Journée Nationale du GT EASY DIM 2015

Modèles de maturité et Projet d'entreprise

Lundi, 29 Juin 2015

Université Lumière Lyon 2 – IUT de Bron

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Objectifs scientifiques et thématiques

Le GT Easy-Dim (http://www.easy-dim.org) du GdR MACS (Modélisation et Analyse de la Commande de Systèmes) du CNRS organise chaque année un workshop scientifique d'une journée. Dans son édition 2015, ce workshop concerne la définition et l'adoption des modèles de maturité dans l'entreprise.

Le contexte actuel de compétitivité oblige les entreprises à évoluer tant au niveau stratégique, organisationnel qu'opérationnel. Les entreprises doivent donc déployer de nouvelles démarches qui induisent des changements intra ou inter organisationnels et elles doivent acquérir de nouvelles capacités et compétences. Face à l'importance des transformations, voire mutations, un des challenges pour l'entreprise est de les maîtriser.

Par la description d'un référentiel, de bonnes pratiques ou de capacités à atteindre, les modèles de maturité permettent également de définir les axes de développement pour assurer la progression de la maturité. Ainsi, les modèles de maturité visent à décrire et à déterminer le niveau d'acquisition (maturité) de différentes compétences ou aptitudes attendues. Les modèles de maturité sont généralement définis par deux axes principaux. Le premier mesure l'état courant sur une échelle qui identifie différents niveaux de progression. Le second axe définit quant à lui les objets analysés à travers différents critères. L'application des modèles de maturité n'est pas limitée à un domaine particulier.

La journée alternera communications scientifiques et industrielles et se clôturera autour d'une table ronde. Elle sera ainsi scindée en deux sessions se concentrant respectivement sur les thèmes suivant :

- Etude des modèles de maturité dans l'entreprise,
- Application des modèles de maturité en entreprise.

Les sujets abordés durant cette journée devront aborder un de ces deux thèmes sachant que les applications d'un modèle de maturité sont très variées comme par exemple :

- L'implémentation d'une application d'entreprise (ERP, CRM, PLM, etc.).
- Le management de processus.
- la mise en œuvre d'une démarche qualité.
- L'alignement stratégique.

http://www.easy-dim.org/
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Comité d'organisation de la journée

- Christian Braesch, SYMME, Université de Savoie Mont-Blanc, christian.braesch@univ-savoie.fr
- Virginie Goepp, ICube, INSA de Strasbourg, virginie.goepp@insa-strasbourg.fr
- Néjib Moalla, DISP, Université Lyon II, Nejib.Moalla@univ-lyon2.fr

Procédure de soumission

Les personnes souhaitant présenter des travaux sur un des deux thèmes retenus doivent soumettre via le site web de la journée (http://easy-dim2015.sciencesconf.org/) un résumé en Français et en Anglais de 500 à 1000 mots avec :

- Objectifs des travaux de recherche
- Approche de recherche proposée
- Les résultats obtenus
- Originalité des travaux et des contributions

Les dates importantes à retenir

- Ouverture de la plateforme de soumission : **20 avril 2015**,
- Date limite de soumission : ~~**17 Mai 2015**~~ ➔ **31 mai 2015**
- Notification d'acceptation ou de rejet : **07 Juin 2015**,
- Date limite d'inscription (via le site web de la journée) : **22 Juin 2015**,
- Date de la journée : **29 Juin 2015**.

Sponsors

Cette journée est organisée en collaboration avec :

GIS INTEROP Grande-Région | **GDR MACS** | **Université Lumière Lyon 2 Laboratoire DISP**

Cette journée est supportée scientifiquement par :

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LUNDI, 29 JUIN 2015, UNIVERSITÉ LUMIÈRE LYON 2 – IUT DE BRON

Programme de la journée :

09h00 à 09h15	***Accueil*** ***(Salle 3.212)***	
09h15 à 09h30	Présentation de la journée et des sponsors	
	Session 1 ***(Salle 3.212)***	
09h30 à 10h30	**KeyNote_1**	Titre : Some considerations on Maturity Models *Par :* ***Christian Braesch*** *Institution : Université de Savoie Mont-Blanc*
10h30 à 10h50	***Pause-Café*** ***(Salle 3.213)***	
10h50 à 11h25	**Papier_1**	Titre : Modélisation des hôpitaux de campagne - Application au cas de l'ESCRIM *Par :* ***Laurie Mailhac****, Nicolas Daclin, Vincent Chapurlat, Gilles Dusserre, Franck Guarnieri, Jean Blanchard, Bruno Lheritier, Alexandra Picard, Kerstin Streff, and Isabelle Arnaud* *Institution : Laboratoire LGI2P, Ecole des Mines d'Alès*
11h25 à 12h00	**Papier_2**	Titre : A Maturity Model to Promote Collaboration in Business Processes *Par :* ***Maroua Hachicha****, Néjib Moalla, Yacine Ouzrout* *Institution : Laboratoire DISP, Université Lyon 2*
12h00 à 13h50	***Déjeuner*** ***(Buffet en Salle 3.213)***	
	Session 2 ***(Salle 3.212)***	
13h50 à 14h50	**KeyNote_2**	Titre : Different Approaches of the PLM Maturity Concept and their Use Domains – Analysis of the State of the Art *Par :* ***Hannu Kärkkäinen*** *Institution : Tampere University of Technology, Finland*
14h50 à 15h25	**Papier_3**	Titre : Lifecycle Systems Improvement based on Maturity Evaluation and Reputation *Par :* ***Haiqing Zhang****, Aicha Sekhari, Yacine Ouzrout, Abdelaziz Bouras* *Institution : Laboratoire DISP, Université Lyon 2*
15h25 à 16h00	**Papier_4**	Titre : Augmentation de la productivité des projets de R&D sous fortes contraintes via les méthodes agiles et les systèmes intelligents *Par :* ***Florian Pereme,*** *Virginie Goepp* *Institution : Laboratoire ICube, INSA de Strasbourg*
16h00 à 16h30	***Echange autour d'un cocktail de clôture*** ***(Salle 3.213)***	

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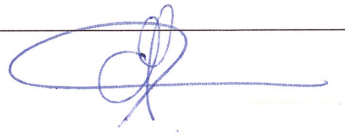
Fiche d'émargement :

NOM	Prénom	Etablissement	Signature
BRAESCH	Christian	Université de Savoie Mont-Blanc	
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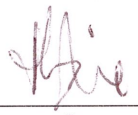
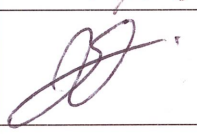
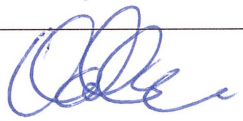
ELHARIRI ESSAMLALI	Mohammed Taha	Université Lumière Lyon 2	
GOEPP	Virginie	INSA de Strasbourg	
HACHICHA	Maroua	Université Lumière Lyon 2	
HANNU	Kärkkäinen	Université technologique de Tampere, Finlande	
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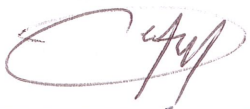
MOALLA	Néjib	Université Lumière Lyon 2	
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Key Note 1

Titre : Some considerations on Maturity Models

Par : ***Christian Braesch***
Institution : Université de Savoie Mont-Blanc

Présentation

SYMME

UNIVERSITÉ SAVOIE MONT BLANC

Some considerations on Maturity models

Christian Braesch

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Journée Easy DIM – 29 juin 2015 - Lyon

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Context of ongoing works

- **Arc 8 Project : Maturity Models for PLM**
  - Special session in PLM14 – Yohohama
  - Workshops
    - Helsinky (juin 2014)
    - Annecy (janvier 2015)
    - *Bruxelles* (janvier 2015)
- **IFIP Working Group 5.1**
  - Special Interest Group « Maturity PLM »

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Table of contents

- What is maturity?
- What is a maturity model?
- Literature review
- Conclusion

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What is maturity ?

- **Cambridge dictionary:**
  - Mental development:
    - The quality of behaving mentally and emotionally like an adult
  - Full growth:
    - The state of being completely grown physically
- **Oxford English dictionary**
  - The state of being complete, perfect, or ready; fullness of development.
- **Wikipedia:**
  - Stage of growth where an organism reached its full potential
- **Larousse dictionary**
  - Feature of an ecosystem which has attained steady state

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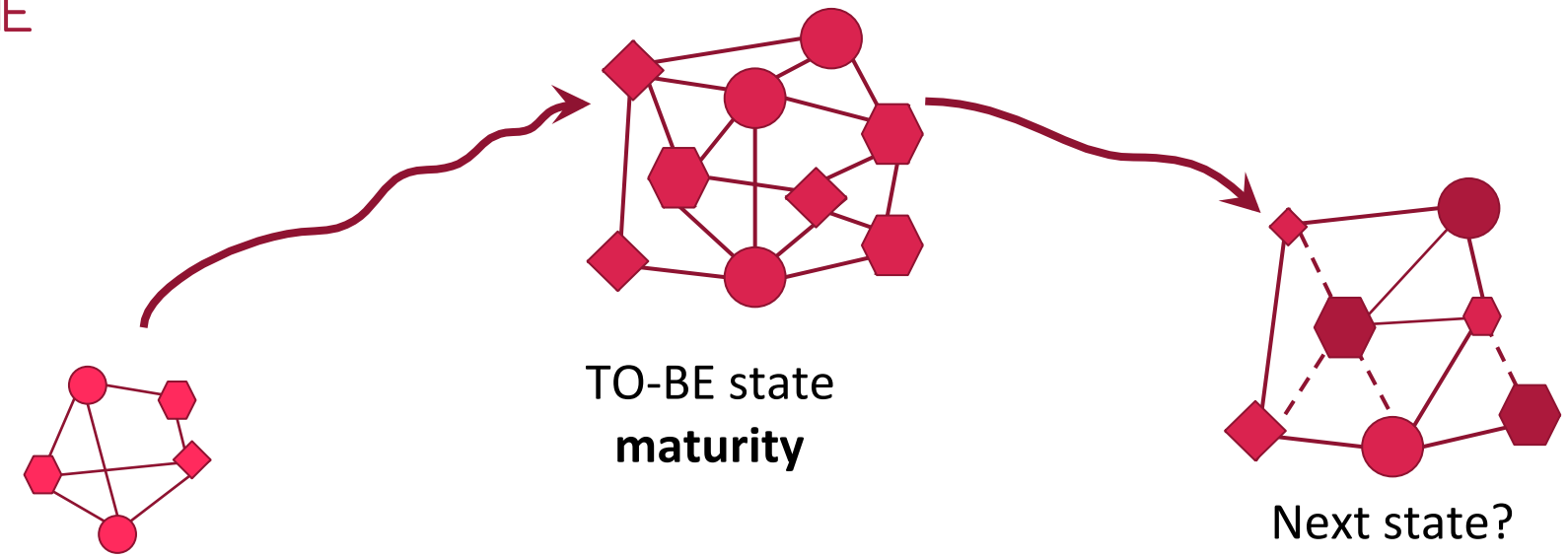
Should an enterprise reached maturity?



When an organism matures, it will decline (degradation of functions).

Wikipedia

Senescence is the gradual deterioration of function characteristic of most complex life forms ...

Linguee.fr

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What is a Maturity model?

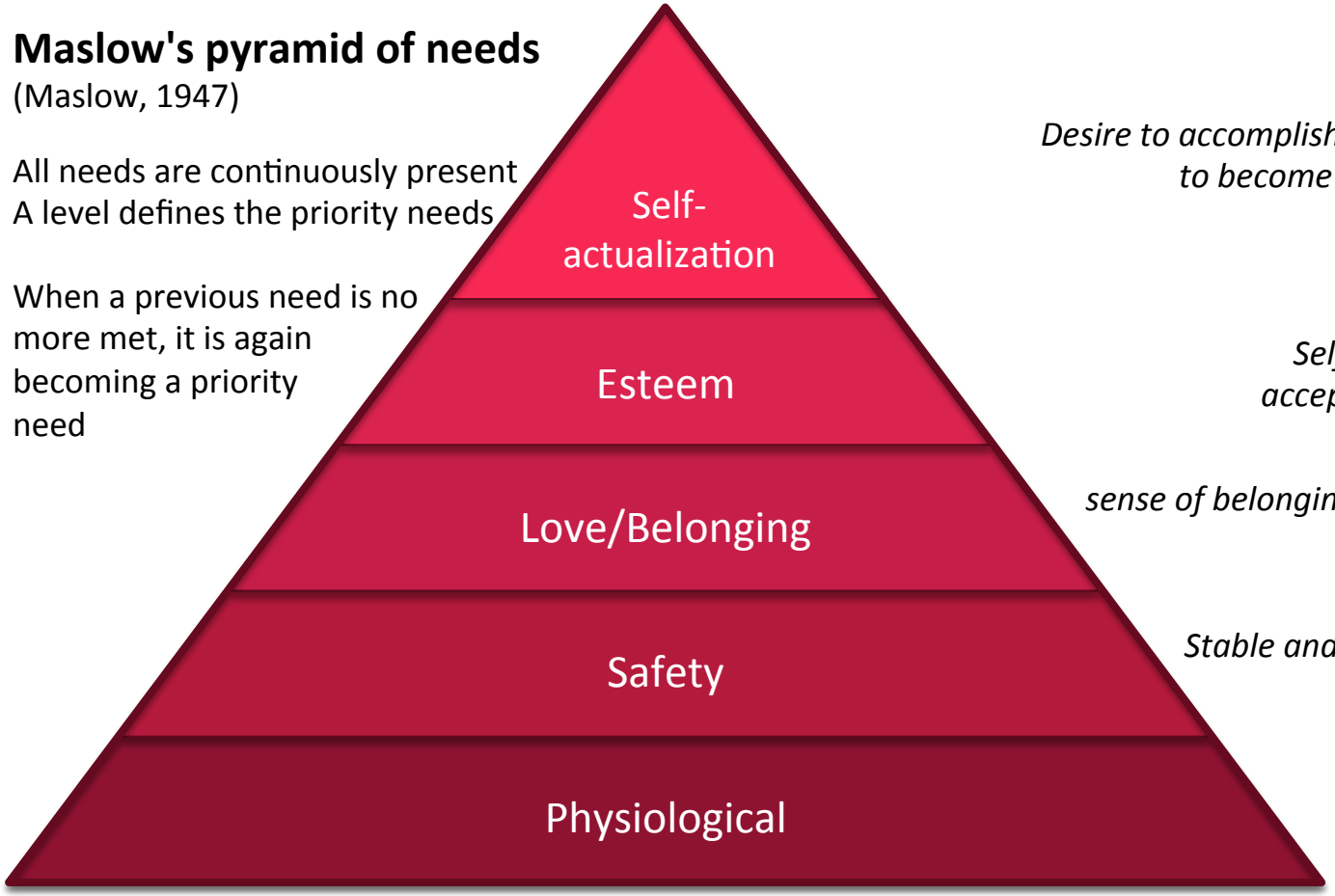
- **Few publications give a clear definition**
- **Publications rather use descriptions of purpose and functioning of the models**
- **Some definitions:**
  - Maturity models describe the development of an entity over time. This entity can be anything of interest: a human being, an organisational function, etc. (Klimko, 2001)
  - A maturity is a structured collection of elements that describe the characteristics of effective processes at different stages of development. It also suggests points of demarcation between stages and methods of transitioning from one stage to another. (Pullen, 2007)

One of the first maturity model

Maslow's pyramid of needs
(Maslow, 1947)

All needs are continuously present
A level defines the priority needs

When a previous need is no more met, it is again becoming a priority need



Desire to accomplish everything that one can, to become the most that one can be

Self-respect and desire to be accepted and valued by others

sense of belonging and acceptance among their social groups

Stable and predictable environment (no crisis, no stress)

Physical requirements for human survival

Maturity model for IT in business

- **Nolan's model first deals with Data processing**
- **Model based on 6 stages:**
  - **Initiation**: introduction of IT into organization
  - **Contagion**: adoption of computers in a range of different areas
  - **Control**: organization of tasks for control of computer operating cost
  - **Integration**: adoption of new technology to integrate systems
  - **Data administration**: managing corporate data rather than IT
  - **Maturity**: application portfolio is complete
- **Criticism:**
  - Several shortcomings and slightly out of date
  - Stage of « maturity » as the ultimate level seems to be meaningless today (Klimko, 2001)

Maturity model for data processing (DP)

Applications portfolio	Functional cost reduction applications	Proliferation	Upgrade documentation	Retrofitting existing applications	Organization integration of applications	"mirroring" information flows
DP organization	Specialization for technical learning	User-Oriented programmers	Middle management	Establish computer utility and user account teams	Data administration	Data resource management
DP planning and control	Not extensive	More lax	Formalized planning and control	Tailored planning and control systems	Shared data and common systems	Data resource strategic planning
User awareness	Hand off	Superficially enthusiastic	Arbitrarily accountable	Accountability learning	Effectively accountable	Acceptance of joint user and DP accountability
Level of DP expenditures	**Initiation** **Stage 1**	**Contagion** **Stage 2**	**Control** **Stage 3**	**Integration** **Stage 4**	**Data administration** **Stage 5**	**Maturity** **Stage 6**

(Nolan, 1979)

Quality Management Maturity Grid

- **Crosby's maturity grid deals with Quality management**
- **Grid defines 5 levels and 6 measures:**

- **Levels:**
  - **Uncertainty**; no comprehension of quality as a management tool
  - **Awakeness**: a quality leader is appointed
  - **Enlightenment**: Quality is elevated to a functional level
  - **Wisdom**: Top management participates in and understands quality
  - **Certainty**: quality is an essential part of the organization

- **Measurement categories:**
  - Management understanding and attitude
  - Quality organization status
  - Problem handling
  - Cost of quality as % of sales
  - Quality improvement actions
  - Summary of company quality posture

- **In sum**
  - Uncertainty : We don't know why we have problem with quality"
  - Certainty: "We know why we do not have problems with quality"

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Quality Management (QM) Maturity Grid

Measurement categories	Stage 1 Uncertainty	Stage 2 Awakening	Stage 3 Enlightenment	Stage 4 Wisdom	Stage 5 Certainty
Management understanding and attitude	No comprehension of quality as a management tool	Recognising QM but no money or no time to support it.	QM becoming a support function.	Necessity of QM is understood.	QM is considered as an essential part of company system.
Quality organization status	Quality is a part of manufacturing or engineering departments.	A quality leader is appointed but still part of another departments.	Quality department reports to top management.	Quality manager is involved with customer affairs.	Quality manager is member of the board.
Problem handling	Problems are fought as they occur.	Teams are set up to attack major problems.	Corrective action are established.	Problems are identified early by all functions.	Most of problems are prevented.
Cost of quality as % of sales	20 %	18 %	12 %	8 %	2.5 %
Quality improvement actions	No organized activities.	Trying obvious "motivational" short-range efforts.	Programme with thorough understanding.	Starting pro-active / preventive initiatives.	Quality improvement is a continued activity.
Summary of company quality posture	We don't know why we have problems with quality	Is it absolutely necessary to always have problems with quality	We are identifying and resolving our problems	Defect prevention is a routine part of our operation	We know why we do not have problems with quality.

(Crosby, 1979)

Definition of a Maturity Model

"A maturity model consists of a sequence of maturity levels for a class of objects. It represents an anticipated, desired, or typical evolution path of these objects shaped as discrete stages." (Becker, 2009])

- **The two model components:**
  - Stages
    - Set **stages** (or levels) describing the development of the examined object in **simplified way**.
    - Stages are **sequential** by nature and represent a **hierarchical progression**.
  - Measured objects : capabilities
    - Criteria for measurement (conditions, processes, application targets).

Another definition of a Maturity Model

- **Nolan's model and Crosby's grid give two points of view of a maturity model:**
  - Lifecycle perspective: Maturity model for data processing ➔ evolution of IT in organisations
  - Potential performance perspective: Quality Management Maturity Grid
- **Today:**
  - Most of the available maturity models follow the potential performance perspective

" Maturity models describe and determine the state of perfection or completeness (maturity) of certain capabilities." [Wendler, 2012]

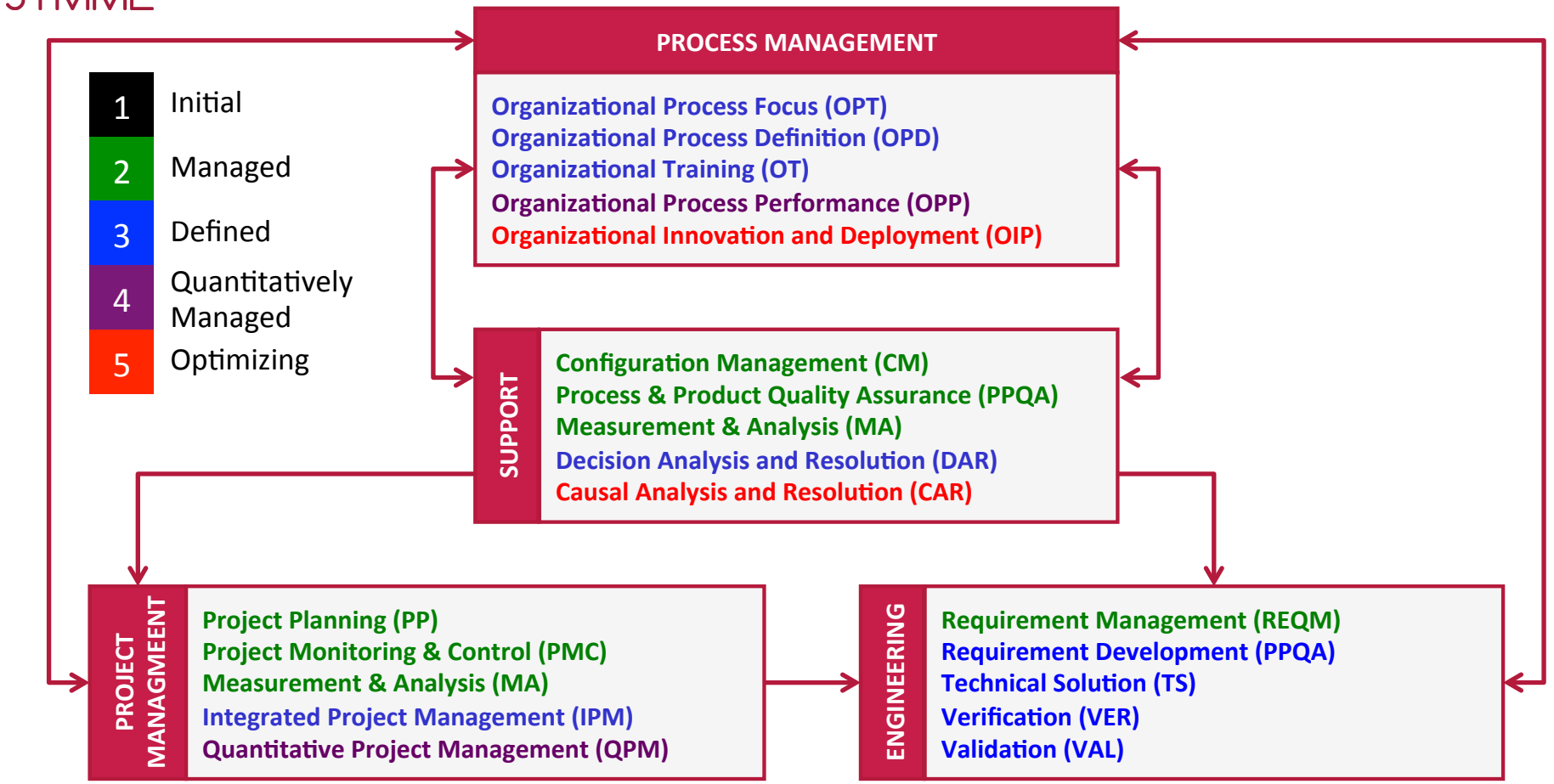
Capability Maturity Model

- **Oxford dictionary:**
  - Power or ability to do something (fulfill specified tasks and goals).
- **Organisational capability:**
  - "*A skill to carry out the deployment, the combination and the coordination of resources and competences through various value flows to put in work the strategic objectives*" (Booto Ekinoea, 2007)
    - Application of organisational competences in order to achieve the business goals
    - Ability to assemble, integrate and deploy the value resources (tangible, intangible or human resources) in order to reach business performance
- **Capability maturity model:**
  - A model of maturity levels describes how organisational capabilities could contribute to reach business performance.

