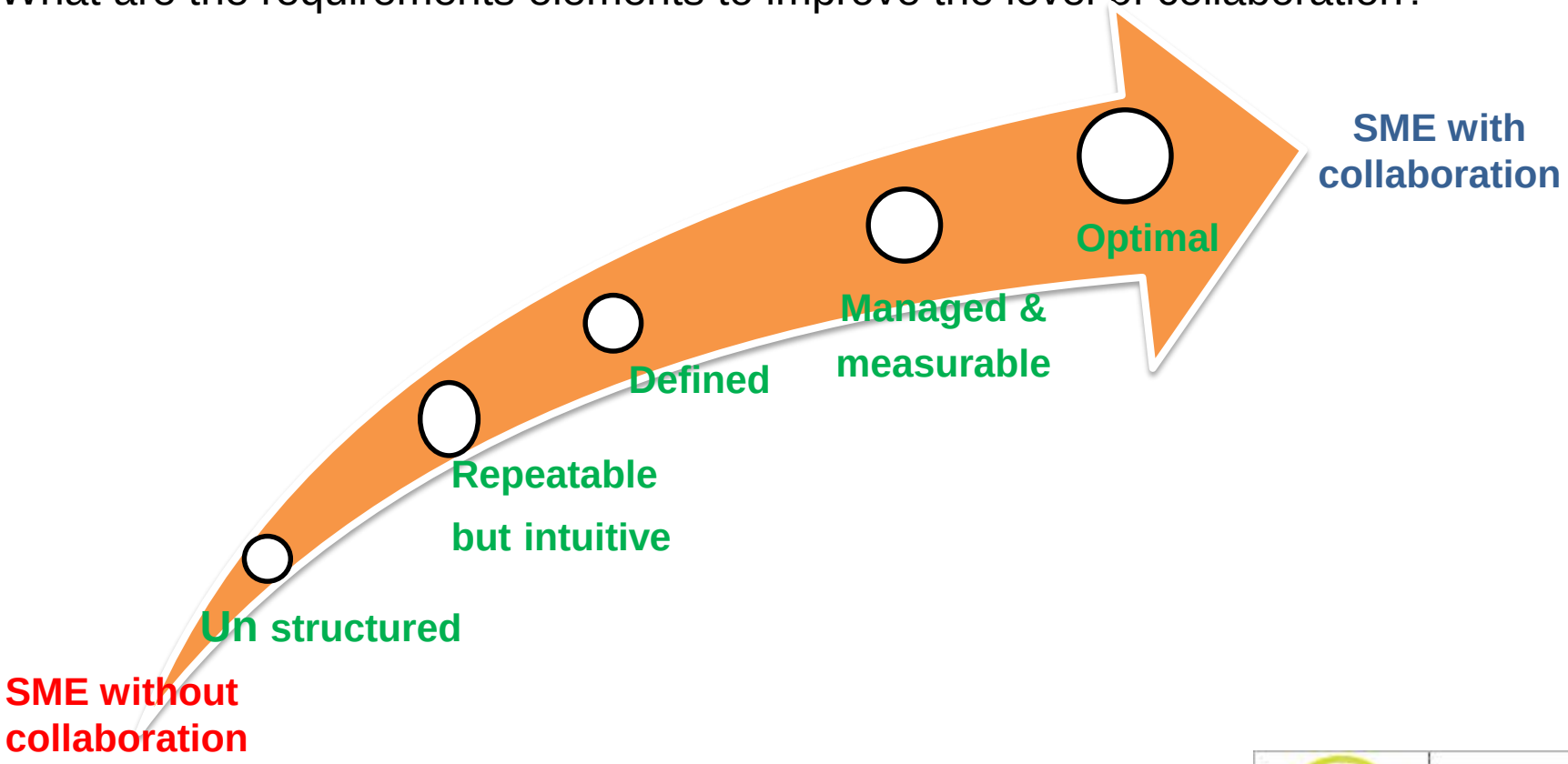
[S. Goode et K. Stevens, 2000]; [H. Hollenstein, 2004]; [Giunta et Trivieri, 2007]; [Bocquet et al, 2008]; [I. Coello, 2009]