Capability Maturity Model Integration (CMMI)

- **First development in software engineering (Software CMM)**
- **Developed by Software Engineering Institute (SEI)**
- **Based on best practices**
- **CMMI model**
  - Guidance for developing or improving processes that meet the business goals of an organization
  - Framework for appraising the process organization
- **How do we know …**
  - … what we are good at?
  - … if we are improving?
  - … if the process we use is working well?
  - … if our requirement change process is use
  - … if our products are as good as they can be?
- **CMMI helps an enterprise to:**
  - Identify and achieve measurable business goals
  - Build better products
  - Keep customer happier
  - Ensure that enterprise is working as efficiently as possible

CMMI – Levels and Process Area



CMMI - Summary

- **CMMI framework: collection of components**
  - Model components: process areas, goals, practices and informative material (use of the model).
  - Training components: guidebooks and audio-visuals (how to use the model).
  - Appraisal components: process of appraising the organisation's processes.
- **Constellation: group of components addressing an area of interest**
  - CMMI for Acquisition (CMMI-ACQ): acquisition of products and services (SEI, 2011)
  - CMMI for Development (CMMI-DEV): development of products and services. [SEI, 2010a)
  - CMMI for Services (CMMI-SVC): providing superior services [SEI, 2010b)
  - CMMI for System Engineerring / Software Engineering (CMMI-SE/SW) : process improvement in organizations of any structure (SEI, 2000)

Benefits of a maturity model

- **Maturity models:**
  - Generate an awareness of analysed aspects:
    - State, importance, potentials, requirements, complexity, etc.
  - Serve as reference frame to implement a systematic and well-directed approach for improvements.
  - Ensure a certain quality and avoid errors.
  - Assess one's own capabilities on a comparable basis.
  - Are a useful way of communicating best practices.

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Literature review: Global and Specific

- **Global review:**
  - The Maturity of Maturity Model research: a systematic mapping study, (Wendler, 2012)
    - Definition of research questions of the study
    - Search process definition
    - Systematic classification process
    - Definition of classification scheme
- **Domain specific review: Maturity Models for Business Process Models**
    - Definition of BPMM
    - Definition of BPM capabilities areas

Wendler's Research questions

RQ1: What are the main focus of the maturity model research and what topics research topics are relevant besides developing and using maturity models?

RQ2: How can the field of maturity model research be restructured?

RQ3: What are the most common research designs and methods applied?

RQ4: How important are design oriented vs. conceptual designs for the development of maturity models?

RQ5: How are developed maturity models validated?

RQ6: How important are qualitative vs. quantitative methods for validation?

RQ7: What are the most common maturity models addressed in research? How important are maturity models developed by industrial consortia practitioners, or standardization organizations for research?

RQ8: In what domains are maturity model research applied?

RQ9: How have publication amount, frequency, and research topics changed over time?

RQ10: What are relevant search terms and what are the main publication forums?

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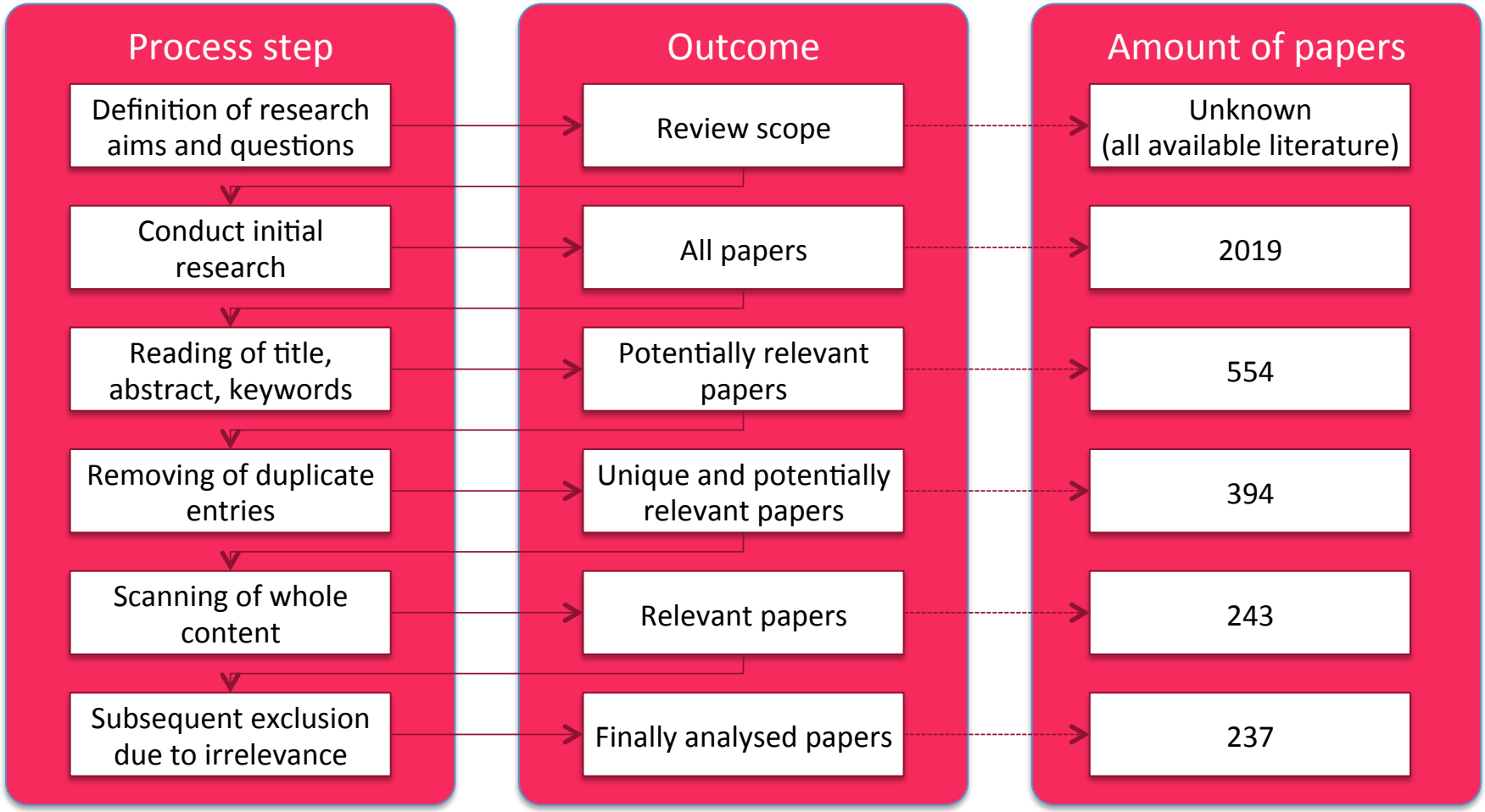
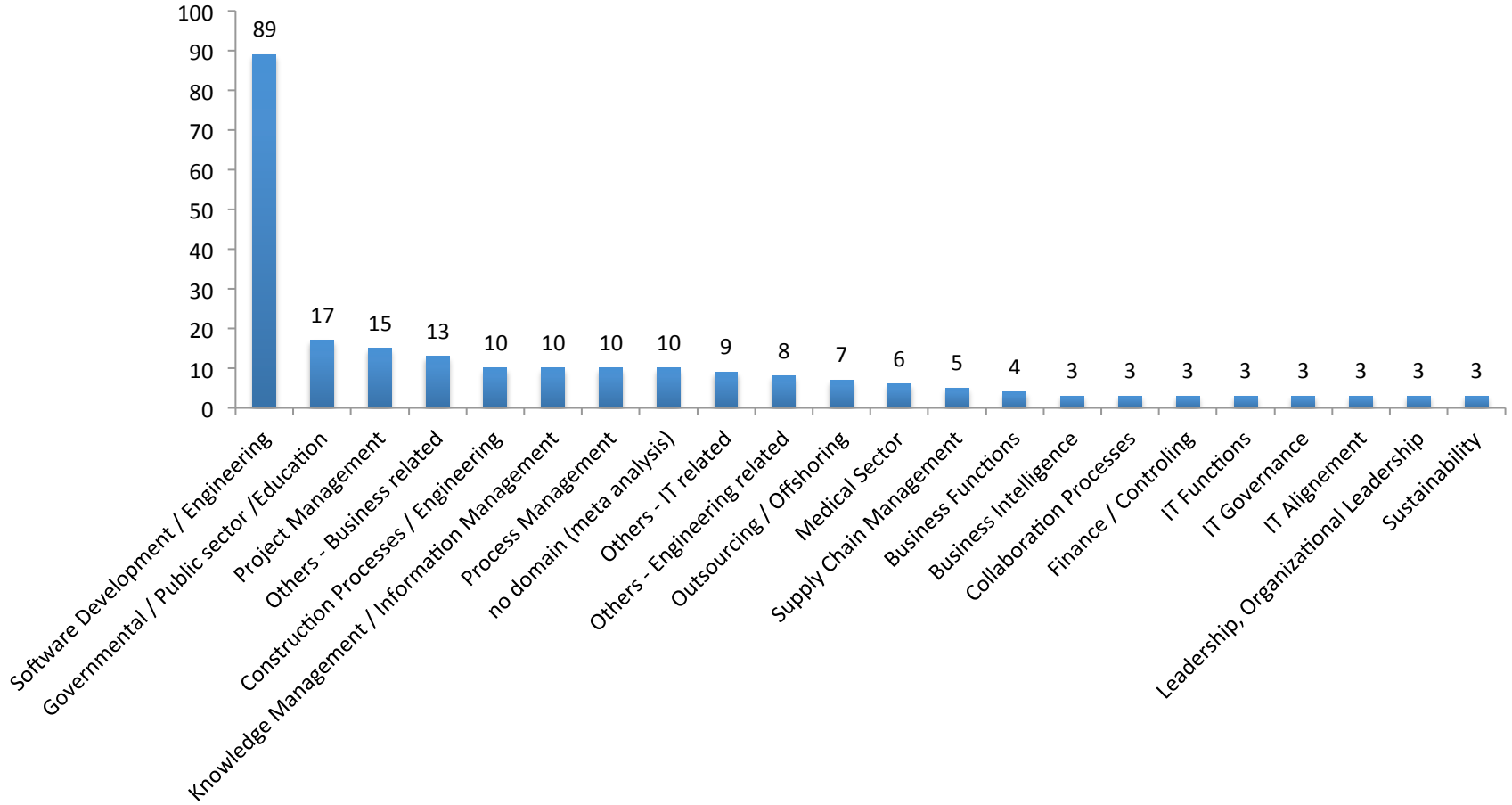
Wendler's Search Process



Number of used/developed MM per topic area

	Own Other	Crosby's Maturity Grid	CobiT CMM	BPMM (OMG)	SPICE (construction)	SPICE (software)	ISO 0000	CMM(I)
Model development	105				1			3
Model application	27	1	3		4	4	1	48
Model validation	11			1			6	19
others	3						1	3
Total number of used model	**146**	**1**	**3**	**1**	**5**	**4**	**8**	**73**

Application domains



Business Process Maturity Model (BPMM)

- **A BPMM assesses and improves a business process throughout its lifecycle by focusing on the necessary capabilities to perform** (Van Looy, 2010)
- **150 available models addressing one or more components of BPM** (de Bruin, 2007)
  - Some models do not encompass all facets of BPM that are critical to progression
  - Some models are relevant to the management of a specific process and not to the management of all process.
- **Identification of BPM Capability Areas**
  - Dephi Technique: establish a "common ground" with an expert panel (de Bruin, 2007)
  - Statistical Analysis: establish a "common ground" by statistical analysis (Van Looy, 2012)

Van Looy's Research Questions

RQ1: Which capability can be assessed and improved by a BPMM in order to reach business (process) excellence?

Identification and foundation of a conceptual framework

RQ2: Which capability areas are actually assessed and improved by existing BPMMs?

Empirical validation of the conceptual framework

RQ3: If RQ2 shows that different capabilities areas are actually assessed and improved, do existing BPMMs Measure different types of maturity?

Classification of BPMMs to refine the earlier findings

	Generic BP	Supply chain	Collaboration	
Academic	13	9	6	**28**
Non-academic	24	15	2	**41**
	37	**24**	**8**	**69**

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A few definitions

- **Business Processs (BP):**
  - A set of executing activities organised by a control scheme to reach a goal.
- **Business Process Management (BPM):**
  - Concepts, methods and techniques to support the design, administration, configuration, enactement, and analysis of business processes.
- **Business process Orientation (BPO):**
  - Organisation that emphasis process, a process oriented way of thinking, customers, and outcomes as opposed to hierarchies
    - Process-oriented culture (rewards linked to the performance of business processes instead of departments)
    - Process-oriented structure (horizontal or matrix chart instead of vertiacal departments).

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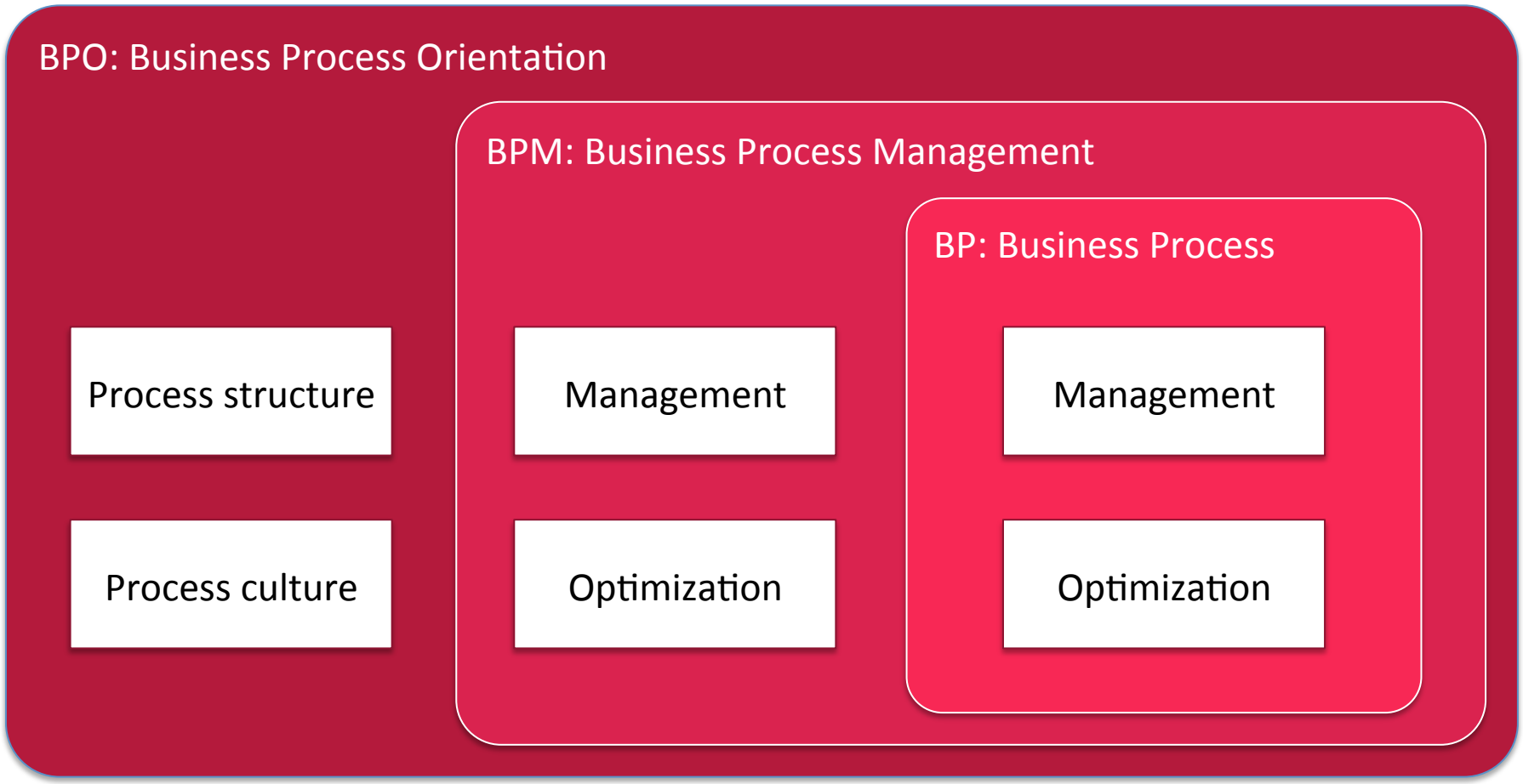
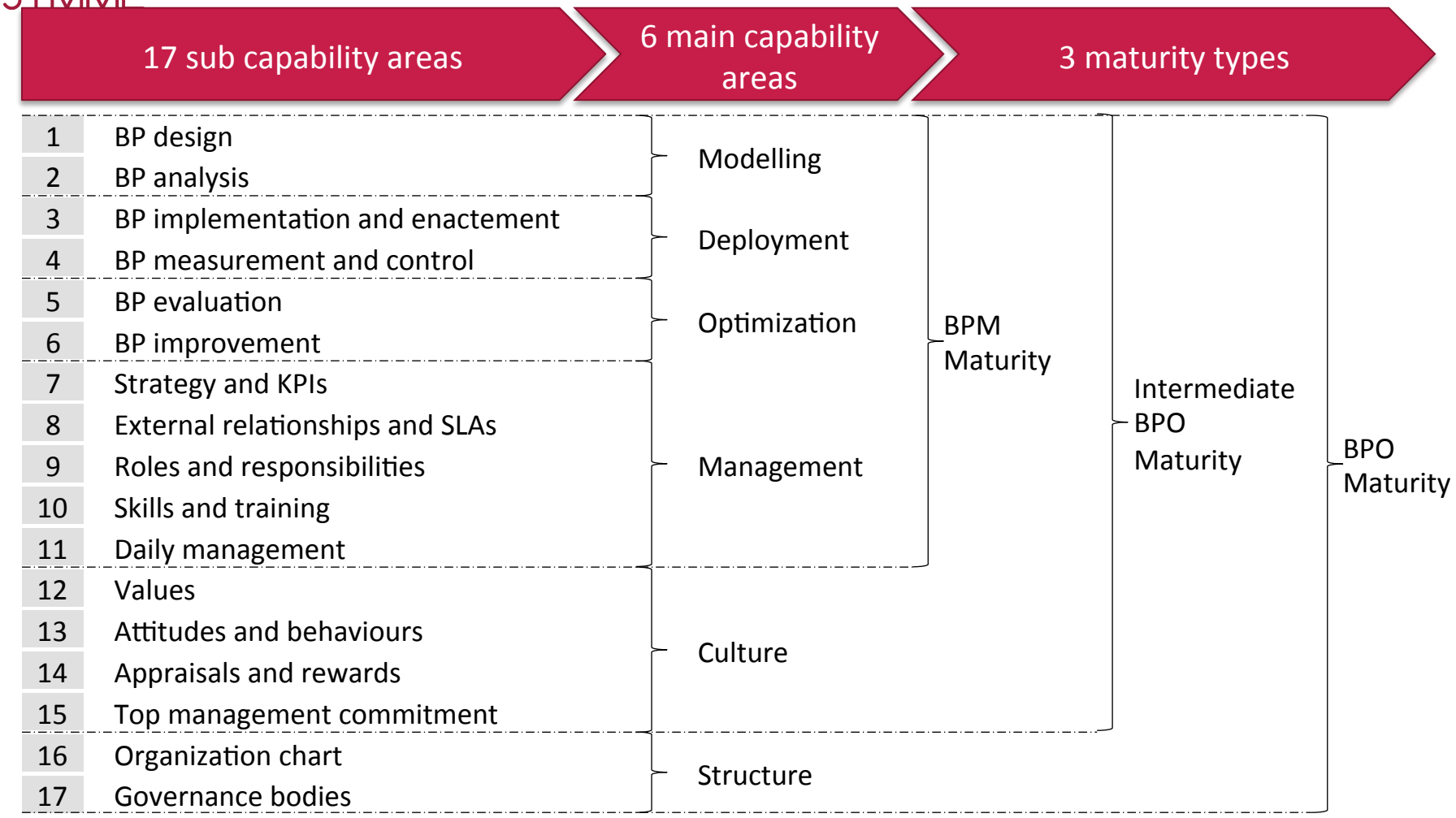
Main Capability areas

- **Modelling**
  - Methods and IT for the design and analysis of business processes.
- **Deployment**
  - methods and IT for the implementation and enactment of business processes (including measurement and control during enactment.
- **Optimization**
  - Methods and IT for the evaluation and improvement (incremental or reengineering) of business processes after enactment.
- **Management**
  - Daily management of business processes by linking process goals to the organisational strategy and the relationships with customers, suppliers and other stakeholders.
- **Culture**
  - Values that favour business processes and their translation in attitudes and behaviours.
- **Structure**
  - Shift in the organisation chart to visualise horizontal business processes and specific governance bodies to coordinate the management of all business processes.

Structure of components in BPMM



Conceptual and classification of capabilities



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Conclusion

- **Definition:**
  - "A maturity model describes and determines the state of perfection or completeness (maturity) of certain capabilities." (Wendler, 2012)
- **The two model components:**
  - Current state of completion : stages
    - Set of levels or **stages** (or levels) describing the development of the examined object in **simplified way**.
    - Stages are **sequential** by nature and represent a **hierarchical progression**.
  - Measured objects : capabilities
    - Criteria for measurement (conditions, processes, application targets).
- **Maturity Models are no "silver bullets"**
- **Application of maturity model is not limited to any particular area**
- **A maturity model represents an anticipated, desired or typical evolution path**

Conclusion

- **Some comments:**
  - Many existing Maturity Models
  - Maturity Models address a lot of areas: project, interoperability, PLM, knowledge, business process, etc.
  - Some studies are based on rigorous literature reviews to analyse:
    - Capabilities to be addressed through a maturity model ((Van Looy, 2012), for example)
    - Maturity Models (holistic study: (Wendler, 2012)), domain study: (Van Looy, 2013), for example)
- **Some questions coming to my mind :**
  - What is my Maturity Model used for?
  - Is it necessary to develop a new Maturity Model? (cf. BPMM studies)
  - Is it possible to use a Domain Maturity Model without taking into account Enterprise Maturity Model?
  - What are the existing methods to rigorously define the factors and capability areas?
  - How can I choose a maturity model for my study?

SYMME

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Journée Nationale du GT EASY DIM 2015

Modèles de maturité et Projet d'entreprise

Lundi, 29 Juin 2015, Université Lumière Lyon 2 – IUT de Bron

Papier 1

Titre : Modélisation des hôpitaux de campagne - Application au cas de l'ESCRIM

*Par : **Laurie Mailhac**, Nicolas Daclin, Vincent Chapurlat, Gilles Dusserre, Franck Guarnieri, Jean Blanchard, Bruno Lheritier, Alexandra Picard, Kerstin Streff, and Isabelle Arnaud*

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Papier & Présentation

Evaluation de la maturité des hôpitaux de campagne – Application au cas de l'ESCRIM[1]

Contexte et objectifs des travaux de recherche

« Une crise (humanitaire, sociale…) est définie comme un phénomène grave, créé par un élément déclencheur, qui plonge le système de départ (social, de décision…) dans une situation instable, d'urgence et d'incertitude » [1]. Pour faire face et aider les régions impactées, certains pays et organisations non gouvernementales proposent des solutions médicales : les hôpitaux de campagne. Ces hôpitaux sont déployés en quelques jours seulement et assurent les services d'un hôpital commun sur le lieu de la crise jusqu'à ce que les structures médicales locales soient capables gérer le flux de patients.

Dans ce contexte, la France peut déployer l'ESCRIM, hôpital de campagne géré par le personnel du Service Départemental d'Incendie et de Secours du Gard (SDIS 30) et de l'Unité d'Instruction et d'Intervention de la Sécurité Civile n°7 (UIISC7).

L'optimisation de la mise en œuvre de l'ESCRIM nécessite une bonne connaissance des processus ainsi que des normes, bonnes pratiques et guides. L'évaluation par modèle de maturité peut permettre au SDIS 30 et à l'UIISC7 d'améliorer le déploiement de l'ESCRIM mais également de fournir un référentiel générique pour tous les autres organismes de ce type.

Approche de recherche proposée

Le développement du modèle de maturité s'appuie (1) sur l'analyse bibliographique des normes relatives aux hôpitaux de campagne et (2) sur la collecte d'informations par interview auprès de deux Organisations internationales Non Gouvernementales à but humanitaire[2] et de l'assistance médicale d'un événement sportif itinérant (rallye).

De l'étude bibliographique, il ressort qu'aucun document ne guide le déploiement et le fonctionnement complet (logistique, gestion des ressources…) d'un hôpital de campagne excepté la classification proposée par l'OMS [2] qui permet d'évaluer les services médicaux selon trois niveaux.

Les interviews sont réalisées pour établir des modèles de processus à l'aide du langage BPMN [3] qui sont ensuite validés par les parties prenantes. L'analyse de ces modèles permet de constituer les axes de développement. Ils doivent particulièrement tenir compte de la difficulté à maîtriser et stabiliser le service médical fourni tout en assurant la logistique ou encore la gestion des ressources.

[1] Elément de Sécurité Civile Rapide d'Intervention Médicale
[2] Pour des raisons de confidentialité ces deux ONG ne sont pas nommées

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Les points remarquables de chaque structure nous permettent d'établir le comparatif suivant :

Tableau 1 : Points remarquables des hôpitaux de campagne étudiés

	Standardisation du matériel	Gestion des périmés	Rapport avec les autorités ou organismes extérieurs	Evaluation du lieu de crise	Gestion des ressources (eau énergie, alimentation) et autonomie	Gestion des déchets	Donations	Démarche processus / qualité
ESCRIM	--	++	+-	++	++	++	+-	+-
ONG A	++	++	--	+-	+-	++	++	+-
ONG B	+-	--	++	++	--	++	++	++
Assistance méd. sport	--	--	++	++	+-	--	--	++

++ : Pleinement considéré par la structure
+- : Partiellement considéré par la structure
-- : Non considéré ou sous-traité

Résultats obtenus

Le modèle de maturité proposé s'inspire en partie de modèles existants comme le CMMI [4] et comporte cinq axes de développement :

- Gestion du matériel : périmés, donations, standardisation…
- Gestion des relations : internes à l'hôpital de campagne et avec son environnement (interopérabilité intra-/exter-)
- Gestion des ressources humaines
- Préparation au départ et au repli
- Organisation de la vie quotidienne en mission : gestion de l'eau, de l'énergie, des déchets et autonomie (alimentation, lieu de vie)

Chaque axe est caractérisé par 5 niveaux de progression pour avoir une évaluation précise de la maturité. A titre d'exemple l'axe Organisation de la vie quotidienne (gestion des déchets) est défini par la figure suivante :

Tableau 2 : Niveaux de progression détaillés sur la Gestion des déchets

	Gestion des déchets
Sources	Manuel de gestion des déchets CICR [5], Standards OMS [6], Guide d'élimination du Ministère de la Santé [7], Code de l'environnement [8]
Niveau 5	✓ Utilisation de documents prescriptifs et/ou normatifs nationaux tel que le guide d'élimination du Ministère de la Santé ✓ Gestion des déchets domestiques selon le Code l'environnement
Niveau 4	✓ Utilisation d'un règlement de la gestion des déchets défini, validé, formalisé, accessible et régulièrement mis à jour, en accord avec les autorités locales
Niveau 3	✓ Gestion des déchets médicaux selon un règlement établi en interne (non validé, non formalisé) ✓ Ou sous-traitance à une entreprise locale agréée ✓ Ou rapatriement et traitement des déchets vers la France
Niveau 2	✓ Gestion primaire des déchets : enfouissement, incinération ✓ Tri des déchets (piquant/tranchant, déchets infectieux/déchets domestiques)
Niveau 1	✓ Pas de gestion des déchets mise en place au préalable ✓ Gestion quotidienne et sur événement avec les moyens locaux

Un dernier axe concerne les services médicaux – selon trois niveaux, tel qu'ils sont décrits par l'OMS. Ces trois niveaux sont conservés dans le modèle final pour garantir l'exactitude des informations contenues dans ce modèle éprouvé. Cependant, les domaines pris en compte dans l'étude d'un déploiement d'hôpital de campagne tels que la logistique, la gestion des ressources humaines, des ressources énergétiques (électricité, eau, alimentation) ou l'interopérabilité possèdent pour certains leur propres modèles de maturité selon cinq niveaux. C'est pourquoi le parti pris est de conserver le nombre de niveaux selon le domaine : trois pour le médical et cinq pour les autres domaines.

Conclusion et perspectives

Pour ce modèle de maturité particulier, les axes d'améliorations ne portent pas sur le bénéfice financier mais sur la qualité des soins prodigués. Les critères de maturité sont donc sélectionnés sans tenir compte de la rentabilité du service.

Le modèle de maturité appliqué aux hôpitaux de campagne s'inscrit dans une démarche globale d'amélioration de l'aide internationale. Elle prend tout son sens à la vue des problèmes rencontrés lors l'aide apportée après le tremblement de terre au Népal (25 avril 2015). En effet, sans moyens logistiques, l'hôpital de campagne ne peut parvenir à sa finalité. L'évaluation de la maturité d'un hôpital de campagne doit donc tenir compte des services de soins prodigués mais aussi de toutes les actions mises en œuvre pour son bon fonctionnement.

Une première version du modèle avec axes de développement et critères définissant les niveaux de progression est réalisée. Cette version doit être validée par les parties prenantes (SDIS et UIISC7). Chaque axe de développement nécessite d'être encore affiné. Il en est de même pour les niveaux de progression qui doivent être caractérisés précisément pour permettre une évaluation efficace de la maturité. Une dernière partie concerne l'agrégation de l'évaluation des axes de développement pour fournir un niveau de maturité globale.

Enfin des recommandations s'appuyant sur le modèle de maturité doivent être émises pour permettre aux utilisateurs d'évoluer au travers des niveaux et tendre vers leurs objectifs.

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Maturity assessment of field hospitals – Application to the case of ESCRIM[1]

Context and objectives

A crisis (humanitarian, social ...) is defined as a serious phenomenon which leads the starting system (social, decision ...) in an unstable, emergency and uncertainty situation". To face up and support impacted areas, some countries and non-governmental organizations make available medical solutions: field hospitals. These hospitals are deployed in few days and provide the common hospital's services on site and until local medical facilities enabling to manage patients flow.

In this context, France can deploy ESCRIM, field hospital managed by the Departmental Service Fire and Rescue of Gard (SDIS 30) and the Unit of Instruction and Intervention Civil Security 7 (UIISC7).

The implementation of the ESCRIM requires understanding processes, available standards, best practices and guidelines. The use of maturity model allows the SDIS 30 and UIISC7 to improve the implementation of ESCRIM but also to provide a generic repository for all other such organizations.

Proposed research approach

The development of the proposed maturity model is based (1) on the literature review of standards related to field hospitals and (2) the collection of information through interviews with both Non-Governmental Organizations[2] and medical assistance organization for itinerant sports event (rally).

The literature review highlights a lack of document dealing with the deployment and the running (logistics, resource management ...) of a field hospital. To this purpose, only the WHO proposes a classification to assess medical services at three levels.

The interviews allow to model processes. These ones are modeled with BPMN and are validated by stakeholders. Their analysis is, first, a basis to propose "development axes" of the maturity model. They should pay particular attention to the difficulty of controlling and stabilizing the medical service provided, while ensuring the logistics and the management of resources.

Results

The maturity model proposed is based on the CMMI model [4] and has five development axes:

- Equipment Management: outdated, donations, standardization...
- Relationship management: internal to the ESCRIM and its environment (interoperability intra / exter-)
- Human Resource Management
- Preparation and withdrawal

[1] Elément de Sécurité Civile Rapide d'Intervention Médicale
[2] For privacy reasons these NGOs are not nammed

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- Organization of the mission: water management, energy, waste and autonomy (food, life-place)

Each axis is characterized by 5 levels of progression to have an accurate assessment of maturity. For instance the axis Organization of the mission (waste management) is defined by:

- Level 5: Use of prescriptive documents and / or national standards such as the removal guide of the Ministry of Health (http://www.sante.gouv.fr/IMG/pdf/Guide_Dasri_BD.pdf), Waste Management Domestic according to the Code de l'environnement
- Level 4: Use of rules documents on the management of waste. This document is defined, validated, formalized, accessible and regularly updated, in agreement with the local authorities (e.g. Https://www.icrc.org/fre/assets /files/publications/icrc-001-4032.pdf)
- Level 3: Medical waste management according to established internal rules (not validated, not formalized) or subcontracting to a local approved firm or repatriation and waste treatment to France
- Level 2: Primary Waste management: landfill, incineration, waste sorting (prickly/sharp, infectious waste/household waste)
- Level 1: No waste management set up before, daily management and on event with local resources

A last axe concerns the medical services (three levels) as they are described by WHO. These three levels are kept in the final model to ensure the accuracy of the information contained in this reliable model. However, the choice of five levels for the other criteria seems relevant since the studied areas take in consideration logistics, resource management and not medicine.

Conclusion and prospects

Last, let us note that the proposed maturity model does not integrate financial aspect but focuses only on providing healthcare. Indeed, the deployment of field hospitals has no profitable purpose.

The maturity model applied to field hospitals is part of a whole approach to improve international aid. It takes on its full meaning with regards to the encountered problems in the assistance after the earthquake in Nepal (25 April 2015). Indeed, without logistics, field hospital cannot achieve its purpose. Thus, the maturity assessment of a field hospital depends not only on care services but also on all actions implemented to its operation.

A first version of the model with development priorities and criteria defining the levels of progression is done. This version must be validated by stakeholders (SDIS 30 and UIISC7). Furthermore, each axe of development requires refinement. In the same way, progression levels must be characterized precisely to enable effective assessment of the maturity. A last aspect is related to the aggregation of the evaluation of development axes to provide global maturity evaluation.

Finally recommendations must be provided to allow stakeholders to evolve through the levels and to reach their objectives.

Evaluation de la maturité des hôpitaux de campagne. Application au cas de l'ESCRIM.

L. Mailhac – G. Dusserre – N. Daclin – V. Chapurlat – F. Guarnieri – J. Blanchard – B. Lhéritier – A. Picard – K. Streff – I. Arnaud

Plan

- Contexte
- Objectifs des travaux de recherche
- Approche de recherche proposée
- Résultats obtenus
- Conclusions et perspectives

Contexte

- **Hôpitaux de campagne : solution médicale aux crises humanitaires (naturelles, technologiques ou conflits)**
- **Différents types :**
  - Organisations gouvernementales (ex. ESCRIM)
  - Organisations privées
  - Organisations Non Gouvernementales

Contexte

Présentation de l'ESCRIM

- Hôpital de campagne projetable français
- Transports air – terre – mer
- Activités médicochirurgicale et obstétricale
- 75 personnes : sapeurs pompiers du Gard et militaires de l'Unité d'Intervention de la Sécurité Civile n°7
- Durée de l'intervention : 2 à 8 semaines
- Plus de 1000 m² de surface de tentes

Source : escrim.org

Objectifs de l'étude

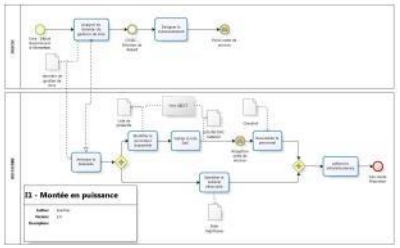
- **Amélioration de l'organisation du déploiement de l'ESCRIM**

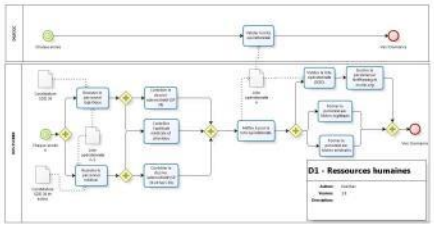
- **A la demande de l'ESCRIM :**
  - Démarche processus
  - Référentiel en terme de normes et niveaux de maturité

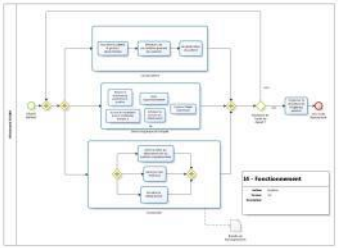
- **Objectif à long terme : Généraliser le référentiel pour en faire un modèle générique à tous les hôpitaux de campagne**

Approche de recherche proposée

- **Démarche de recherche :**
  - Analyse bibliographique des normes et bonnes pratiques relatives à l'aide d'urgence internationale
  - Interviews auprès de :
    - ESCRIM
    - Deux ONG's
    - Structure privée (assistance médicale d'un rallye raid)
  - Analyse de la modélisation des processus
  - Développement du modèle de maturité
  - Validation par les structures étudiées







Approche de recherche proposée

- **Analyse bibliographique**
  - SEI. CMMI
  - SEI. People CMM
  - OMS. Classification and Minimum Standards for Foreign Medical Team in Sudden Onset Disaster
  - Guides publiés par la Croix Rouge
  - Guides publiés par Médecins Sans Frontières

Sources accessibles sur Internet (cf. résumé)

Approche de recherche proposée

- **Interviews**
  - Contraintes fortes du déploiement :
    - Environnement et conditions de vie dégradées
    - Capacité du système à être résilient
  - Un hôpital ne peut fonctionner sans :
    - Stérilisation
    - Eau potable
    - Electricité
    - Relations humaines de confiance
    - …

Résultats obtenus

- **6 axes de développement**
  - Soins
  - Logistique (médicale et non médicale)
  - Gestion des ressources humaines
  - Gestion des ressources (eau, énergie) et impacts (économique, éthique, pollution)
  - Organisation du déploiement
  - Interopérabilité

Résultats obtenus

- **Nombre de niveaux de progression**
  - 3 pour les soins
  - 5 pour les cinq autres axes

- **Les 5 niveaux de progression :**
  - Niveau 1 : Initial
  - Niveau 2 : Reproductible
  - Niveau 3 : Défini
  - Niveau 4 : Maîtrisé
  - Niveau 5 : En optimisation

Résultats obtenus

- **Exemple de la gestion des déchets dans l'axe Gestion des ressources et Impacts :**

	Gestion des déchets
Sources	Manuel de gestion des déchets CICR [5], Standards OMS [6], Guide d'élimination du Ministère de la Santé [7], Code de l'environnement [8]
Niveau 5	✓ Utilisation de documents prescriptifs et/ou normatifs nationaux tel que le guide d'élimination du Ministère de la Santé ✓ Gestion des déchets domestiques selon le Code l'environnement
Niveau 4	✓ Utilisation d'un règlement de la gestion des déchets défini, validé, formalisé, accessible et régulièrement mis à jour, en accord avec les autorités locales
Niveau 3	✓ Gestion des déchets médicaux selon un règlement établi en interne (non validé, non formalisé) ✓ Ou sous-traitance à une entreprise locale agréée ✓ Ou rapatriement et traitement des déchets vers la France
Niveau 2	✓ Gestion primaire des déchets : enfouissement, incinération ✓ Tri des déchets (piquant/tranchant, déchets infectieux/déchets domestiques)
Niveau 1	✓ Pas de gestion des déchets mise en place au préalable ✓ Gestion quotidienne et sur événement avec les moyens locaux

Résultats obtenus

Modèle de maturité (1/2)

	Gestion des Ressources Humaines		Logistique		Organisation d'une mission			
	Personnels	**Suivi des personnels**	**Logistique non médicale**	**Logistique médicale**	**Evaluation de la situation**	**Déploiement**	**Fonctionnement**	**Désengagement**
Sources	People CMM – SEI 2009	Recueil d'informations auprès des hôpitaux de campagnes	OMS Recueil d'informations auprès des hôpitaux de campagnes	OMS	Recueil d'informations auprès des hôpitaux de campagnes	Recueil d'informations auprès des hôpitaux de campagnes	OMS Recueil d'informations auprès des hôpitaux de campagnes	Recueil d'informations auprès des hôpitaux de campagnes
Critères	Critères du people CMM : - Compétences - Reconnaissance - Formation - Développement - Communication - Coordination - Autonomie - Performance - Amélioration continue - +Transmission du savoir, de l'expérience	- Prise en charge médicale en mode dormance et intervention - Prise en charge psychologique - Cohésion d'équipe - Gestion du stress - Adaptabilité	- Capacité à réparer le matériel - Résilience - Polyvalence du personnel - Sécurité & sureté	- Biomédicale - Dispositifs médicaux - Médicaments - Laboratoire - Autonomie	- Evaluation locale pour solution adaptée - Evaluation physique du lieu (appréciation de la situation, pertinence de la réponse, précision de l'évaluation, qualité des informations remontées	- Kits de déploiement rapide	- Horaires d'ouverture - Langues	- Gestion des donations - Formation des locaux - Continuité des soins - Gestion RH des locaux

Résultats obtenus

Modèle de maturité (2/2)

	Impact environnemental		Gestion des ressources et de l'impact			Interopérabilité
	Niveaux de soins	**Normalisation des pratiques**	**Autonomie**	**Coût**	**Gestion des déchets**	**Interopérabilité**
Sources	OMS Classification and minimum standards for FMT in sudden onset disaster	Normes NF	Recueil d'informations auprès des hôpitaux de campagnes OMS	Recueil d'informations auprès des hôpitaux de campagnes	Guide de la Croix Rouge, Standards OMS, Normes française	Normes
Critères	- Critères de l'OMS: - Triage - Réanimation - Stabilisation du patient - Soins des blessures - Gestion des fractures - Anesthésie - Chirurgie - Soins intensifs - Soins des maladies transmissibles - Urgences obstétriques - Urgences pédiatriques - Urgences des maladies chroniques - Rééducation - Laboratoire et transfusion sanguine	- Savoirs et savoirs faire - Diplômes/titres - Norme NF/ISO - Traçabilité - Ethique du malade - Droit du patient - Langues	- Transports - Personnels - Infrastructure/hébergement - Alimentation fluides énergies	- Impact sur l'économie locale - Impact éthique	- Tri des déchets - Incinération, enfouissement	- Interopérabilité entre le SDIS et UIISC - Interopérabilité avec les centres de soins locaux - Interopérabilité avec les autorités et ambassade - Enregistrement à l'OMS

Conclusions et perspectives

- **Hôpitaux de campagne : méthodes, fonctionnement et processus différents**
- **Modèle de maturité en cours d'élaboration : 2ème boucle de développement**
- **Après avoir finalisé le modèle : émission des recommandations pour permettre à l'ESCRIM d'évoluer vers leurs objectifs**

Evaluation de la maturité des hôpitaux de campagne. Application au cas de l'ESCRIM

L. Mailhac – G. Dusserre – N. Daclin – V. Chapurlat – F. Guarnieri – J. Blanchard – B. Lhéritier – A. Picard – K. Streff – I. Arnaud

Journée Nationale du GT EASY DIM 2015

Modèles de maturité et Projet d'entreprise

Lundi, 29 Juin 2015, Université Lumière Lyon 2 – IUT de Bron

Papier 2

Titre : A Maturity Model to Promote Collaboration in Business Processes

Par : ***Maroua Hachicha****, Néjib Moalla, Yacine Ouzrout*

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Papier & Présentation

A Maturity Model to Promote Collaboration in Business Processes

I. Contexte, motivation and problematic

To remain competitive and agile, modern organizations invest several business and IT enablers in order to supervise their change management initiatives. In this perspective, research in enhancing business process management (BPM) capabilities (maturity, risk assessment, etc.) presents relevant guidelines in order to adapt IT solutions when business requirements evolve. In this paper, we will focus on these capabilities and mostly on the maturity of Collaborative Business Processes (CBP).

Maturity is defined as a measure to assess the capabilities of an organization in regards to a certain discipline and practices. Maturity models (MMs) have been confirmed as an important tool for permitting organizations a better understanding of their current state of development and help them to find the best way for change and achieving an appropriate level of maturity. The main objective of MMs is to assess organizations in order to know their maturity level with respect to a set of best practices. MMs describe the evolution of a specific entity over time. CB P can evolve over time, and MMs can show and measure this evolution. Thus, MMs are based on the description of processes that must be implemented to achieve the excellence level of maturity. Achieving each level of maturity allows an incremental and lasting improvement in performance. How to evaluate the maturity of CBPs in Service oriented Architectures (SOA)?

II. Related work

II.1. Maturity Models

The assessment of process maturity is to evaluate organization's strength and weakness and to enable organization to know which level the organization stays in [1]. Rosemann et al. [2] and Melenovsky & Sinur [3] based on six critical success factors' performance, comparing Fisher [4]'s five factors. Although these authors focus on the different factors, all the authors try their best to introduce factors into the BPM-maturity model. Rosemann et al [2] and Melenovsky & Sinur [3]apply the similar factors (strategic alignment, culture and leadership, people, governance, methods and information technology) and a lot of organizations begin to use their achievements.

MMs can be used as a representation of the as-is situation, a recommendation for achievement, an instrument for controlling and measuring the success of an action [5]. According to Santos et al. [6] a MM is as an assessment tool to evaluate the maturity of different organizations not only in terms of interoperability but also collaboration capabilities.

In the literature, there is several MMs, for example : The capability maturity model (CMM) [7] and [8], business and IT alignment is Luftman's maturity model [9], ICoNOs maturity model [10], Levels of Information Systems Interoperability' (LISI) [11], EIMM [12], Supply Chain Management Maturity Model, SCM-MM [13], SCOR MM [14], ECMM [15], Paché and Spalanzani [16] and MMEI [17].

In this papier, we are interested to CMM models that focus on improving processes in an organization. They contain the essential elements of effective processes for one or more disciplines and describe an evolutionary improvement path from ad hoc, immature processes to disciplined, mature processes with improved quality and effectiveness [18].

II.2. CMMI (Capability Maturity Model® Integration)

All CMMI models contain 16 core process areas. These process areas cover basic concepts that are fundamental to process improvement in any area of interest (i.e., acquisition, development, services)[19]. CMMI is an integrated, extensible framework for improving process capability and quality in an enterprise, coordinating process improvement efforts and measuring and monitoring the status of those efforts. The CMMI provides a basis for benchmarking the "capability" of individual processes and the "maturity" of organizational efforts relating to process. One distinctive feature of CMMI is its use of "levels" to measure both: the capability of an organization in individual process areas (from capability level 0 to capability level 5, with capability level 5 being best), and an overall organizational process maturity rating (from maturity level 1 to maturity level 5, with maturity level 5 being best) [20].
Organizations achieve Maturity Level 3 have done so by institutionalizing practices that have worked well on previous projects. The determination that the practices work well is generally established qualitatively. It's not until an organization reaches Maturity Level 4 that it begins to have a quantitative knowledge of the efficacy of its processes. There are limitations on the ability to quantitatively relate process maturity to delivered product quality.

III. Methodology

We developed an analysis and assessment approach for CBP-SOA based environments. This approach aims to maintain CBP performance (Alignment Business/IT, synchronization, agility, maturity, interoperability, etc.) in extremely competitive and dynamic markets. Our proposal includes an assessment model that integrates execution measures for CBPs with services implementing them. Therefore, our approach proposes an evaluation method using execution traces by monitoring IT combined with a high level method using Key Performance Indicators (KPI) (see Figure 1). In the literature, the concepts of enterprise architecture provide several decompositions of viewpoints. We identified in our work three abstraction levels which are elaborated by [22] [23]:

- Business: we describe the objectives and company requirements,
- Functional: we define the process specifications to ensure the feasibility of the process execution,
- Applicative: the process is executed and it runs.

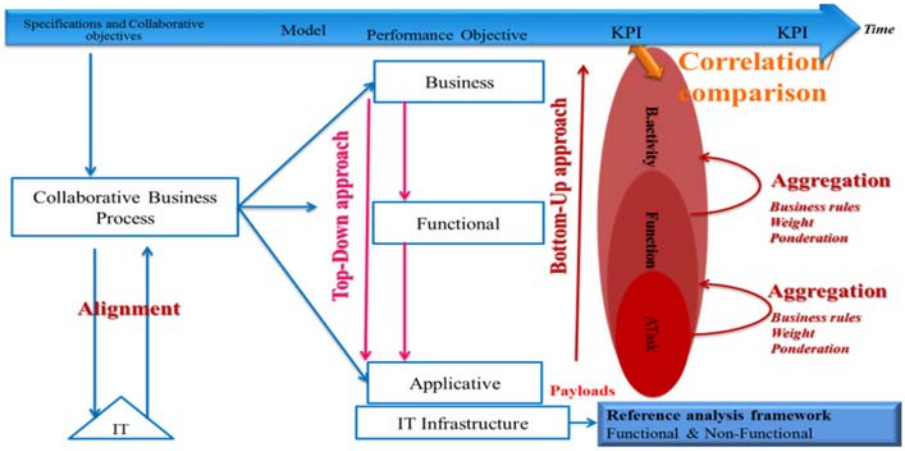

Figure 1. Aggregation model

Table 1. Maturity levels

Maturity Level	***Explanation***	***Potentiality quantification***
Level 1: Initial	No reliable process, no control, general indiscipline	20%
Level 2: Managed	disciplined process	40%
Level 3: Defined	Standardized, improved processes	60%
Level 4: Quantitatively managed	Quantified, systematic application of measurement processes	80%
Level 5: optimizing	continuous improvement, control of change	100%

We create at the applicative level a reference analysis framework that will exploit data collected from business process execution environment (SOA/BPM) given from IT infrastructure. In this reference, we identified functional and non-functional concepts (duration, maturity, risk, frequency, interoperability, etc.).