Link between KPIs

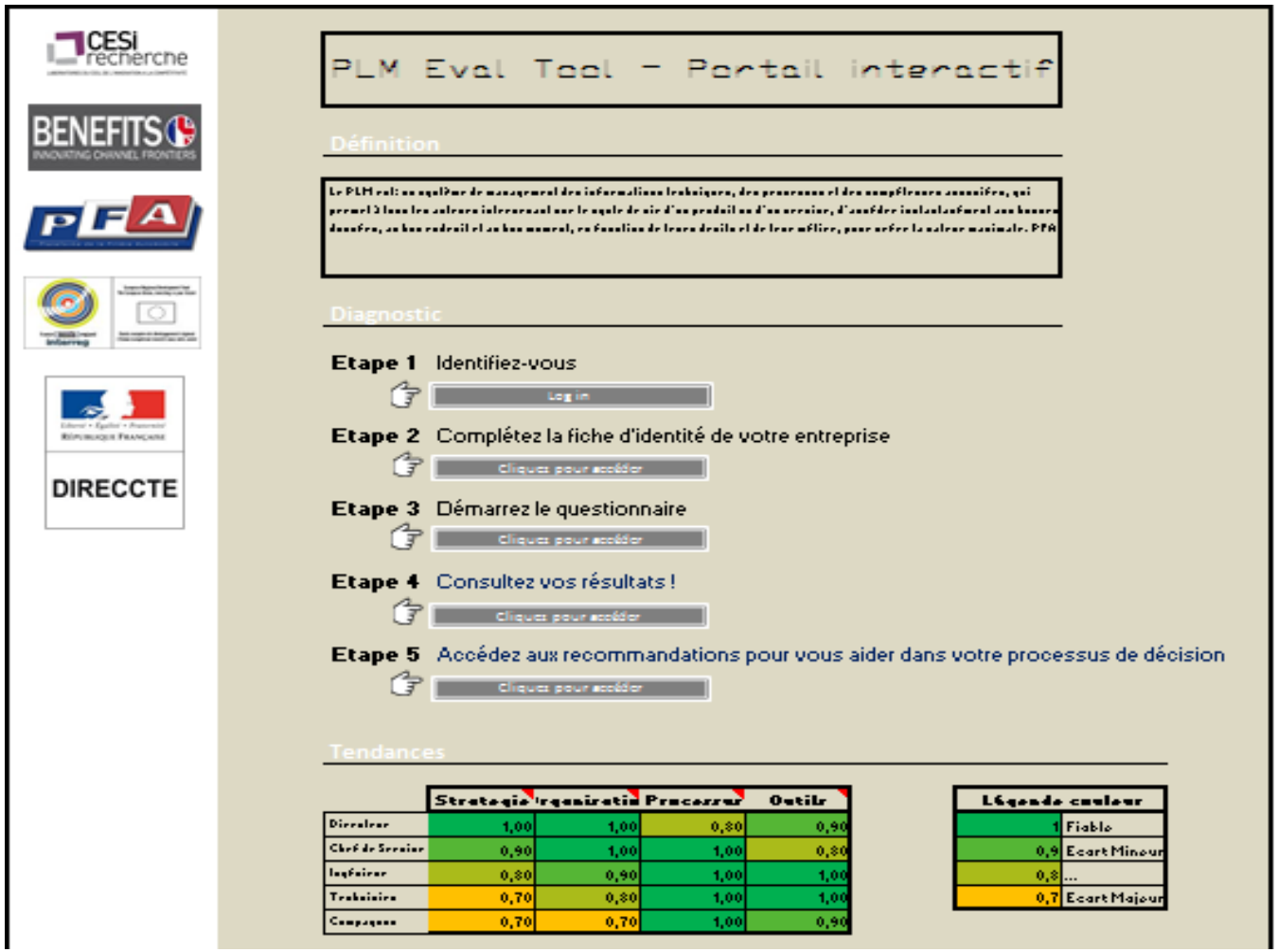
- The larger companies have more financial resources for KM implementation
- we expect that incremental innovations require a higher KM maturity
- we expect companies with a certified QM to have a higher KM maturity
- Modules of Business Intelligence can be interfaced to the ERP system to improve the decision making of managers
- The introduction of CAD/CAM software, for example, requires suitably qualified employees
- …..