These set of technical indicators have been calculated in the run time. In order to facilitate the exploitation of collected information, we propose a first level of aggregation mechanism permitting to define a common value for the assessment of each applicative task. Some aggregation rules (min, max, average, etc.) have been fixed to move from one level to the higher level until the business level in order to consolidate performance level for the CBP (see Figure 2).
In this paper, we will focus on the maturity of CBP. Our CBPs are assessed using the scheme of five levels of The CMMI model (see Table 1): Initial, Repeatable, Defined, Managed and Optimized. For each level, we associate the appropriate ponderation in order to facilitate the calculation of maturity of the integrity of the CBP.

In the perspective of defining an assessment model for the maturity of CBPs, we propose an analytic process model. In fact, the analysis of any process lifecycle allows identifying the following steps:

- Perception: the process has been selected,
- Business specifications: the stage where we answer to the strategic and business objectives,
- Functional specifications: it is the adaptation stage where we define what is possible to implement,
- Implementation of the application: we choose the technology of implementation and execution of the process,
- Test the application: we make sure in this stage that our application is ready to be deployed,
- Deployment: instances of the process are launched and ready to be used by the end users,
- Use: the stage where process is used and runs,
- Test of performance: the stage where the process has been evaluated its performance by using metrics and indicators,
- Detection of deviation: we identify events and degradation in the performance trajectory of the process,
- Alignment Business/IT: the company's strategy are in harmony with business processes and systems that support them,

- Dissemination: the stage where the process doesn't answer to any business / or strategic objective and we should freeze it for revision.
- End of lifecycle: process is stopped.

Table 2. Process lifecycle management maturity

	Initial	Managed	Define	Quantitatively managed	Optimizing
Perception	X				
Business specification		X			
Functional specification		X			
Implementation of the application			X		
Test the application			X		
Deployment			X		
Use			X	X	
Test of performance				X	
Detection of deviation				X	
Alignment Business/IT				X	X
Dissemination	X				
End of lifecycle	X				

The correspondence between process lifecycle stages and maturity levels is resumed in the above table (see Table 2). Only the most relevant projections between business process stages and maturity levels are considered. This matrix is able to supervise the evolution of business process maturity during its lifecycle. The objective of this matrix is to achieve the process optimization. The CMMI is considered a basic foundational building block for achieving process improvement.

The process is considered disciplined and managed when its business specifications and objectives are identified. Once the functional specifications are define, the process start to be improved. The business process is considered optimized if the business objectives are aligned with IT supporting the business process. In fact, once alignment Business / IT is reached, the business objectives become in correspondence with the business processes and systems supporting them. Besides, the process is stable and all special causes of variation have been removed. Therefore, the process is considered optimizing.

The knowledge of process performance tends to be more qualitative rather than quantitative up to Maturity Level 3 'define'. In this level, we can obtain measures that provide information about the status of the various implemented processes, but they don't provide the same type of knowledge that exists at Maturity Level 4 'Quantitatively managed'.

The real use of the business process by its end users corresponds to the Maturity level 4. In this level, the organization has collected various types of data on process status and performance. It insists on managing process performance and addressing the main causes and sources of process variation. These causes of process variation can indicate a problem in process performance and may require correction and solution to maintain process performance during its utilization. At Maturity Level 5, organization emphasizes on reducing the common cause of variation and noise and it improves the process performance level.

Based on this framework, a specific aggregation model for the maturity is created in order to evaluate the maturity of the CBP (see Figure 2).

From the execution traces of the process, we calculate using *potentiality quantification* in the table 1 for each task of the CBP.

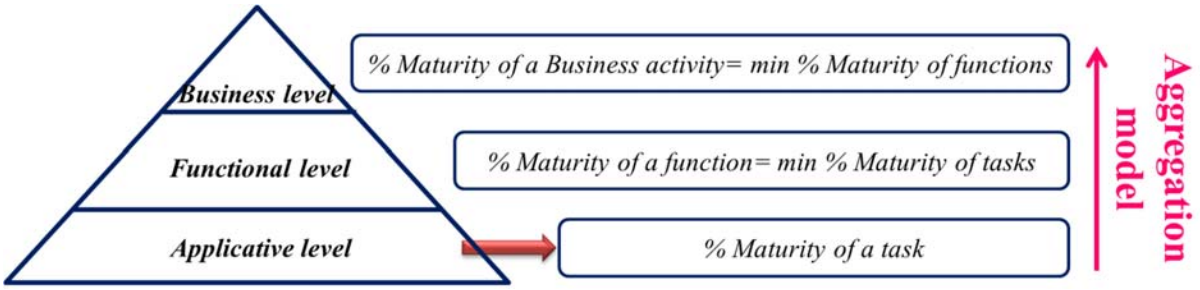

Figure 2. Aggregation model for CBP maturity

For the aggregation at the applicative process level, we apply a serialization mechanism for process tasks in order to solve parallel branches by the maximum value rule. After that, we assume the following composition rules:
- The applicative level is composed of a set of applicative tasks,
- The functional level is composed of a set of functions,
- The business level is composed of a set of business activities,
- Each applicative task is a sub-class of a functional task,
- Each functional task is a sub-class of a business task.
- Maturity of a function task is the min of maturity of the applicative tasks composing it.
- Maturity of a business activity is the min of maturity function tasks composing it.

To validate our aggregation model, we studied CBPs of APR (Application Plastique du Rhône) company. This process has been defined in the framework of FITMAN project and it focus on the customer and supplier management of request.

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Modèles de maturité et Projet d'entreprise

A Maturity Model to Promote Collaboration in Business Processes

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Agenda

- Purpose
  - Context
  - Motivating issues
  - Research questions
  - Objectives
- Related work
- Proposed approach
- Results and discussions
- Relevance/contribution
- Conclusion & perspective

Context

2 Europeans Projects :

- Deployment software components allowing the integration of information systems and promoting collaboration in networked enterprises,
- Integration of Future Internet enablers and related technologies (BPM, SOA, ontologies,…) to support for business collaboration,
- Evaluation of Business processes (BP) performance in manufacturing industry.

Motivating issues

Objective of companies: Remain competitive and agile

- Investment in several business and IT enablers → to supervise their change management initiatives.
- Investment in building and maintaining new collaborations.

Research in enhancing BPM capabilities (**maturity**, risk Interoperability, etc.) presents relevant guidelines → adapt IT solutions when business requirements evolve.

Research questions

- Evolution of Collaborative Business Processes (CBP) during the time: CBP objectives, IT supporting collaborative processes;

How to enhance and accelerate the evaluation of collaborative BP performance?

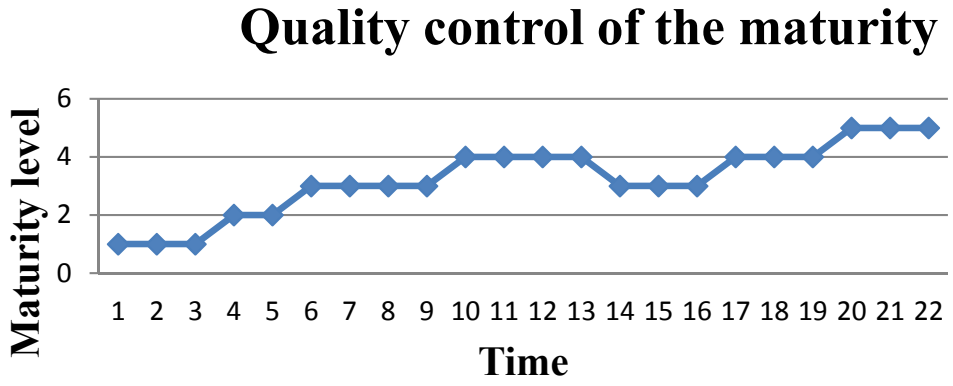
- key indicators of the CBP performance (**Maturity**, Risk, etc.).
- Evolution of the maturity during the time and the impact on the performance.

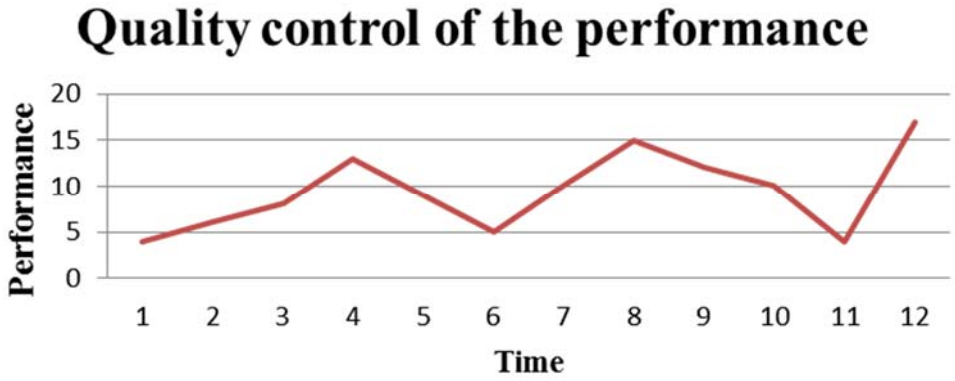
What is the relationship between maturity and performance?

Maturity ? **Performance**

Objectives

- **Execution tracking**: Find aggregation model to evaluate CBPs from execution traces.
- **Analysis**: analyze the impact of the maturity on CBP performance and vice versa.





- **Definition of maturity rules:** Implement of rules based on the history of analysis and traces.

Maturity Models (MM)

- The assessment of process maturity is to evaluate organization's strength and weakness and to enable organization to know which level the organization stays in [1].

- MMs can be used as a representation of the as-is situation, a recommendation for achievement, an instrument for controlling and measuring the success of an action [5].

- Examples of MMs : The capability maturity model (CMM) [7] and [8], business and IT alignment is Luftman's maturity model [9], ICoNOs maturity model [10], Levels of Information Systems Interoperability' (LISI) [11], EIMM [12], SCOR MM [14], ECMM [15], and MMEI [17].

CMMI

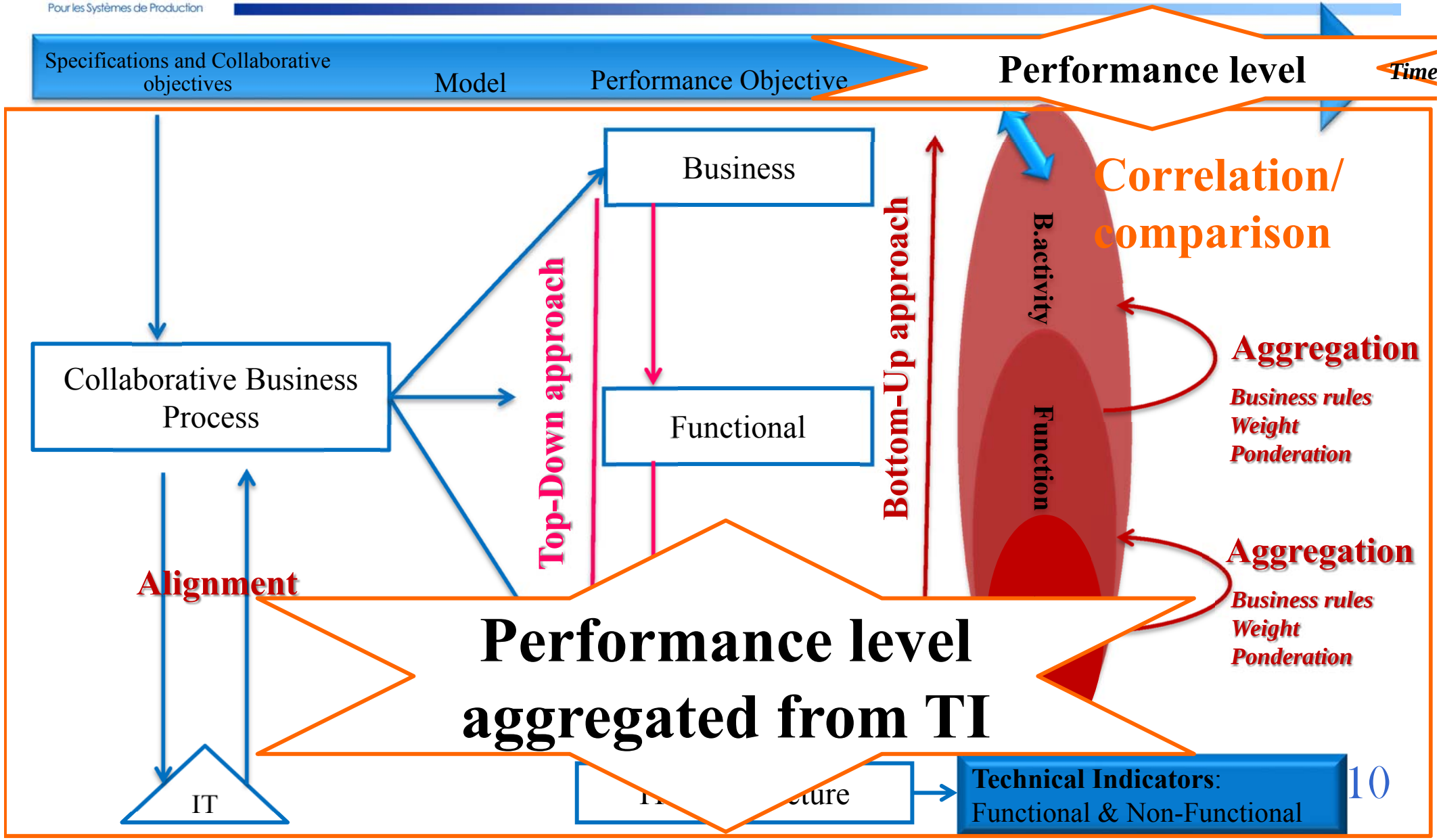
- CMMI is evolutionary tools to systematically assess and improve capabilities (i.e. skills or competences) in order to reach business (process) excellence [31].

- There are two possible representations of the CMMI approach:
  - Staged representation: 5 maturity levels are defined related to all activities that must be evaluated ; process area are defined for each activity and they must be improved in order to achieve the specific level of maturity,
  - Continuous representation: levels of capacity (CL) are defined. A CL is a measure assigned to a single area of the area of the process.

Research gap

	Existing researches in literature	Our proposed approach
Evaluate the performance of Business Process	X	X
Measure the maturity of business process	X	X
Analyze the evolution of the maturity and its impact on the performance		X

Proposed Approach

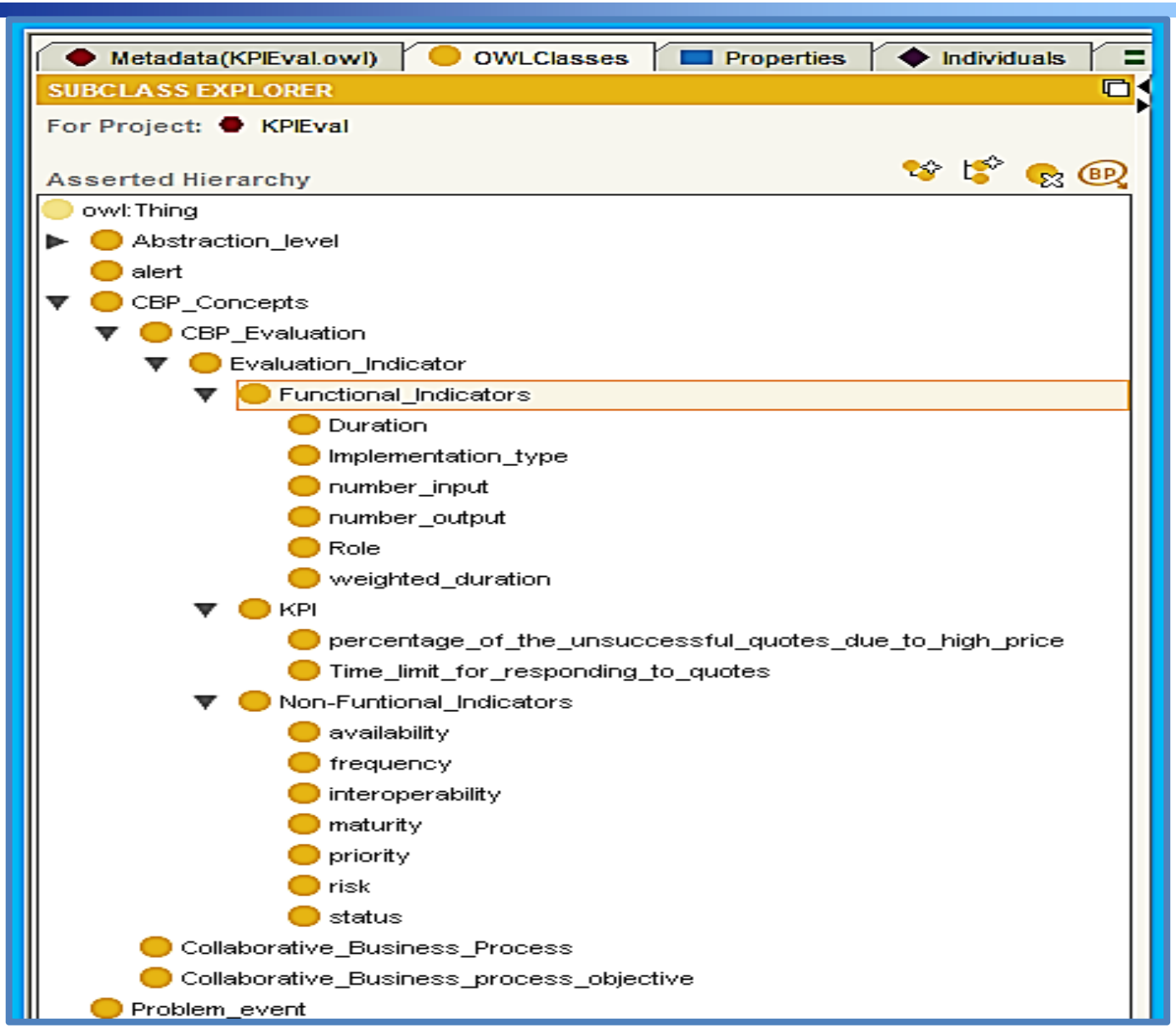


Reference analysis Framework (Applicative level)

Technical Indicators		Concept details	Performance
Functional	*Implementation type*	User task or Manuel task or service task	%
	input	Number of parameters	%
	output	Number of parameters	%
	Role	Internal / External	%
	Duration	Time between start time and end time of the task	%
		Task duration/average duration of the same type	%
Non-Functional	*Priority*	low priority, medium priority, high priority	%
	Status	Task completed or uncompleted	%
	Maturity	level of maturity	%
	Risk	% risk for succeed	%
	Frequency	Number of Calls	%
	Availability	Number of successful answers	%
Applicative task			%

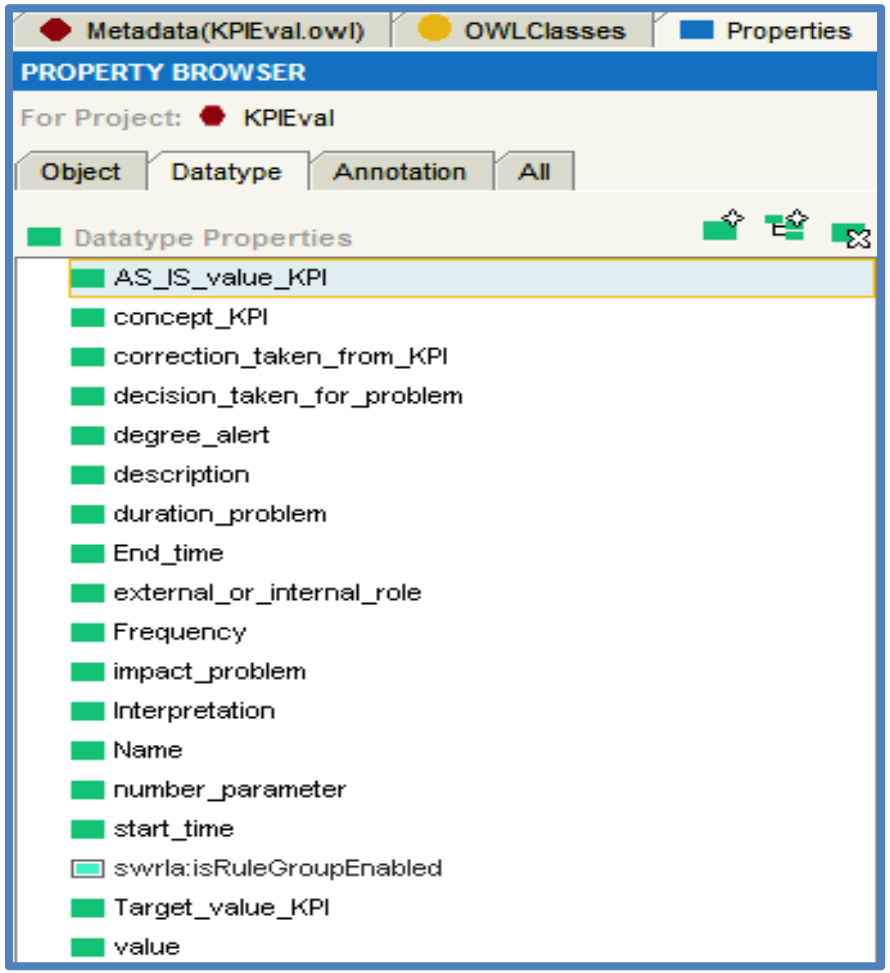
A knowledge repository based on ontological model

Concepts/ classes

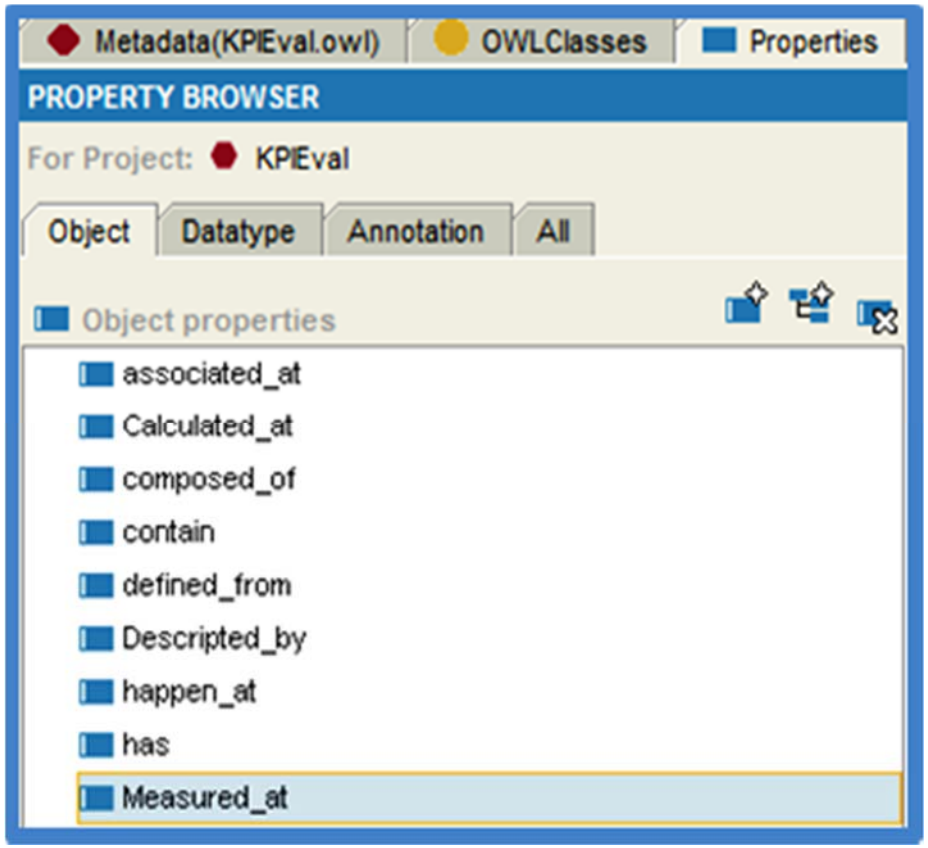


A knowledge repository based on ontological model(Proprieties)

Attributes: containing information of concepts

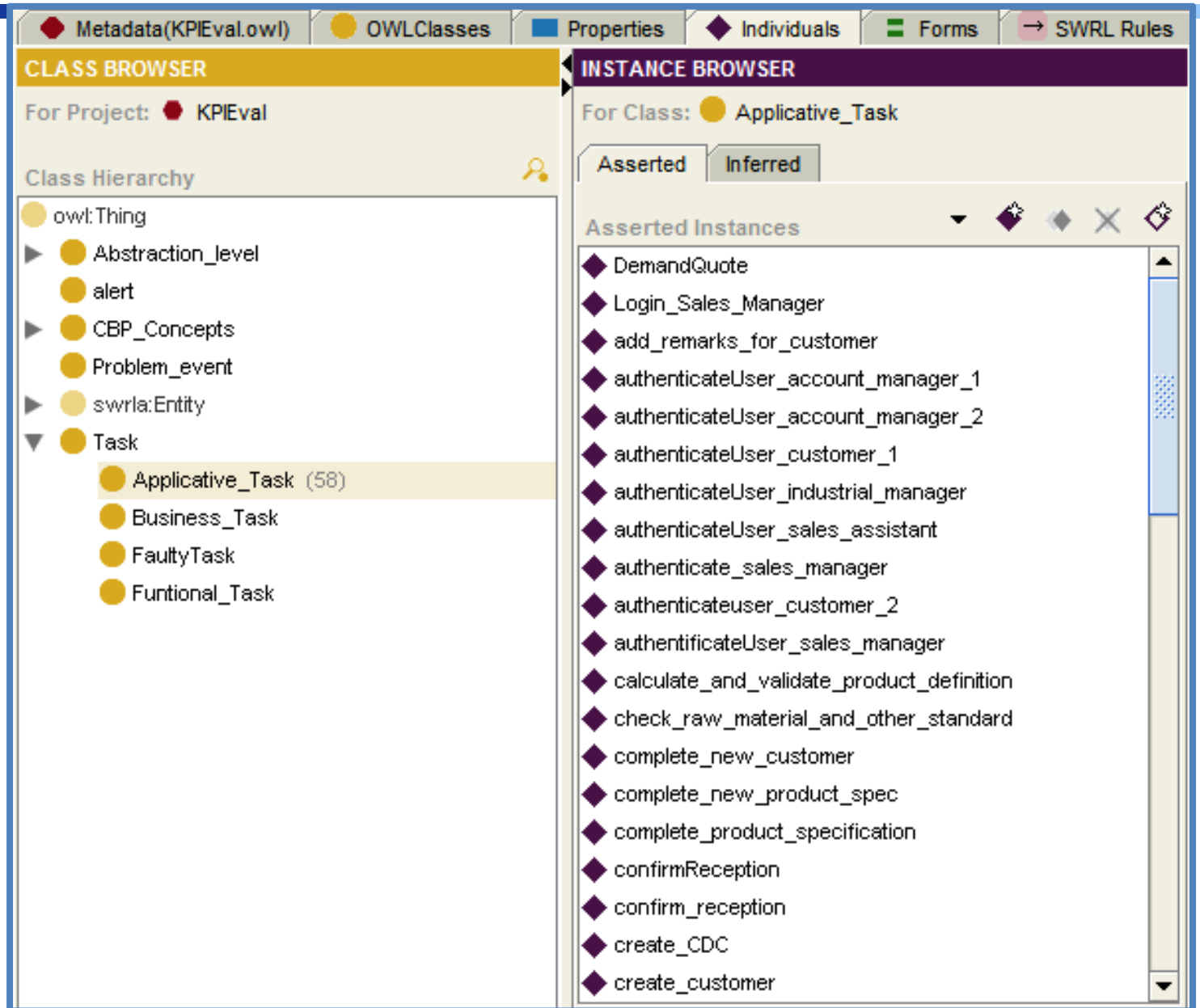


Relations between concepts



A knowledge repository based on ontological model (Instances)

Individualization



A knowledge repository based on ontological model

(SWRL Rules)

Aggregation Rules from the application level to the business level

Metadata(KPIEval.owl) | OWLClasses | Properties | Individuals | Forms | SWRL Rules

SWRL Rules

Enabled	Name	
☑	Businesslevel_Duration	→ Duration(?x) → sqwrl:sum(duration_value_functional_task)
☑	Businesslevel_Frequency	→ frequency(?x) → sqwrl:min(value_frequency_functional_task)
☑	Businesslevel_Input	→ number_input(?x) → sqwrl:max(number_parameter_input)
☑	Businesslevel_Output	→ number_output(?x) → sqwrl:max(Number_parameter_output)
☑	Businesslevel_Priority	→ priority(?x) → sqwrl:avg(value_priority_functional_task)
☑	Businesslevel_Risk	→ risk(?x) → sqwrl:max(value_risk_functional_task)
☑	Businesslevel_Status	→ status(?x) → sqwrl:min(value_status_functional_task)
☑	Functional_Frequency	→ frequency(?x) → sqwrl:min(value_frequency_applicative_task)
☑	Functional_implementationType	→ Implementation_type(?x) → User_Task(?x)
☑	Functional_Output	→ number_output(?x) → sqwrl:max(Number_parameter_output)
☑	Functional_Priority	→ priority(?x) → sqwrl:avg(value_priority_applicative_task)
☑	Functional_Risk	→ risk(?x) → sqwrl:max(value_risk_applicative_task)
☑	Functional_status	→ status(?x) → sqwrl:min(value_status_applicative_task)
☑	Funtional_Duration	→ Duration(?x) → sqwrl:sum(duration_value_applicative_task)
☑	Funtional_Input	→ number_input(?x) → sqwrl:max(number_parameter_input)

The exploitation Model of execution traces

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Business level

Functional level

Applicative level

BPMN | SOA | ERP

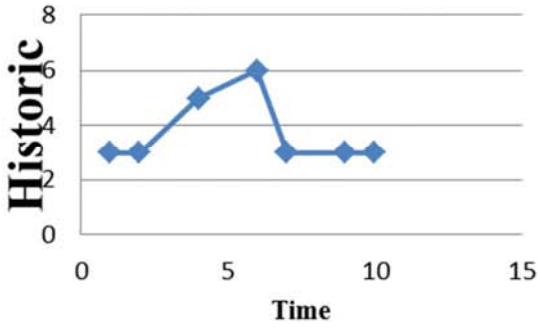
Batch

Traces in DB

Queries to fetch data

Take decision for the performance

estimation rules to improve the repository



Template/Repository:

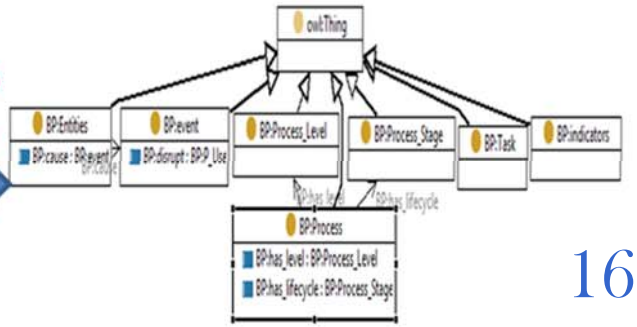
Reference analysis framework

*-Filling, in **run-tim,** of the **Functional Indicators with Frequency F1***

*-Filling of the **Non-Functional Indicators with Frequency F2** (Evolution, average during a period)*

- Using Rules (Formula, calculation)

Queries to fetch data



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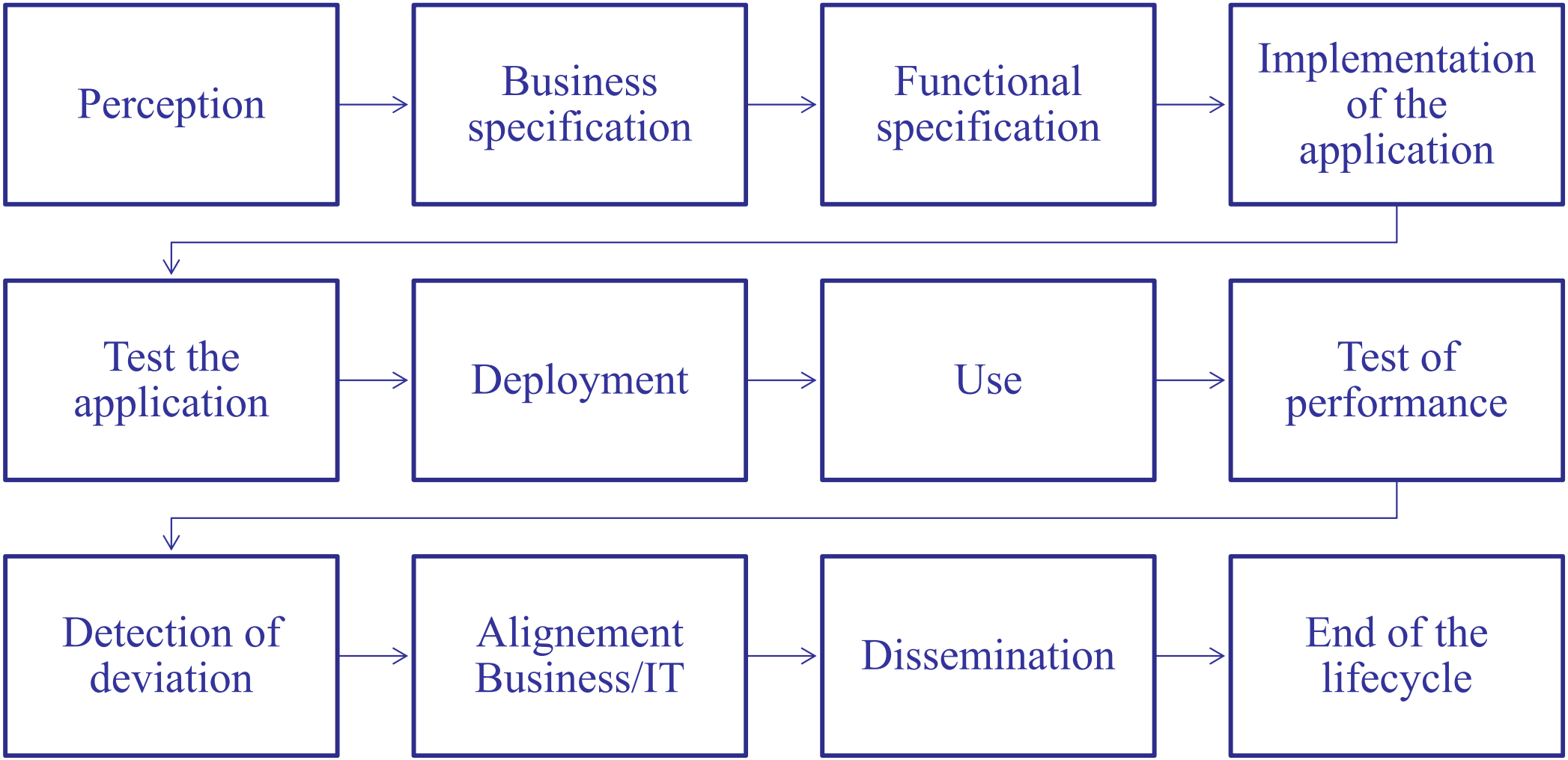
Business Process lifecycle



Quantification of Maturity levels

Maturity Levels[2]	Explanation	Potentiality quantification
Level 1: Initial	No reliable process, no control, general indiscipline	20%
Level 2: Managed	disciplined process	40%
Level 3: Defined	Standardized, improved processes	60%
Level 4: Quantitatively managed	Quantified, systematic application of measurement processes	80%
Level 5: optimizing	continuous improvement, control of change	100%

Process lifecycle management maturity

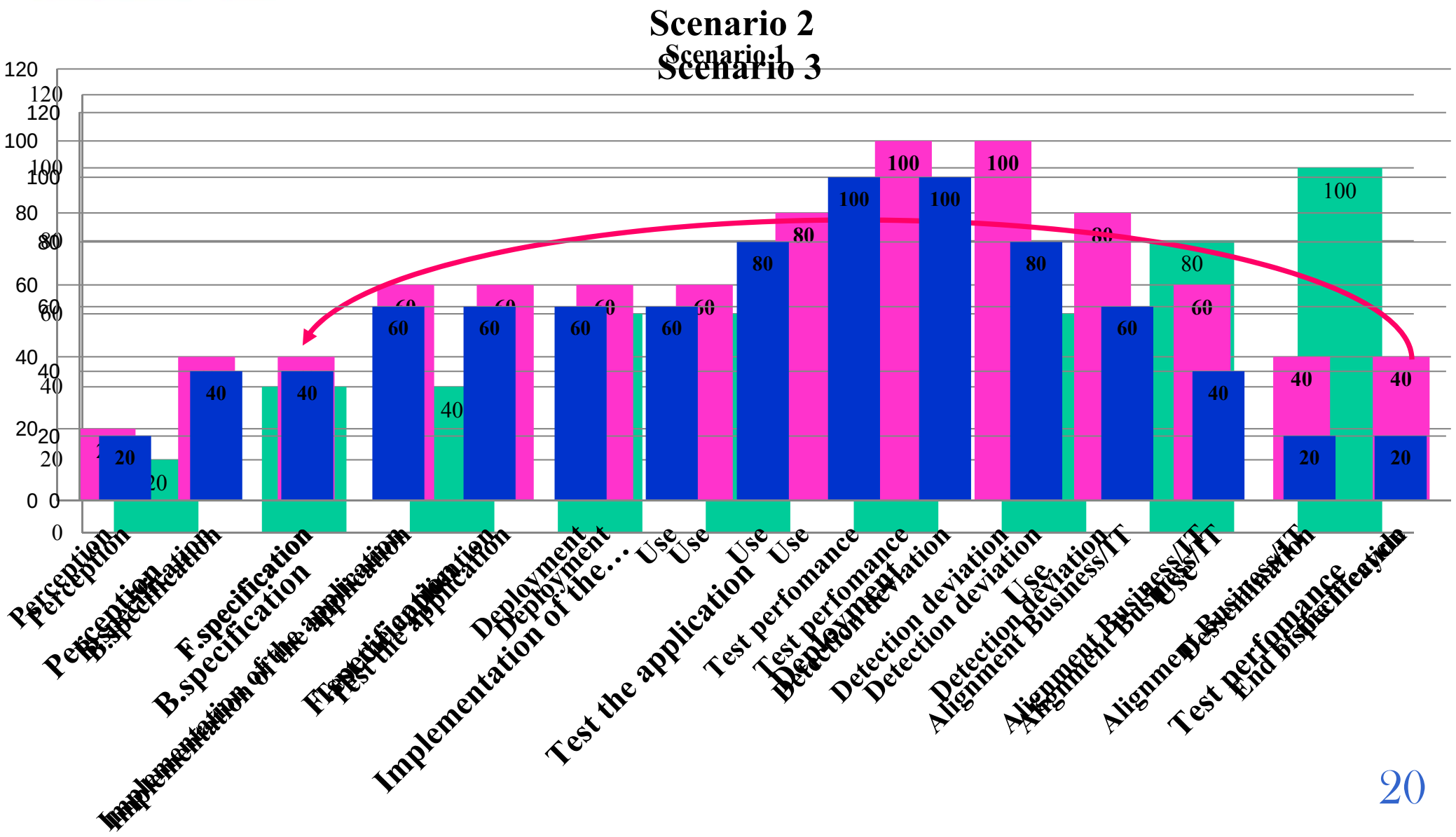
	Initial	Managed	Define	Quantitatively managed	Optimizing
Perception	X				
Business specification		X			
Functional specification		X			
Implementation of the application			X		
Test the application			X		
Deployment			X		
Use			X	X	
Test of performance				X	X
Detection of deviation				X	X
Alignment Business/IT		X	X		
Dissemination	X				
End of lifecycle	X				

Scenario1: No detected problems

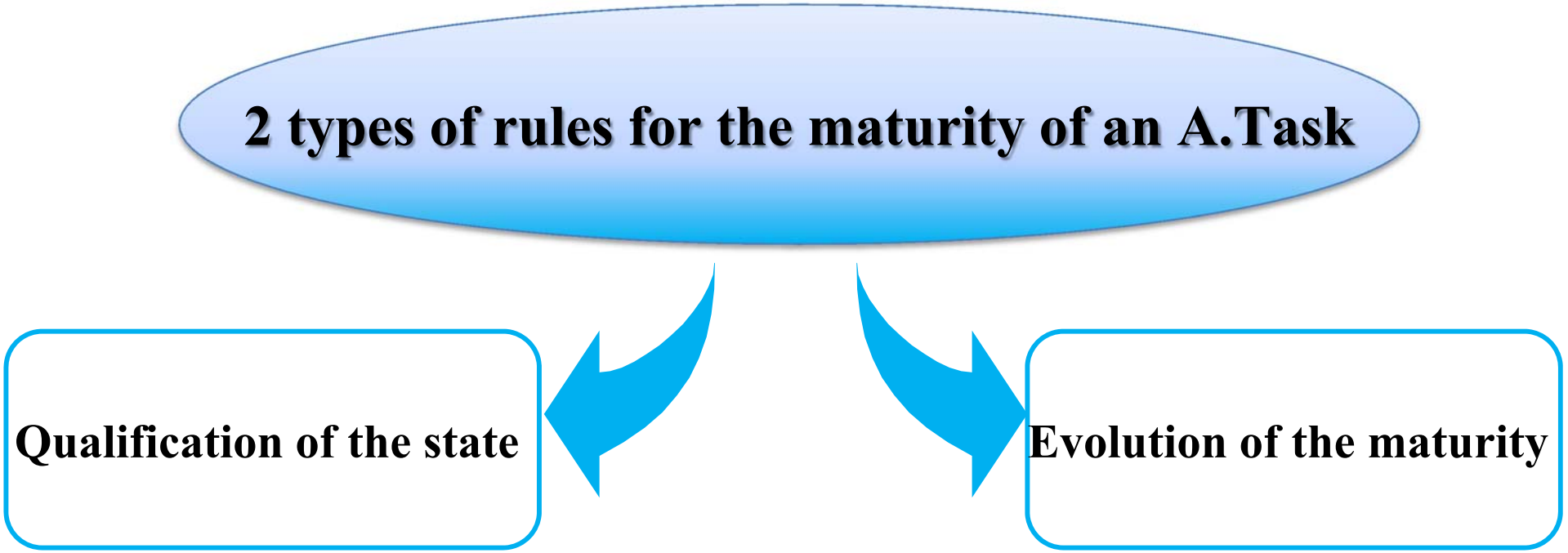
Scenario2: Detected problems and resolution

Scenario 3: Detected problems and end of the BP

Analysis of the 3 scenarios



Applicative Task Maturity rules



Definition of these rules:

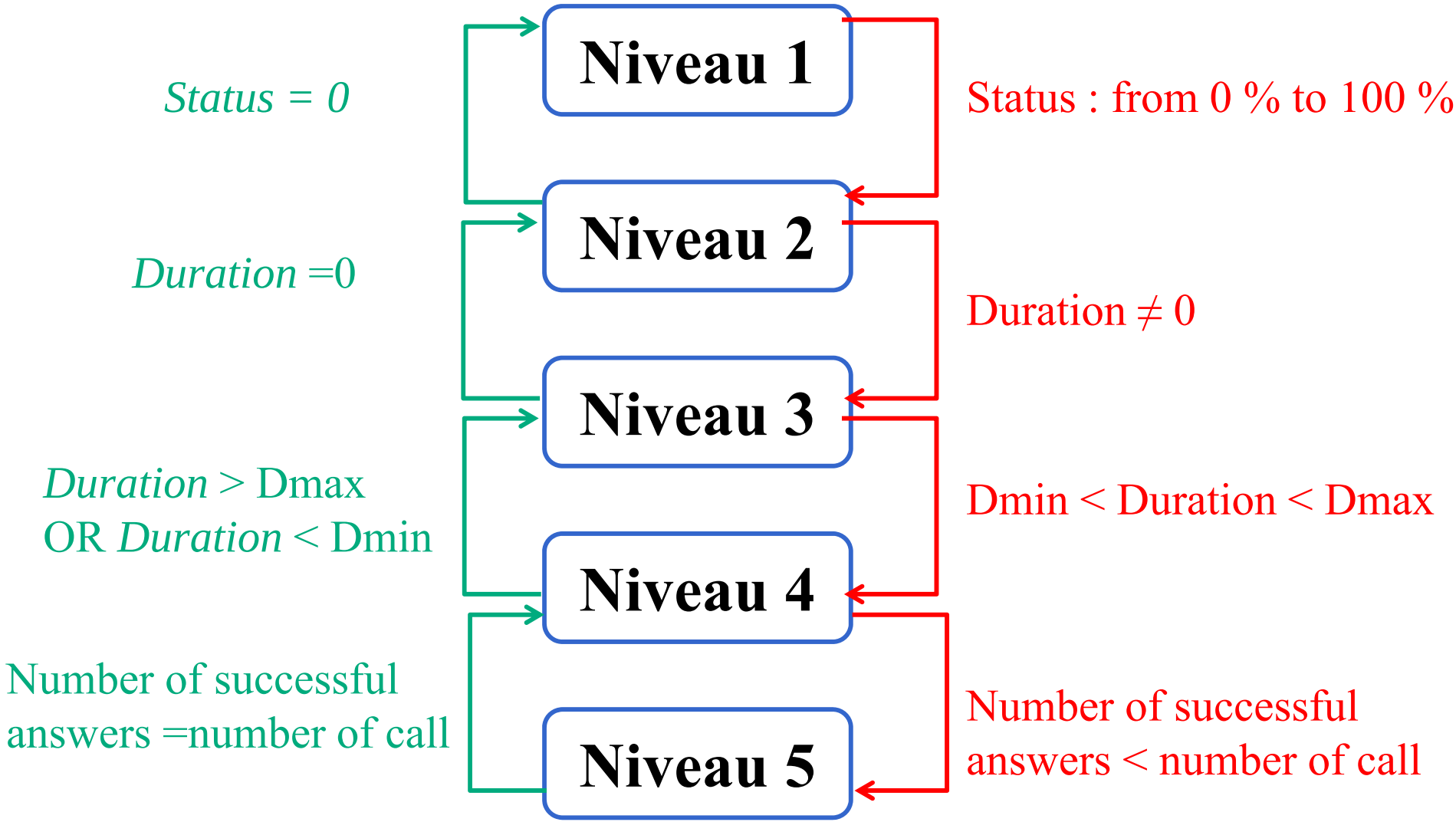
- From collected data and executions traces;
- Estimation rules based on the existed data in the ontology.