Level of collaboration through PLM

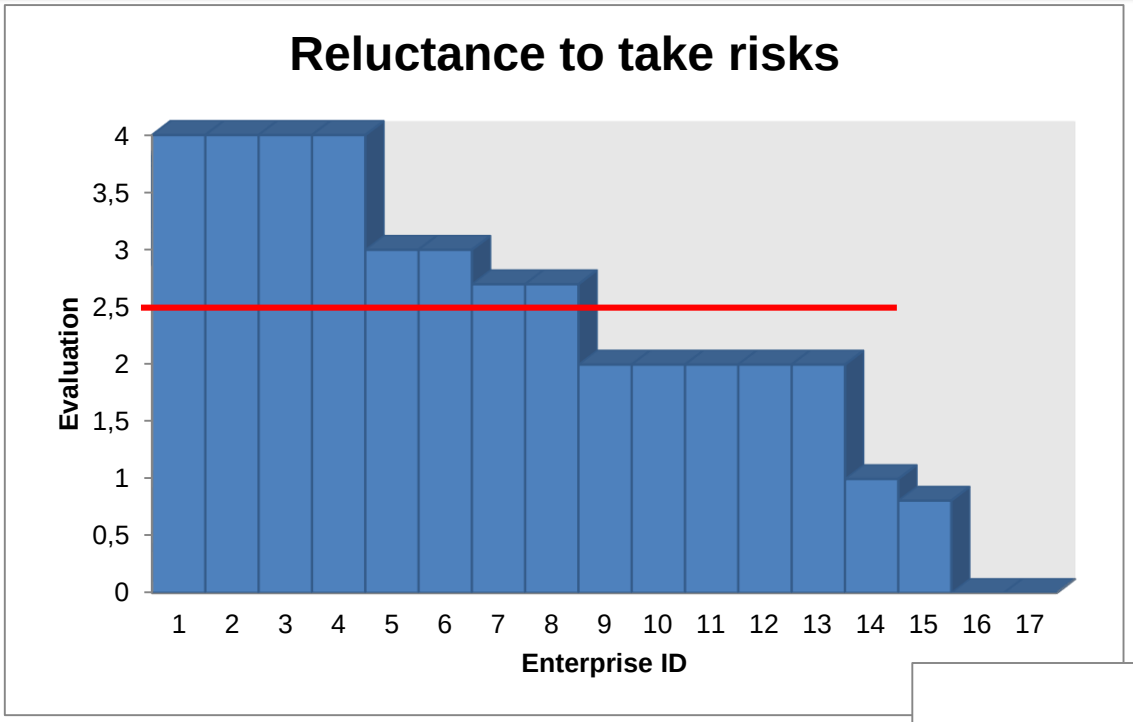
- What are the activities of each level of co-PLM?
- What is the actual level of collaboration?
- What are the requirements elements to improve the level of collaboration?