Qualification of the state Rules

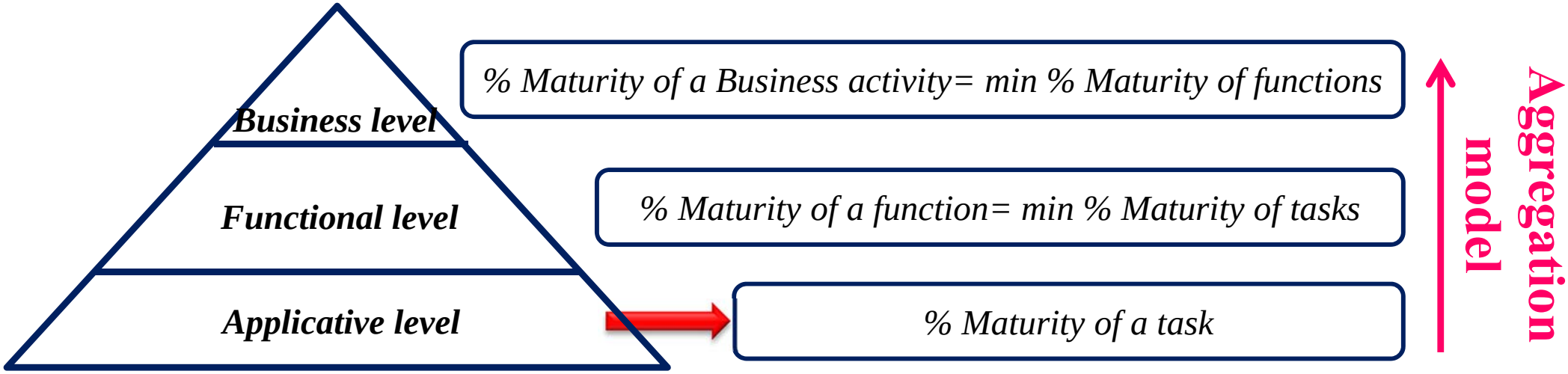
During a defined period T :

Maturity levels	Rules
Level 1	*Status* = 0%
Level 2	*Status* = 100%
Level 3	*Status* = 100% AND *Duration* > 0
Level 4	*Status* = 100% AND Dmin < *Duration* < Dmax
Level 5	*Number of successful answers* < Number of call OR *Duration* > Dmax OR *Duration* < Dmin

Evolution of the maturity rules



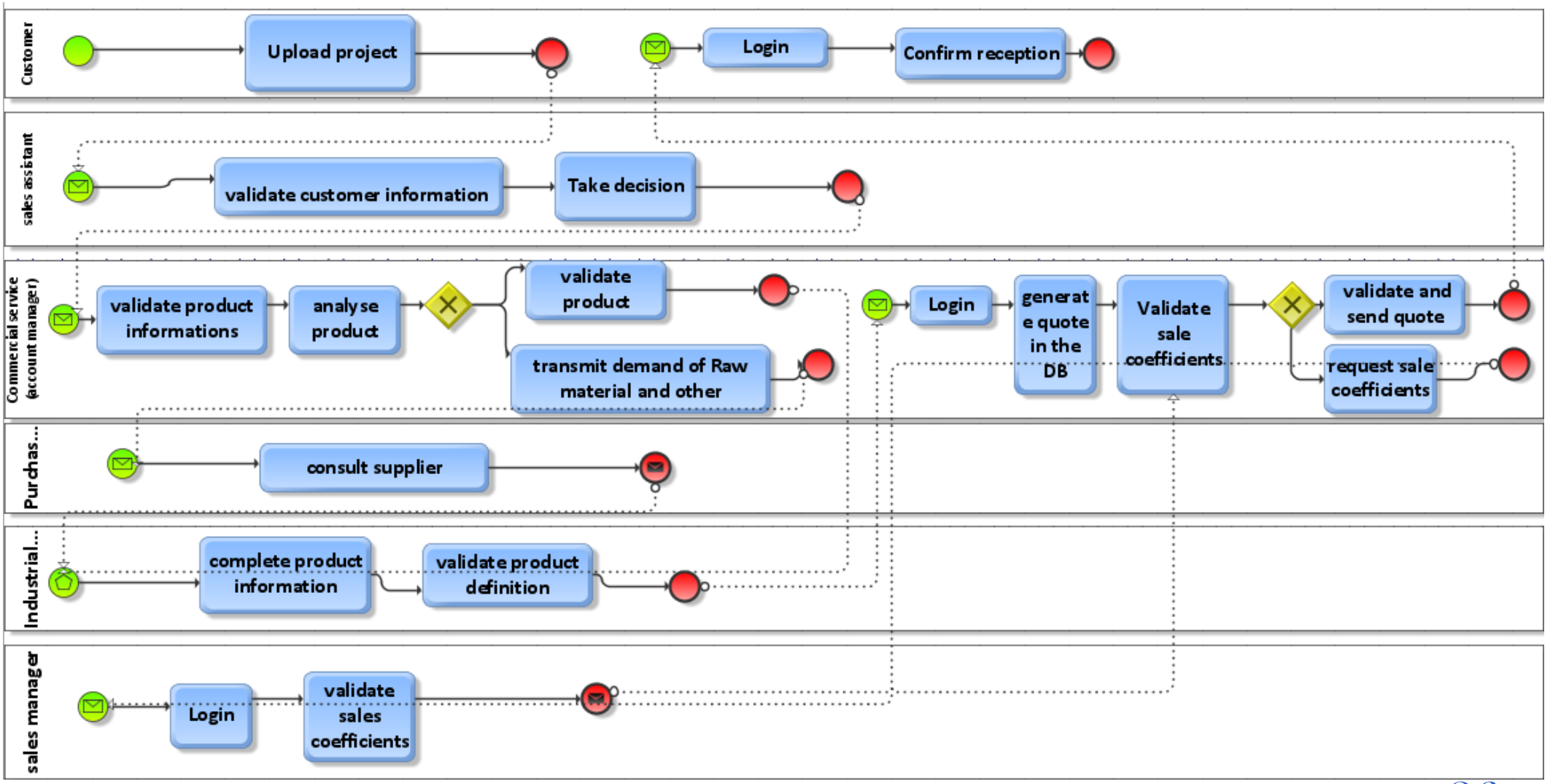
Aggregation model for CBP maturity



Case Study: APR (Applications Plastiques du Rhône)

- 40 years of experience in machining, injection, molding, negotiation, etc. of plastic,
- Treating 2500 projects / year,
- Partner in FITMAN Project,
- Targets ICT enablers for business collaboration:
  - Improve information quality to support the collaboration with customers and suppliers,
  - Reduce project treatment delays and improve their business added values.

Example of collaborative business process: *Create quote*



Results and discussions

- Our proposed maturity model is able to define the Performance APR:
  - Involve the precision
  - Mitigate and anticipate deviations
  - Improve the performance : optimization.

- Maturity  Performance

Relevance contribution

- Measure the maturity of business processes from execution traces due to the aggregation model,
- Bridge the maturity with the performance concatenated at the business level.
- Analyze the role of the maturity in the evolution of the Collaborative business process perfomance.

Conclusion & perspective

- An evaluation method based on tracking the collaborative process execution traces to assess the business process performance in the SOA environment;
- A knowledge repository based on ontological model was developed in order to structure the semantics of business process performance.
- An set of rule for maturity of applicative task :
  - defined from execution traces ;
  - Estimated from the ontological model.
- We will focus on the validation of the consistency of our approach (aggregation rules and maturity rules) : testing others CBP proposed in FITMAN project.

Laboratoire
Décision et Information
Pour les Systèmes de Production

Thank you for your attention

Maroua HACHICHA: Maroua.Hachicha@univ-lyon2.fr

Journée Nationale du GT EASY DIM 2015

Modèles de maturité et Projet d'entreprise

Lundi, 29 Juin 2015, Université Lumière Lyon 2 – IUT de Bron

Key Note 2

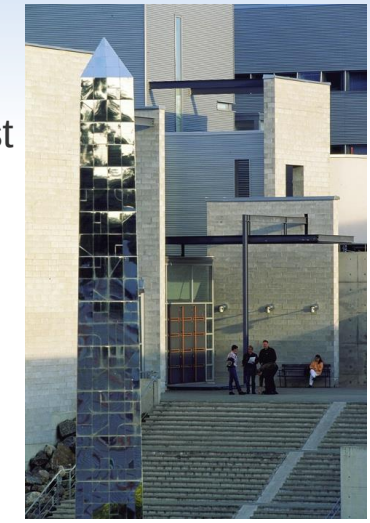
Titre : Different Approaches of the PLM Maturity Concept and their Use Domains – Analysis of the State of the Art

Par : ***Hannu Kärkkäinen***
Institution : Tampere University of Technology, Finland

Présentation

La journée Nationale du GT EasyDIM
29.6.2015
Lyon, l'Université Lumière Lyon2

PLM Maturity Special Interest Group (SIG) Activities



Professor Hannu Kärkkäinen
Tampere University of Technology
Finland

TAMPERE UNIVERSITY OF TECHNOLOGY

SIG Rationale: Why ”PLM maturity”?

1. PLM includes very **extensive changes in intra- and inter-organizational practices**, and requires new types of skills and capabilities, and moreover, large cultural and strategic changes.
2. Due to the magnitude of required transformations and coordination, a **controlled and proper PLM implementation can be very challenging**, and companies often face difficulties when adopting it., e.g. failures and long implementation times.
3. PLM implementations are **often led by IT investments, and other important management areas** (e.g. company strategies, business processes, or employee skills) are either lagging behind or are **not properly aligned with IT**.
4. One important **rather recent solution for the above types of problems are various types of maturity –related approaches**.
5. A **growing attention has been addressed by IFIP WG 5.1 members** to PLM implementation, adoption and maturity- related issues, as demonstrated by the increasing number of papers and related conference tracks in PLM conferences.
6. In order to facilitate the research of related topics and the dissemination of related results, a **new Special Interest Group (SIG) on PLM Maturity has been founded** inside the IFIP WG 5.1.

Examples of SIG interests within the PLM maturity theme

The areas of interest of the SIG, without being limited to, include the following:

- various approaches related to the evaluating, measuring, monitoring and managing PLM maturity in companies
- deriving, dividing and prioritizing PLM implementation and adoption into manageable steps based on PLM maturity assessment results
- assessing the as-is situation of PLM maturity, and helping to set to-be situation
- with various PLM maturity approaches, coordinating and balancing the necessary improvement actions
- controlling and monitoring PLM maturity progress
- helping companies to establish their own PLM strategies and goals based on the maturity assessment results
- communicating planned changes in an illustrative way using various maturity approaches
- benchmarking PLM maturity status to other companies or other company units

Purpose of SIG

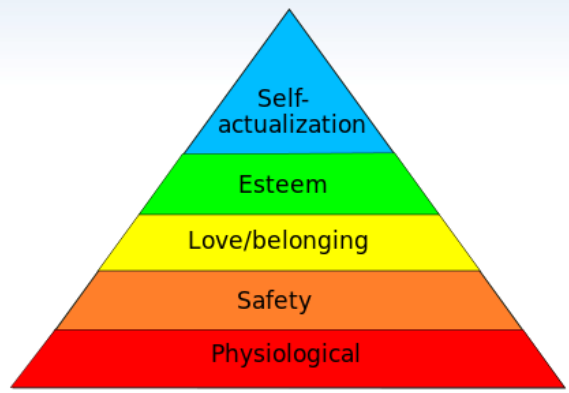
The purpose of the SIG is to exchange knowledge and stimulate advances in PLM domain, with the following specific goals:

- to connect international research groups and researchers making research in various types of Product Lifecycle Management and innovation- related maturity evaluation and modelling approaches, as well as the practitioners related to the topic
- to promote cross-fertilization between researchers and practitioners working on similar problems with different point of views
- to promote the understanding and practices of the facilitation of products and services lifecycle management by means of various approaches related to maturity evaluation, modelling and roadmapping

Different Approaches of the PLM Maturity Concept and their Use Domains

Analysis of the State of the Art

Is Maslow's need hierarchy a generic maturity model?



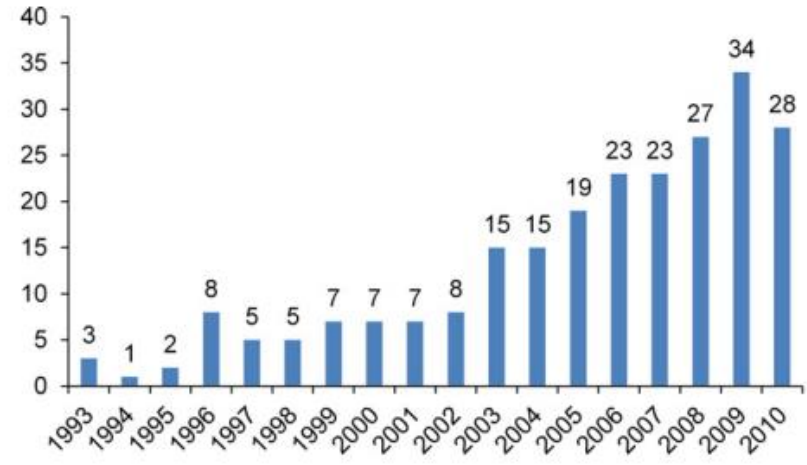
What is PLM (Product Lifecycle Management)?

- PLM enables the collaborative creation, management, dissemination and use of product definition and process operation information across the extended enterprise, i.e. from product concept to its disposal (Lee et al., 2007).
- The common aim of PLM adoption is to integrate people, processes, data, information and knowledge throughout the product's lifecycle, within a company and between companies.
- PLM includes very extensive changes in intra- and inter-organizational practices, and requires new types of skills and capabilities, and moreover, large cultural and strategic changes.

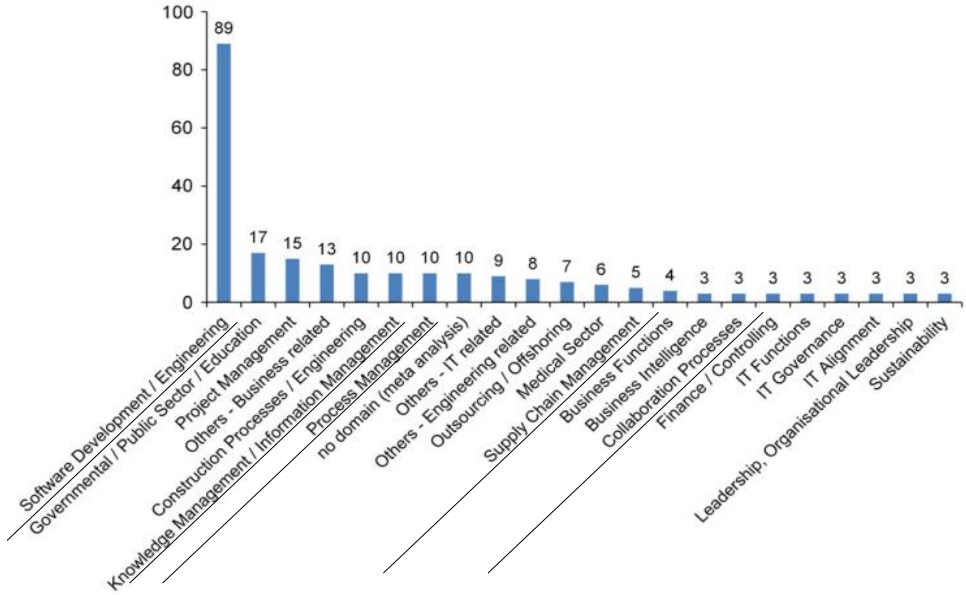
PLM maturity compared to the more traditional maturity concept applications

- According to Wendler (2012) maturity model research is currently applied to more than 20 domains, heavily dominated by software development and software engineering
- PLM interesting area from maturity perspective:
  - Very extensive and complex topic
  - Not an individual process, such as original software maturity
    - => cannot measure only single process maturity
    - => traditional process maturity approaches have limited use in PLM
  - Can be seen from functional, organizational and inter-organizational perspectives
  - Extreme complexity of PLM implementation compared to e.g. software maturity or individual process maturity
    - Difficult to optimize in the manner of CMM(I)
  - Can be seen from PDM/PLM software adoption perspective; commonly, however, PLM is seen as a larger PLM concept which involves e.g. maturity of people, processes and technological solutions

Publications in maturity model research (Wendler, 2012)



Broad domains of maturity models (Wendler, 2012)



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Research gap?

- Efficient and coordinated PLM implementation and adoption has been a focal interest of PLM research for a relatively long time
- Various types of approaches have been proposed and developed for the purpose
- Several papers have studied PLM maturity and related approaches (e.g. Batenburg et al., 2006; Pels et al., 2008; Silventoinen et al., 2010; Kärkkäinen et al., 2014; Vezzetti et al., 2014), but
- Very few have tried to systematically interrelate and compare conceptually the different existing PLM maturity- related approaches, except for Vezzetti et al. (2014) and Stenzel et al. (2014).

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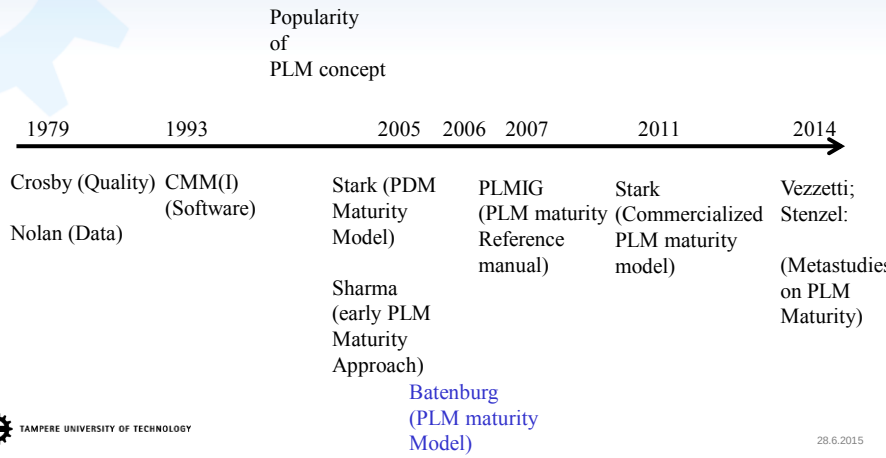
PLM maturity approach timeline



Recent interesting research from PLM maturity and SIG standpoint with a large scope on maturity

- Vezzetti et al (2014) A benchmarking framework for product lifecycle management (PLM) maturity models
- Stenzel et al (2014) Comparison Framework for PLM Maturity Models
- Terzi et al (2019) Product lifecycle management – from its history to its new role

Earlier reviews on PLM maturity approaches (Stenzel et al., 2014)

Design attributes dimension											
Attribute category	Attribute	Model									
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Main purpose	*Descriptive*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Prescriptive	✓	✓		✓	✓	✓	✓		✓	
	Comparative		✓		✓					✓	
Concept of maturity	*Process*	✓	✓	✓	✓	✓		✓	✓	✓	✓
	Object	✓	(✓)	✓		✓	✓	(✓)	✓	✓	✓
	People	✓	(✓)	✓		✓	✓	(✓)	✓	✓	✓
	Customer		(✓)	✓		✓		(✓)			
Composition	*Maturity grid*								✓		
	Likert-like quest./hybrid	✓		✓	✓	✓					
	Others		✓				✓	✓		✓	✓
Assessment approach	*Staged*		✓	✓	✓		✓	✓	✓	✓	✓
	Continuous	✓	✓		✓	✓					
Scope	*One-dimensional*	✓		✓		✓	✓	✓	✓	✓	✓
	Multi-dimensional		✓		✓						
Mutability	*Form*	✓	✓	✓	✓	✓		(✓)	✓	(✓)	
	Functioning	✓	✓	✓	✓	✓	(✓)	(✓)			
Reliability	*Verified*	✓	✓	✓	✓		✓	(✓)		✓	✓
	Validated		✓		✓		✓				

Earlier reviews on PLM maturity approaches (Stenzel et al., 2014)

Usage attributes dimension										
Attribute category	Attribute	Model								
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Method of application	*Self-assessment*	✓	✓		✓	✓	✓	✓	✓	✓	✓
	Third-party assisted assessment		✓	✓							
	Assessment by certified practicioners		✓		✓			✓			
Instruments for application	*Document reviews*		✓		✓	✓			✓		
	Focus groups		✓		✓			✓			
	Questionnaire	✓	✓	✓	✓		✓			✓	✓
Support of application	*No supporting materials*					✓	✓		✓	✓	✓
	Textual description or handbook		✓		✓			✓			
	Software assessment tool	✓	✓	✓	✓			✓			
Guidelines for specific improvement activities	*Not provided*			✓		✓	✓		✓	✓	✓
	Guidelines provided	✓	✓		✓			(✓)			
Practicality of evidence	*Implicit improvement activities*	✓	✓	✓	✓	✓	✓	✓	✓		✓
	Explicit recommendations		✓		✓						

What is not yet understood about PLM maturity approaches?

- Both the existing review articles on PLM maturity focus on the benchmarking of existing models on a high level of abstraction
  - E.g. creating a broad, generic benchmarking framework for PLM maturity approaches
- They do not, however, go into a more detailed comparison and the in-depth analyses of the basic foundations and the presumptions of the models
  - for instance their basic presumptions of what PLM and PLM maturity really are
- The current studies have not, in a broader sense
  - identified, compared and categorized the various different types of existing approaches of PLM maturity
  - been able yet to analyze in more detail their most suitable use domains (e.g. industry types, or other use domains).

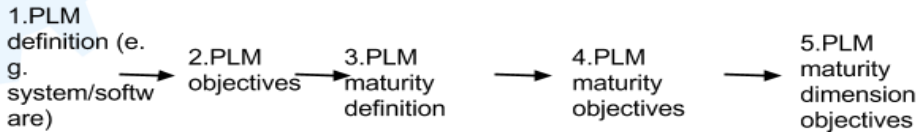
Objectives / research questions of the PLM maturity approach state-of-the-art review

1. What do we know about the PLM maturity concept and approaches and their underlying foundational assumptions?
2. What important differences are there in the existing maturity approaches?
3. How may the differences impact the potential domains of use of the models?

What is PLM maturity?

- In general, "maturity" can be defined as "the state of being complete, perfect or ready". Maturity thus implies an evolutionary progress in the demonstration of a specific ability or in the accomplishment of a target from an initial to a desired or normally occurring end stage.
- Maturity aims at systematically increasing the capabilities (not only IT systems) of business processes and the organization to deliver higher performance over time.
- *Very broadly and briefly, "PLM maturity" refers to the concept of how far an organization is in its implementation of PLM (and how much it still has to go to its targets in PLM implementation or "full PLM");*
  - ✓ *maturity can refer to the maturity of PLM*
    - ✓ *processes,*
    - ✓ *objects (such as ICT systems), and*
    - ✓ *people (e.g. skills).*

PLM maturity from measurement perspective



Identified different types of PLM maturity approaches

	Model	Reference	Year
1	Batenburg	Batenburg R, Helms R, Versendaal J (2006) PLM roadmap: stepwise PLM implementation based on the concepts of maturity and alignment. International Journal of Product Lifecycle Management 1(4):333 – 351	2006
2	Schuh	Schuh G, Rozenfeld H, Assmus D, Zancul E (2008) Process oriented framework to support PLM implementation. Computers in industry 59 (2 – 3):210 – 218.	2008
3	Sääksvuori	Saaksvuori A, Immonen A (2008) Product lifecycle management. Springer, Berlin	2008
4	Sharma	Sharma, A. (2005) Collaborative product innovation: integrating elements of CPI via PLM framework. Computer-Aided Design 37, pp. 1425–1434	2005
5	Karkkainen	Kärkkäinen H, Pels H, Silventoinen A (2012) Defining the customer dimension of PLM maturity. In: Rivest L, Bouras A, Louhichi B (eds) Product lifecycle management. Towards knowledge-rich enterprises, vol 388. Springer, Heidelberg, pp 623 – 634	2012
6	PLMIG-SB (Structure-based model)	PLMIG, PLM Maturity Reference Manual (Version 1.0), PLM Interest Group, 50 pages (March 19, 2007)	2007
7	PLMIG-AB (Activity-based model)	PLMIG, PLM Maturity Reference Manual (Version 1.0), PLM Interest Group, 50 pages (March 19, 2007)	2007
8	Savino	Savino, M.M., Mazza, A., Ouzrout, Y.: PLM Maturity Model: A Multi-Criteria Assessment in Southern Italy Companies. International J. of Operations and Quanttitative Management 18(3) (2012)	2012
9	Stark	Stark, J. Product Lifecycle Management – 21st Century Paradigm for Product Realisation (2011). Springer Verlag, London.	2011

Examples of different types of PLM maturity approaches

1 dimension of maturity

Process focus

Maturity approach by Saaksvuori (2008)

		PLM maturity model
1	**Unstructured**	The PLM topic has been recognized and its importance agreed. Work must be done to define and develop the PLM concept and standards. However, at present, there are no defined approaches concerning lifecycle management; all lifecycle and product management issues are resolved by individuals on a case-by-case basis.
2	**Repeatable but intuitive**	Lifecycle and product management processes have developed to the stage where similar procedures are followed by different people undertaking the same task (i.e. the processes function on ad hoc bases). There is no formal development, definition, training, or communication of standard processes; all responsibility is left to individuals. There is a high degree of reliance on individual knowledge and therefore errors occur.
3	**Defined**	Processes and basic concepts are standardized, defined, documented, and communicated through manuals and training. However, the human factor is important, there is no end-to-end PLM process supporting IT systems, all work is completely or partially manual from the process point of view. IT systems support individual parts of processes. The PLM processes or basic PLM concepts are not best-of-the-breed, nor are they uniform throughout the corporation, however they are formalized.
4	**Managed and measurable**	It is possible to monitor and measure the compliance between processes and to take action where processes are not functioning well. Processes and concepts are under constant improvement and provide best practices. IT systems support PLM processes well. Process automation is used in a partial or limited way. Processes and concepts are developed through clear vision throughout the corporation. The state of uniformity of processes is clear.
5	**Optimal**	Processes and concepts have been refined to the level of best practice, based on continuous improvement and benchmarking with other organizations. IT is used in an integrated manner and process automation exists on an end-to-end basis.

Example of many-dimensional maturity modeling in PLM (Batenburg et al.)

mngt. Dimension not aligned with others, possible bottle neck?