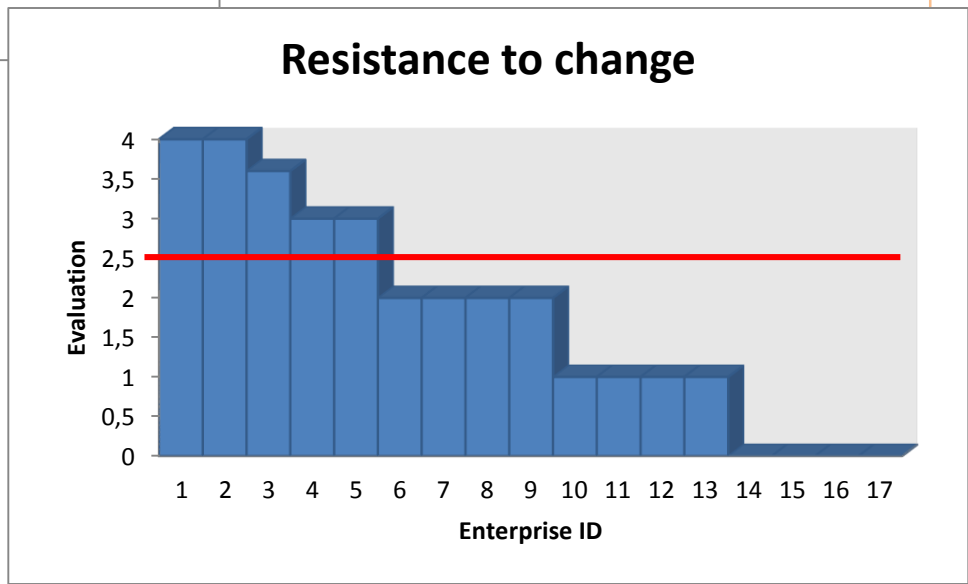


PLM-Eval-Tool



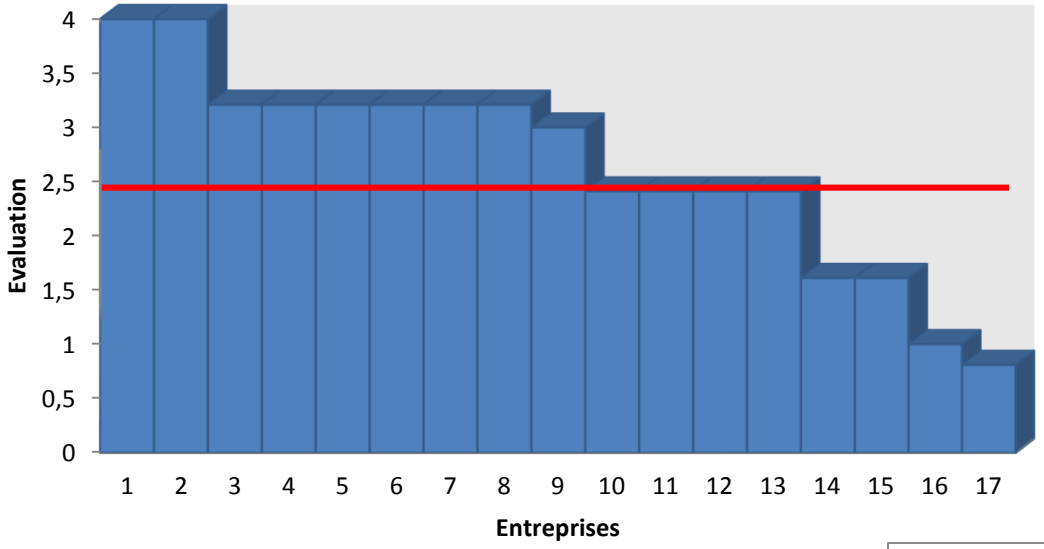
Results (1/3): SMEs from Automotive Sector



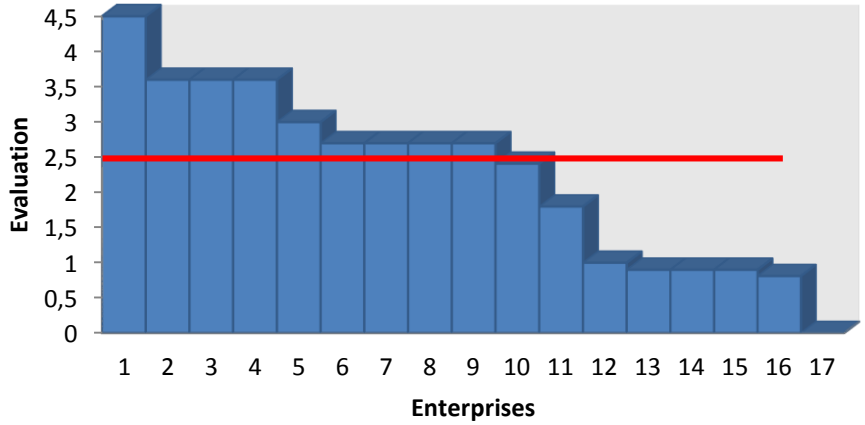


Results (2/3)

Informal communication



Ergonomic complexity of the tools



Results 3/3

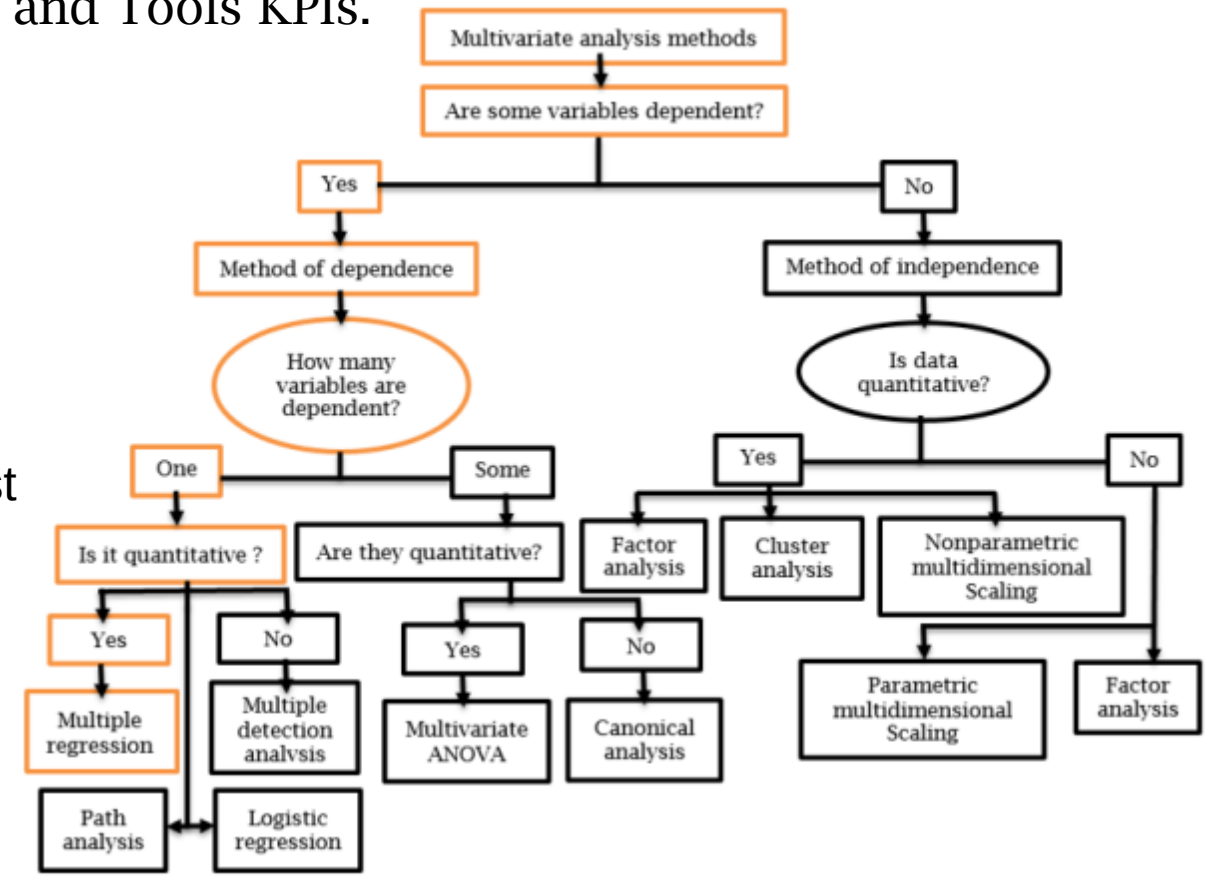
Matrice d'intéraction 4 entrées
Entités fonctionnelles - Facteurs d'adoption - Recommandations

Entité fonctionnelles PME / Facteur d'adoption	Service Ressources Humaines	Impact	Direction Stratégie & Développement	Impact	Département BE / R&D / Opérationnel	Impact
Humain	Pistes d'améliorations					
H1						
H2						
H3						
H4						
H5						
H6						
H7						
H8						
H9						
H10						
Organisationel	Pistes d'améliorations					
O1						

Future Work

- $PLM_{Adoption} = \sum_{i}^{n}(\alpha_i S_i + \beta_i O_i + \gamma_i P_i + \sigma_i T_i)$
  - $\alpha, \beta, \gamma, \sigma$: represent parameters and will be estimated through a survey.
  - S, O, P, T : represent consecutively Strategic, Organizational, Process and Tools KPIs.

- Linear regression
- Anova
- Pearson's chi-squared test



Thanks!

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