Maturity level	Mngt. dimension 1	Mngt. dimension 2	Mngt. dimension 3	Mngt. dimension 4	Mngt. dimension 5
1					
2					
3					
4					

E.g. mutual coordination and alignment of management

Mngt. area too far ahead of others? (Often e.g. IT)

28.6.2015

Batenburg model with 5 management dimensions

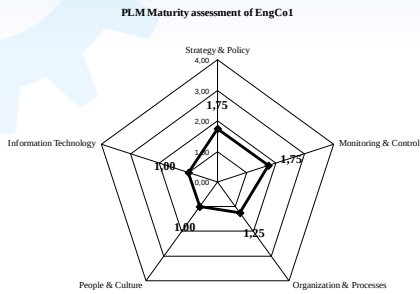
Critical management dimensions

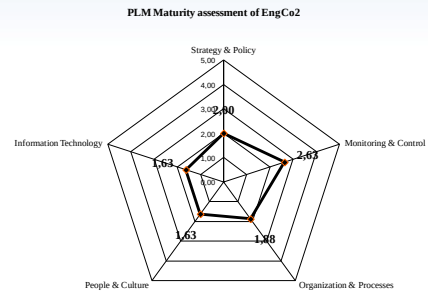
8 questions to evaluate maturity in each dimension:

Implementation or coordination level, scale 0-4
0= no
1= ad-hoc only
2=departmental
3=organizational
4=inter-organizational

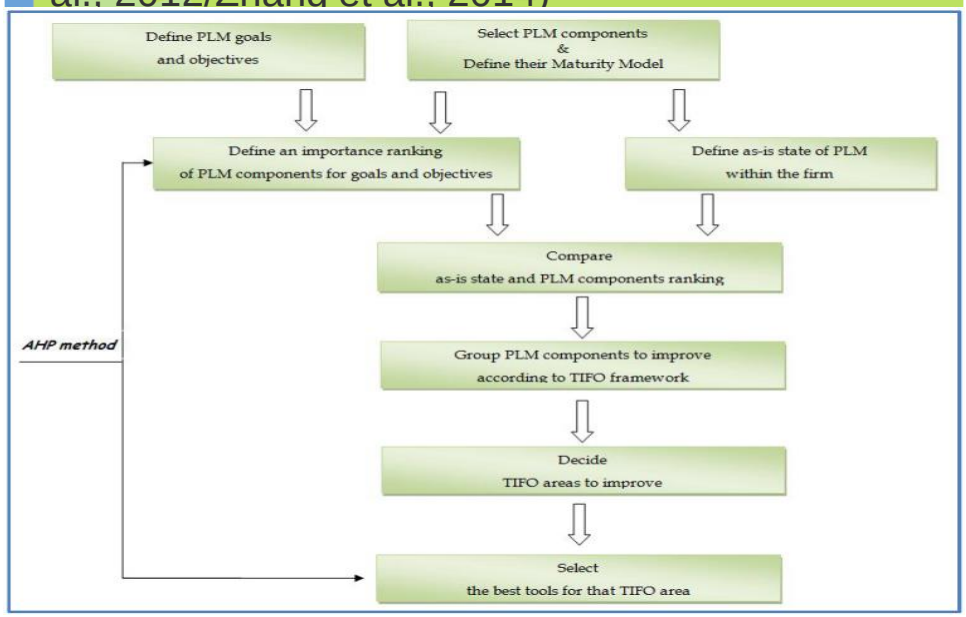
⇒Average of scores counted a) dimensions b) overall score

Strategy & policy	Management & control	Organization & processes	People & culture	Information technology
PLM strategy is described	Responsibility for in-time product delivery is defined	Procedures to support PLM are implemented	Task and job descriptions contain references to PLM processes/procedures	PLM software is used in the company
PLM strategy and its changes are communicated	Time-to-market of new products is monitored	PLM process descriptions are maintained	Employees raise suggestions to influence product lifecycle decisions	PLM software is integrated with other information systems
PLM strategy is aligned with the corporate strategy	Rules about cost allocation during product development are defined	PLM process descriptions are standardized	PLM training benefits the organization	PLM software includes functionality to manage product configurations
PLM strategy is evaluated	Explicit processes for quality control are defined	Product lifecycle teams are organized	Employee reward system is related to product performance throughout its lifecycle	PLM processes are automated by workflow management functionality
PLM strategy is adapted if needed	Metrics for product quality are defined	PLM procedures are formally described	Employees actively support the PLM strategy	PLM software includes functionality to manage documents
PLM strategy is translated into an action plan	Product quality after market introduction is monitored	PLM drives the product release process	Employees collaborate on product lifecycle issues	A roadmap for the implementation of new PLM software is defined
Document management is included in PLM strategy	Status of lifecycles of products is known	PLM includes a document revision process	Employees are actively involved in the implementation of PLM software	PLM software is based on compatible industry and technological standards
PLM strategy addresses the main PLM processes	Project management method for managing a product through its lifecycle is applied	PLM includes change management procedures	The concept of PLM is clearly understood	PLM software includes functionality to manage product changes

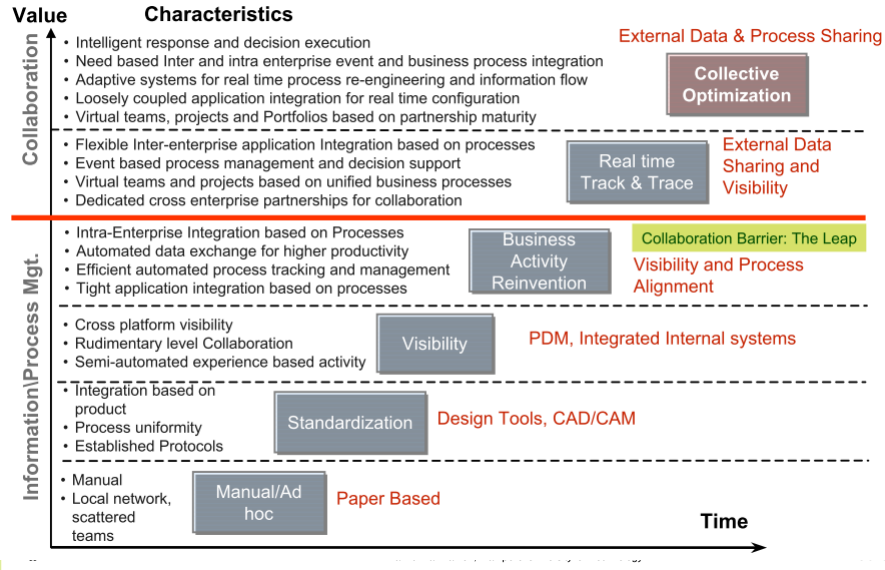




Approach for PLM maturity (Savino et al., 2012/Zhang et al., 2014)



Collaborative maturity approach (Sharma, 2005)



Overall description and analysis of PLM maturity studies

- By evaluation and comparison of identified different types of PLM approaches:
  - the papers reporting the approaches did not clearly identify any specific domains or limitations of use for the approaches
- This would let us presume that the approaches are quite generic and can be used widely in different companies implementing PLM for their business
- The approaches were in general designed, not very surprisingly, for mainly companies in the manufacturing industry
- However, through a more close analysis, we were able to recognize some important differences with the approaches and their most suitable use domains

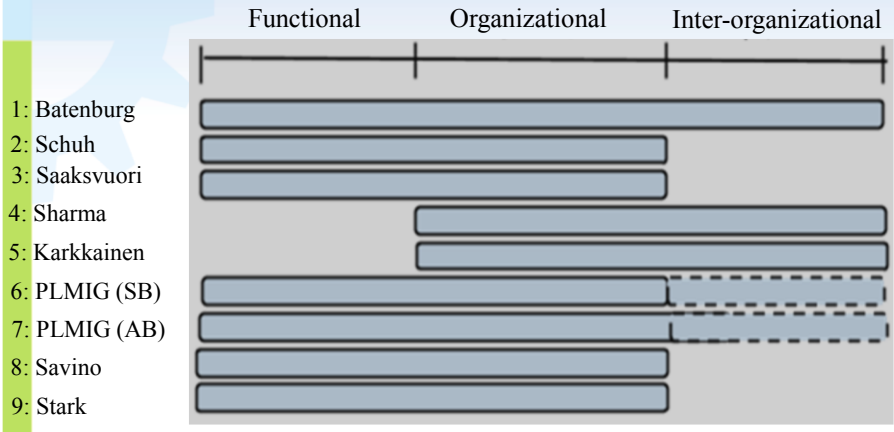
High levels of PLM maturity

- Some maturity approaches considered the process automation and optimization to be the goal of the highest maturity levels
- Others emphasized on high maturity levels significantly the ability of companies to connect to customers and partners and their processes on need-basis and in an ad-hoc manner,
- These reflect very probably different presumptions behind the ultimate goals of PLM, or the different types of business logics behind the maturity model design.
- We will analyse in more detail the above types of different emphases in the identified PLM maturity approaches.

Organizational level foci

- In general, maturity models can focus on understanding maturity of individual company functions, processes, a whole organization or can even include the inter-organizational level of maturity
- PLM, depending on organizational objectives, can focus on functional level to inter-organizational level
- In many industries, product lifecycle management is essentially about the concept of extended enterprise and networks of companies
- High levels of PLM maturity commonly refer to extended enterprise (even if different PLM maturity models have different emphases in this respect)

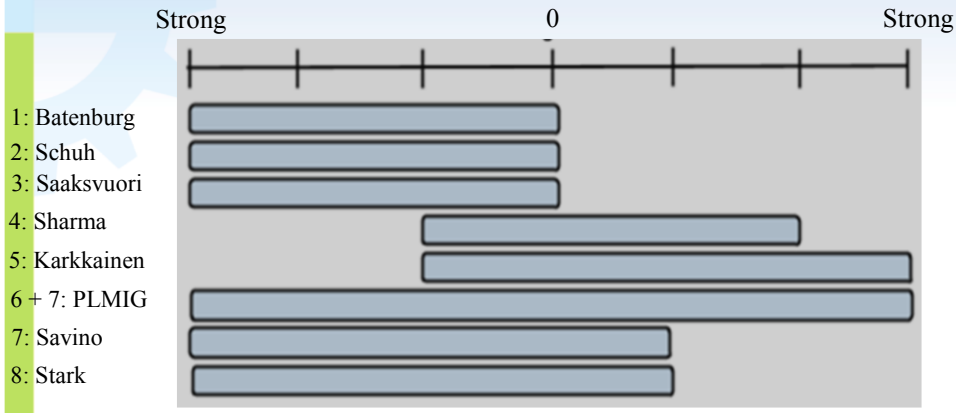
Organizational-level focus of maturity approaches



Data, information, knowledge

- PLM is quite seminally about data, information and knowledge
- More specifically, about getting these properly to serve a company's business and product development (e.g. Schulte, 2008; Kärkkäinen et al., 2012)
- Difference while data and information can be managed and shared in a rather straight-forward manner (using e.g. traditional PDM and CRM systems), the management and transfer of knowledge can be enabled and supported but not essentially easily managed (e.g. context-dependability; know-how, know-why,...)
- PLM is about both data and information, but also about knowledge (e.g. customer understanding)
- Current PDM techniques, for instance, are still most suitable for managing explicit knowledge. (Kärkkäinen, 2012)
- E.g: tailoring-to-needs, investment products: emphasis on knowledge (customer needs); mass production: emphasis on data and information (process management, production)

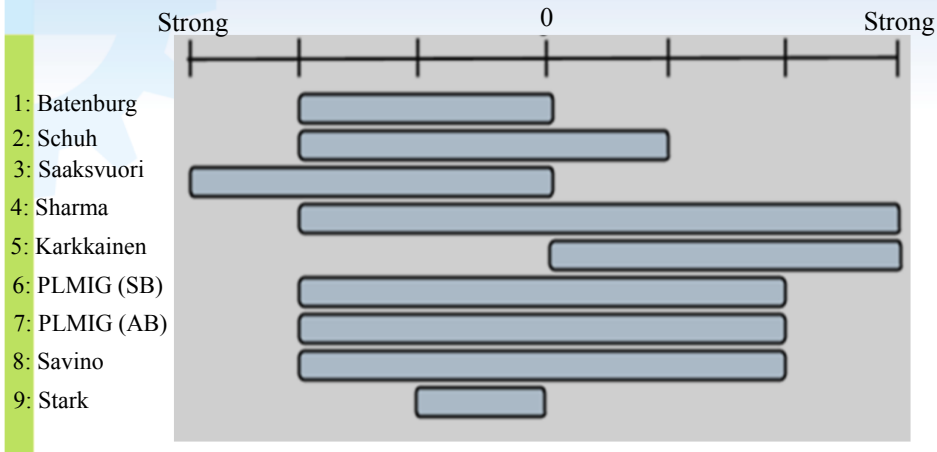
Focus of PLM maturity approaches to data/information vs. knowledge



Process automation vs. ad-hoc integration

- Depending on the overall business goals and strategy of a company, as well as the type of business (e.g. project-based customer-oriented investment products versus mass produced and mass-customized)
- PLM objectives can be very different, either emphasizing strongly the efficiency of processes or the high satisfaction and service-level of customers).
- E.g. competitive strategy: follower (efficiency; data and information) vs. technology/market leader (agility; knowledge)

Process automation vs. ad-hoc process integration focus of PLM maturity approaches



Conclusions

In most of the cases,

- the seminal presumptions behind the PLM maturity approaches and their design have not been defined in detail, for instance:
  - how they define the very central concept “PLM” and its objectives, or
  - how, in accordance with the previous definitions, the concept of PLM maturity is defined, and
  - what types of measurable benefits should be expected from increased levels of maturity – efficiency of processes, flexibility of market changes, or better responsiveness and even prediction of customers’ needs, and
  - how the maturity investments are presumed to be paying off in a more quantitative manner.
- Most of the current maturity studies in the PLM domain contend to state in a rather generic manner that
  - the purpose of their maturity approaches is to make the complex process of PLM adoption a more coordinated and stage-like.

Conclusions

- So, currently, are there generic PLM maturity models?
  - Not really (and perhaps there should not even be)
  - However, there are models that are generic within certain limitations
  - Furthermore, there are also models that enable building focused and specific PLM maturity models from generic components (both generic and specific)
- Despite current PLM maturity approaches not very explicitly mentioning this:
  - current approaches seem to have very different (implicit, hidden) background assumptions about the use domain and the idea and purpose of PLM maturity
- These implicit assumptions should be recognized and taken into consideration when selecting/using PLM maturity models
  - Otherwise, maturity assessment results may not be useful or easily interpretable for pragmatic development actions
- When developing or validating/evaluting PLM maturity models (or other maturity models), you should be well aware of such assumptions

Relevance of different approaches to different situations?

- Differences have implications for instance to the selection of the most suitable maturity approaches for companies with different business logics. For instance:
- Engineer-to-order companies:
  - Models that are relatively knowledge-oriented and enable the fast, flexible and need-based integration of the customers and their knowledge to their own development processes
  - Why?
- Mass-production:
  - Process standardization and automation- focused approaches
  - Why?

Journée Nationale du GT EASY DIM 2015

Modèles de maturité et Projet d'entreprise

Lundi, 29 Juin 2015, Université Lumière Lyon 2 – IUT de Bron

Papier 3

Titre : Lifecycle Systems Improvement based on Maturity Evaluation and Reputation

Par : ***Haiqing Zhang****, Aicha Sekhari, Yacine Ouzrout, Abdelaziz Bouras*

Institution : Laboratoire DISP, Université Lyon 2

Papier & Présentation

Lifecycle Systems Improvement based on Maturity Evaluation and Reputation Analysis

Haiqing ZHANG

In this thesis, a modern company is considered as a complex system which has its own life cycle and can be compared to a tree structure that contains neural networks and multiple child nodes. The Lifecycle system approach is usually used to improve data sharing, creation of correct product development processes, and reduction of energy and time through the whole process of the product's life. The products are the main outputs to represent the competitiveness of the company. In order to improve the overall satisfaction and maturity of the company lifecycle system, we concentrate on figuring out four research issues by studying the elements of lifecycle products/systems.

First Research Issue: Maturity Evaluation and Prediction to Enhance Lifecycle System Implementation

The companies cannot achieve the desired benefits of lifecycle systems due to the gradually growing complexity of information and the dynamically changing requirements. In order to understand the situation of currently used lifecycle systems, some primary research questions should be addressed: 1). What are the complete functionalities of lifecycle system that can cover all of the information fields that are utilized by the companies? 2). What is the AS-IS situation and how far the relative positions by comparing with the other companies? 3). What will be the TO-Be situation if continue to use the current lifecycle system and what is the desired situation if adopt a new lifecycle system?

In order to solve the essential research questions, a TIFOS framework is proposed to conclude the fundamental functionalities of a lifecycle system. Fifteen components of a lifecycle system are given based on the five dimensions of TIFOS framework. In addition, a PCMA maturity model is proposed to evaluate the AS-IS situation. The fifteen components are the maturity dimensions of PCMA, which is broken down into several key areas. The KPIs are defined to assess the maturity levels of each key area. The final maturity situation is determined by KPIs, key evaluation areas, and the maturity dimensions. The TO-BE situation prediction is more complex than the previous issues. The uncertainty and the subjectivity of the linguistic terms in maturity evaluation is taken into consideration. The triangular fuzzy numbers are adopted to explain the maturity. A conception of fuzzy maturity is proposed. Fuzzy extended PCMA maturity model predicts the TO-BE situation by building the relations between the ratios for a pair of existing values and the known maturity levels.

The basic research questions are validated and applied in three companies, which are located in Chengdu, Shanghai, and Shenzhen, respectively. A survey is built to collect the basic information for the three companies based on the defined KPIs. The case studies show that the PCMA maturity model can efficiently achieve the overall maturity situation and reflect the strengths and the weaknesses of the components of lifecycle system. Fuzzy extended PCMA maturity model is used to predict the TO-BE situation. The experiments of maturity analysis show that the predicted maturity levels are very close to the true values.

Second Research Issue: Decision Making Issues Analysis in Lifecycle System Implementation and Selection

After the maturity situation is clarified, the decision making issues should be addressed to answer how to select the right lifecycle system solutions or components to enhance the maturity of lifecycle system. These issues can be depicted into a hierarchy structure: objective, criteria, sub-criteria, and alternatives, which is typically multi-criteria decision making (MCDM) issues. We have studied the MCDM approaches and deeply analyzed five approaches that include: AHP, λ-max method, FPP, fuzzy extended AHP, and VIKOR. The comparison of the five methods reveals the fact that the similar ranking weights have strong relations with the consistency of pairwise comparison matrices (PCM). The extent to persuade the decision makers to adopt the ranking results is different based on the running mechanism of five approaches.

The sensitivity analysis indicates that the five approaches are robust. The real experiments are conducted and reveal that lambda-max, FPP, and integrated fuzzy AHP and VIKOR can credibly achieve the reasonable optimum selection.

Third Research Issue: Inconsistency Repairing in Decision Making Issues

PCMs with crisp or fuzzy elements should satisfy consistency requirements when it is used in MCDM methodologies. The inconsistency repairing algorithm has been presented to obtain a new modified consistent PCM for the related inconsistent one. The algorithm sets a linear programming problem based on all of the constraints. To obtain the optimum eigenvector of the middle value of the new PCM, the segment tree is used to gradually approach the greatest lower bound with the original PCM. As to obtain the lower value and the upper value of the new PCM, a theory is proposed to reduce adding uncertainty factors and could maintain the maximum similarity with original PCM. The experiments for crisp elements show that the proposed approach can preserve more of the original information than references. The experiments for fuzzy elements indicate that the proposed algorithm can effectively reduce inconsistency and obtain suitable modified fuzzy PCMs.

Fourth Research Issue: Maturity Enhancement by Obtention of Valuable Information from Product Features through Information Extraction from Numerous Customer Reviews

The characteristics of the products are often criticized by customers through multi-sources. The customer reviews play an important role in providing correct parameters among product development processes in lifecycle systems and enhancing the competitiveness of the whole products. The extracted information can also enhance the maturity of lifecycle systems by correctly understand customer preferences and help to make correct decisions by obtaining the values of studied criteria.

In order to solve the information extraction issue, this thesis jointly extracts three elements related to the products, which including feature and feature-of relations, opinion expressions and the related opinion attributes, and feature-opinion relations. Handling all of these elements together is very complex. Hence, the existing works have to handle the elements in isolation that only can provide insufficient information; or several algorithms are used together to complete the information extraction tasks that increasing the running time. This thesis proposed an opinion mining extraction algorithm based on dependency relations of syntactic parsing and fuzzy measurement. In detail, the algorithm automatically builds kernel structures to combine closet words into new terms from word level to phrase level, and we ensure the accuracy of opinion expressions and polarity based on three main parts, which include: proposed fuzzy weight measurement definitions, defined opinion degree intensifiers, and proposed opinion patterns. The performance of experiments demonstrates that the proposed algorithm outperforms the baseline approaches regarding precise, recall, and F-score. Some interesting phenomena are discovered when studying 3,458 reviews in different domains.

In conclusion, the thesis focuses on enhancing the overall satisfaction and maturity of the company lifecycle system. In order to achieve this goal, several main contributions are proposed, which include: TIFOS framework is proposed to analyze the functionalities of lifecycle systems; PCMA and fuzzy extended PCMA maturity model are presented to evaluate and predict the maturity situation; MCDM approaches are studied to solve the lifecycle system implementation and selection issues; inconsistency repairing algorithm is provided to solve the inconsistent issues to increase the accuracy of decision making issues; Information extraction algorithm is given to obtain the useful information for product development and support maturity evaluation and decision making. More works will be done to overcome the limitations of the proposed models in future work. The remaining issues related to lifecycle system and product information will be further studied as well.

Keywords: *TIFOS framework; Maturity models; Multi-criteria decision making; Fuzzy logic; Triangular fuzzy number; Linear programming problem; Inconsistency pairwise comparison matrices; Information extraction; Unstructured data; Opinion mining*

Maturity Evaluation and Prediction Based on PCMA and Fuzzy extended PCMA

Laboratoire
Décision et Information
Pour les Systèmes de Production

Haiqing Zhang

Dissertation Supervisors: Abdelaziz Bouras, Yacine Ouzrout, Aicha Sekhari

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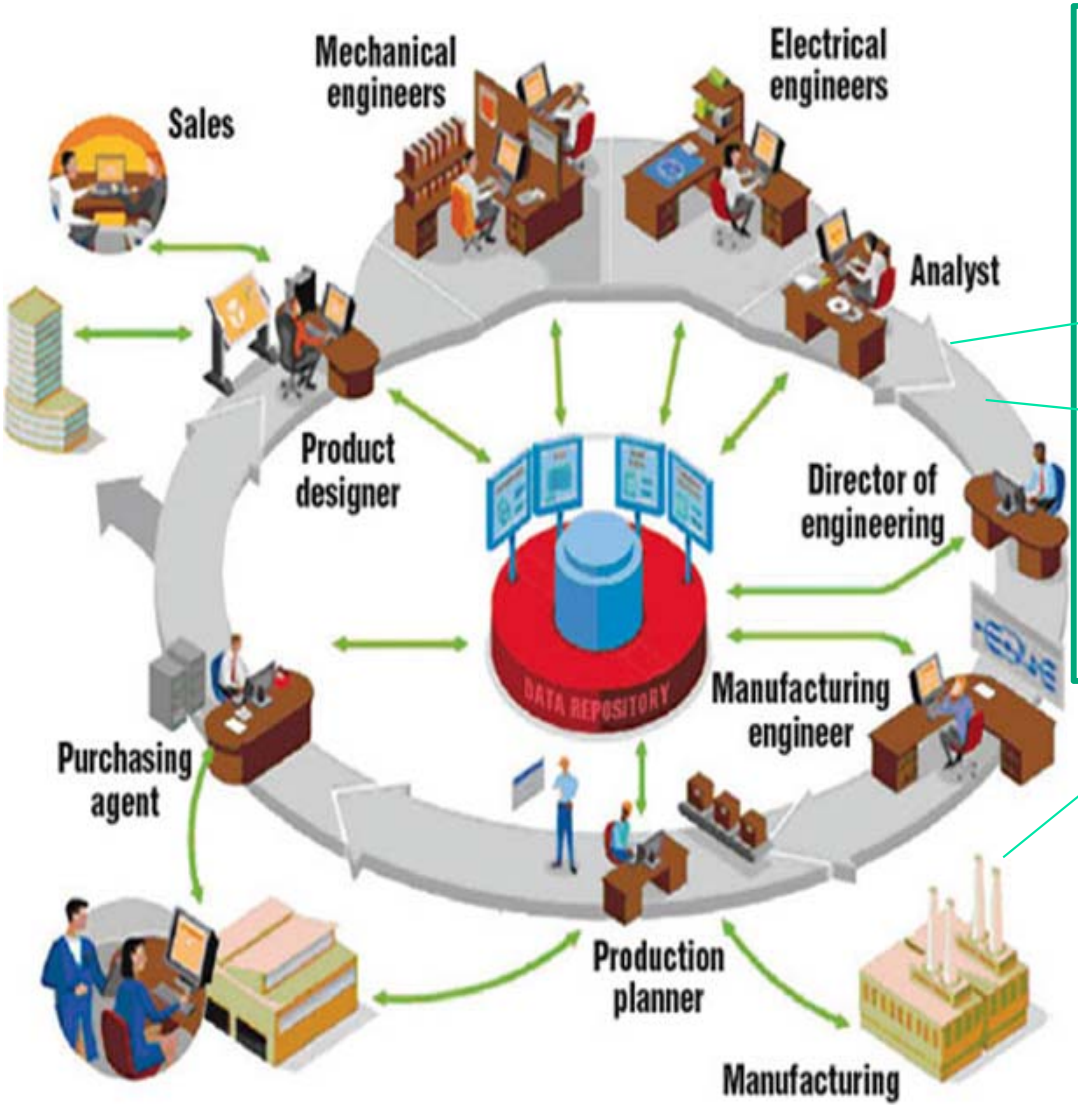
Maturity Evaluation and Prediction to Enhance Lifecycle System Implementation

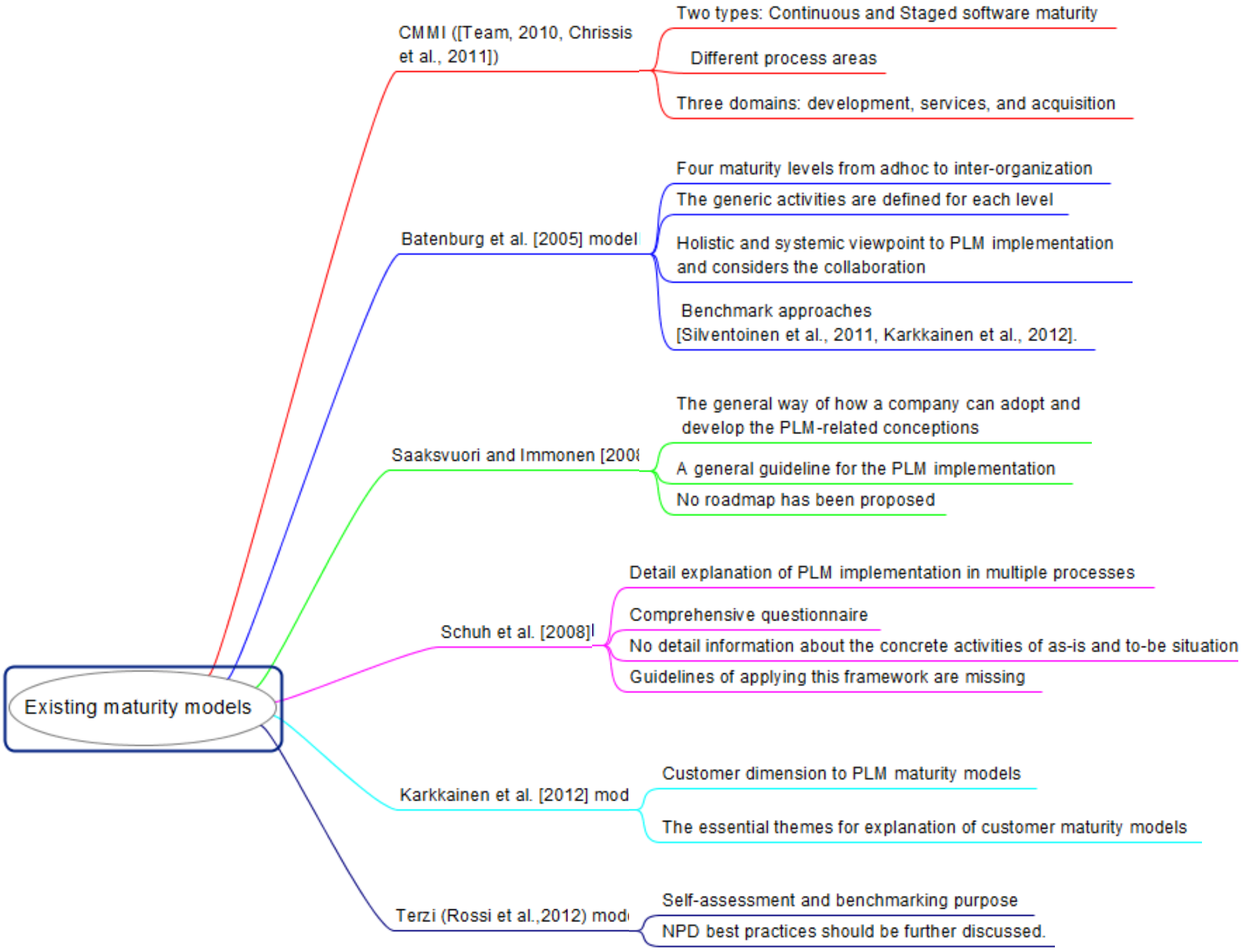


Where AM I?

(Lifecycle System implementation situation)

- Previous Situation: PLM V0
- Present Situation: PLM V1
- Future Situation: PLM V2

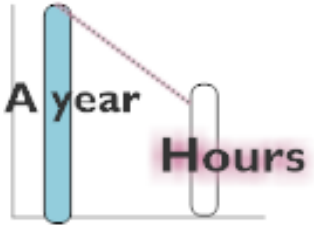
MATURITY ANALYSIS


Existing maturity models
CMMI ([Team, 2010, Chrissis et al., 2011])
Two types: Continuous and Staged software maturity
Different process areas
Three domains: development, services, and acquisition
Batenburg et al. [2005] model
Four maturity levels from adhoc to inter-organization
The generic activities are defined for each level
Holistic and systemic viewpoint to PLM implementation and considers the collaboration
Benchmark approaches [Silventoinen et al., 2011, Karkkainen et al., 2012].
Saaksvuori and Immonen [200
The general way of how a company can adopt and develop the PLM-related conceptions
A general guideline for the PLM implementation
No roadmap has been proposed
Schuh et al. [2008]
Detail explanation of PLM implementation in multiple processes
Comprehensive questionnaire
No detail information about the concrete activities of as-is and to-be situation
Guidelines of applying this framework are missing
Karkkainen et al. [2012] mod
Customer dimension to PLM maturity models
The essential themes for explanation of customer maturity models
Terzi (Rossi et al.,2012) mod
Self-assessment and benchmarking purpose
NPD best practices should be further discussed.

Maturity Analysis: What has been missed in the existing works?

AS-IS Situation

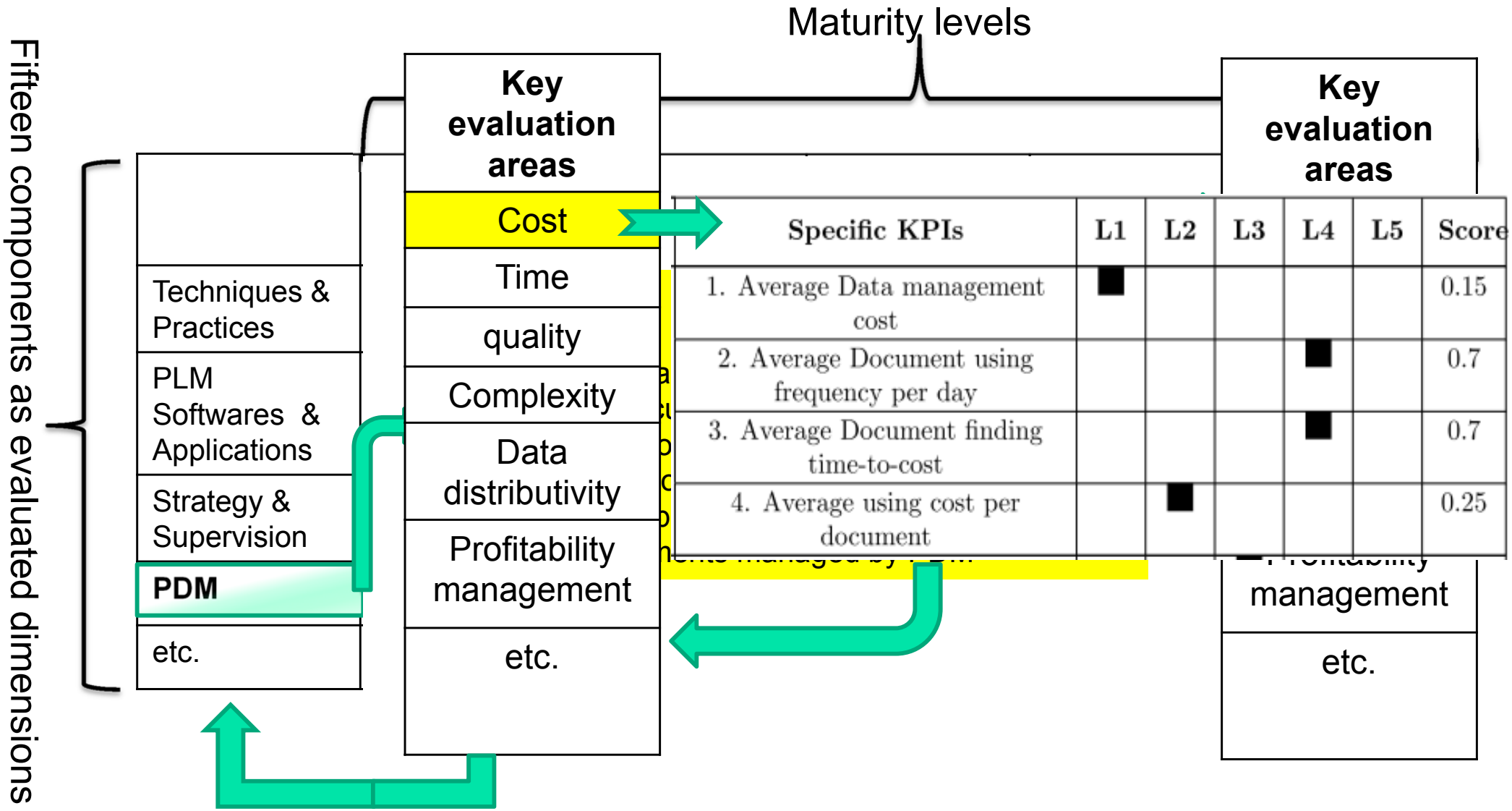
1. How to reduce evaluation time and up-front work?



Maturity Evaluation

TO-BE Situation

Maturity Analysis: Proposed PLM Components Maturity Assessment (PCMA) model



Specific KPIs	L1	L2	L3	L4	L5	Score
1. Average Data management cost	■					0.15
2. Average Document using frequency per day				■		0.7
3. Average Document finding time-to-cost				■		0.7
4. Average using cost per document		■				0.25

Maturity Analysis: What has been missed in the existing works?

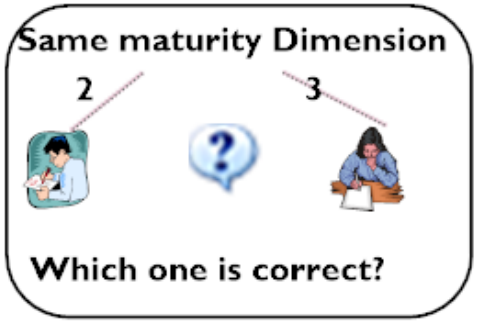
AS-IS Situation

Maturity Evaluation

2. Do we need to repeat the same evaluation process every year?

3. Is it possible to automatically evaluate the implemented situation based on the obtained values?

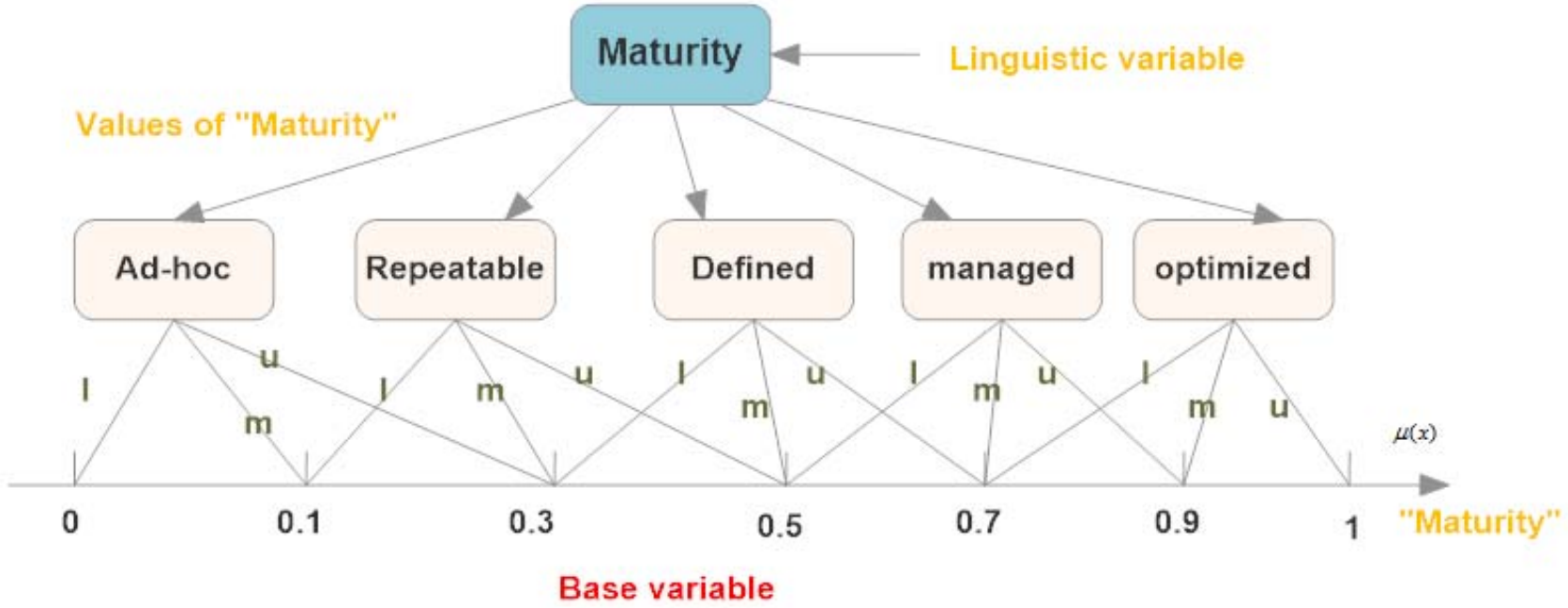
4. How maximally keep and express decision-makers' intentions?



TO-BE Situation

Maturity Analysis: Proposed Fuzzy Extended PCMA maturity model

Definition (Fuzzy maturity): Fuzzy maturity is determined by a triple (x, L(x),μ(x)), in which the variable x represents the maturity value, L(x) denotes the linguistic values of x or the maturity levels, μ(x) is the triangular fuzzy number of each maturity level.



For instance, Fuzzy maturity (0.3,'Repeatable', '0.1, 0.3, 0.5')

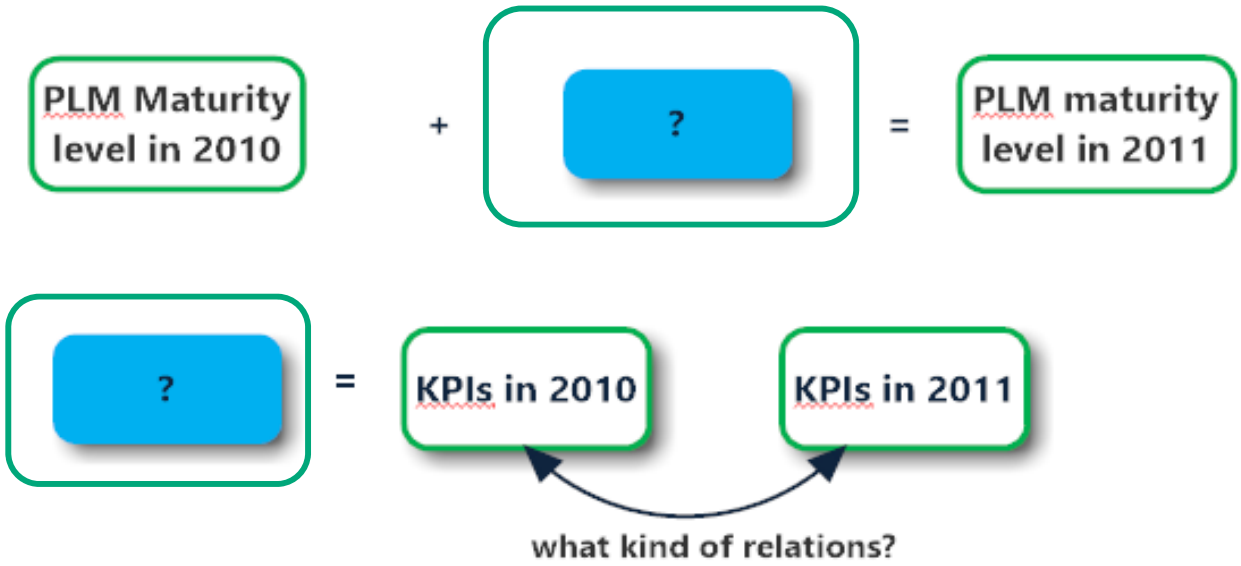
Maturity Analysis: Proposed Fuzzy Extended PCMA maturity model

	2013		2012		2011		2010	
'Cost' KPIs	KPI	M	KPI	M	KPI	M	KPI	Maturity
1. Average Data management cost	3.0-4.0	?	2.8-4.2	?	8.0-10.0	?	35-40	*Defined* [0.3,0.5,0.7]
2. Average Document using frequency per day	10	?	7	?	5	?	2	*Repeatable* [0.1,0.3,0.5]
3. Average Document finding time-to-cost	*man-aged*	?	*man-aged*	?	*man-aged*	?	*man-aged*	*managed* [0.5,0.7,0.9]
4. Average using cost per document	10	?	40/7	?	6	?	5	*Defined* [0.3,0.5,0.7]

How can I deduce the maturity level of the year 2011 by using the data in the year 2010?

Maturity Analysis: Proposed Fuzzy Extended PCMA maturity model

What are the disciplines that can calculate the maturity level for the following years based on the first year?



Maturity Analysis: Proposed Fuzzy Extended PCMA maturity model

$C\_K_i^{j\_year}$ repesents the ith KPI in the jth year for C category;

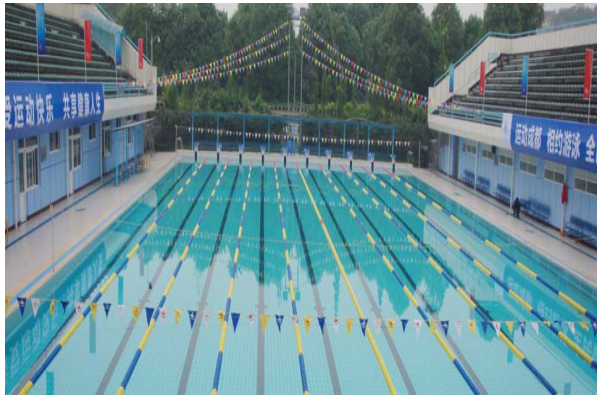
$C\_M_i^{j\_year}$ represents the maturity value of the ith KPI in the jth year for C category;

$$\frac{C\_K_i^{(j+1)\_year}}{C\_K_i^{j\_year}} = f(k_i) \bullet \frac{C\_M_i^{(j+1)\_year}}{C\_M_i^{j\_year}}$$

represents the (j+1) year maturity level can be deduced from the jth year maturity level. The proportion between the jth year and the (j+1) year for ith KPI in C category determines the changing trends and the varying degree of the (j+1) year maturity level.

Implementation and Validation of the Proposed Maturity Models

Company	Type of Industry	Employee	Years in the market	PDM Experience (Year)	PLM Experience (Year)
Chengdu	Swimming pool Equipment	Around 50	21	11	0
Shanghai	Industrial control	Around 1000	6	6	2
Shenzhen	Industrial control	Around 1600	13	13	4



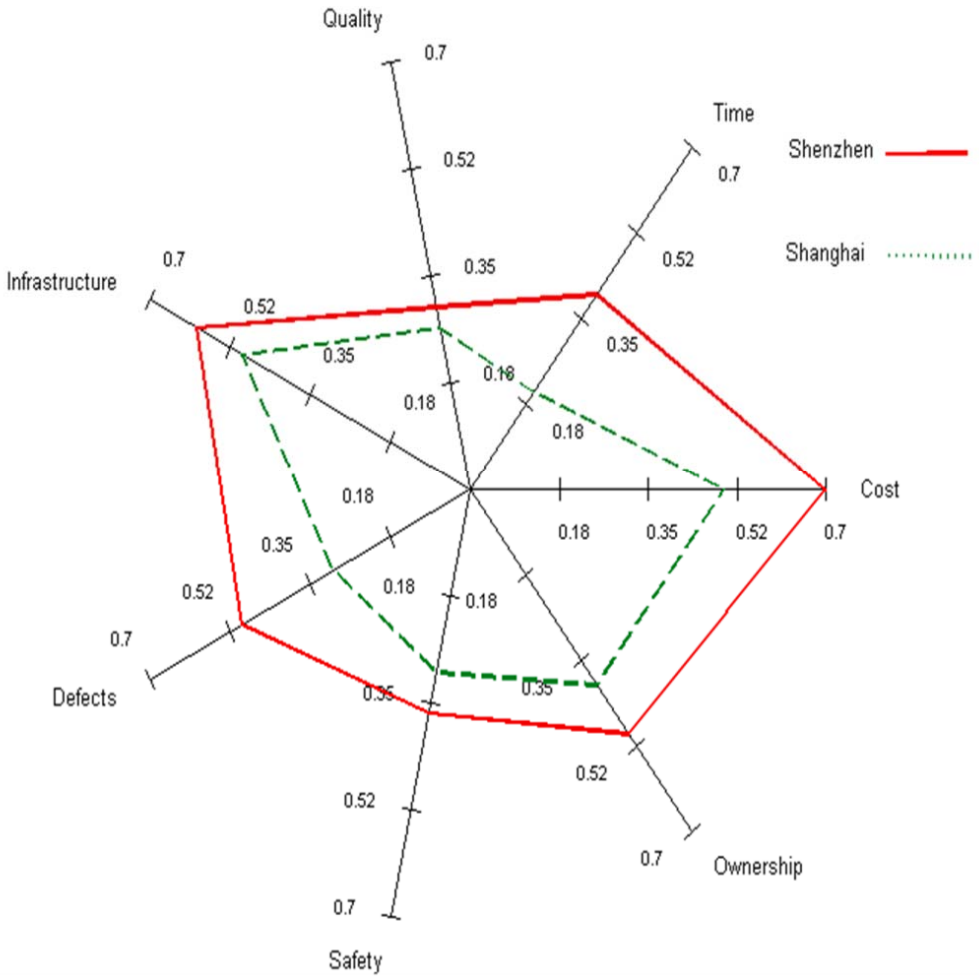
Chengdu

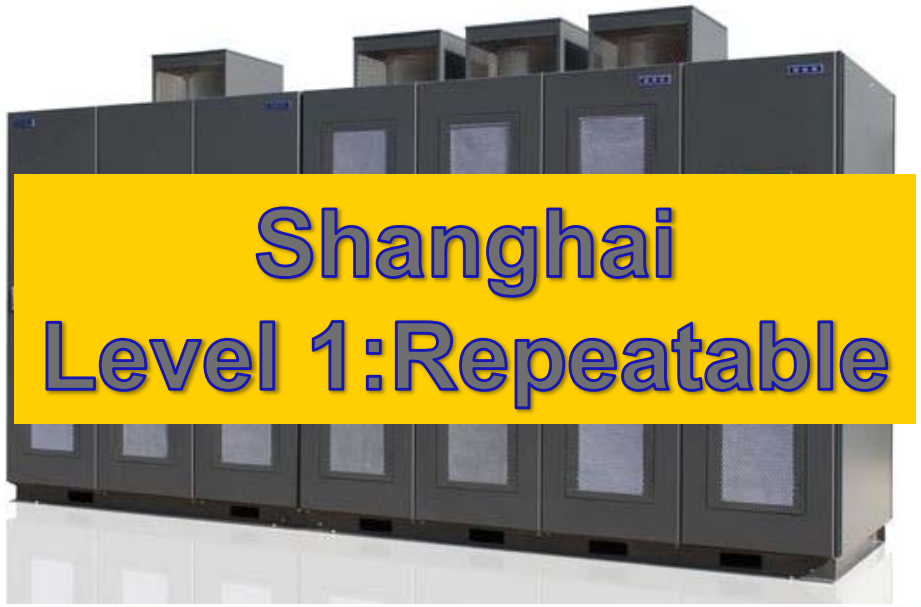
Shanghai

Shenzhen

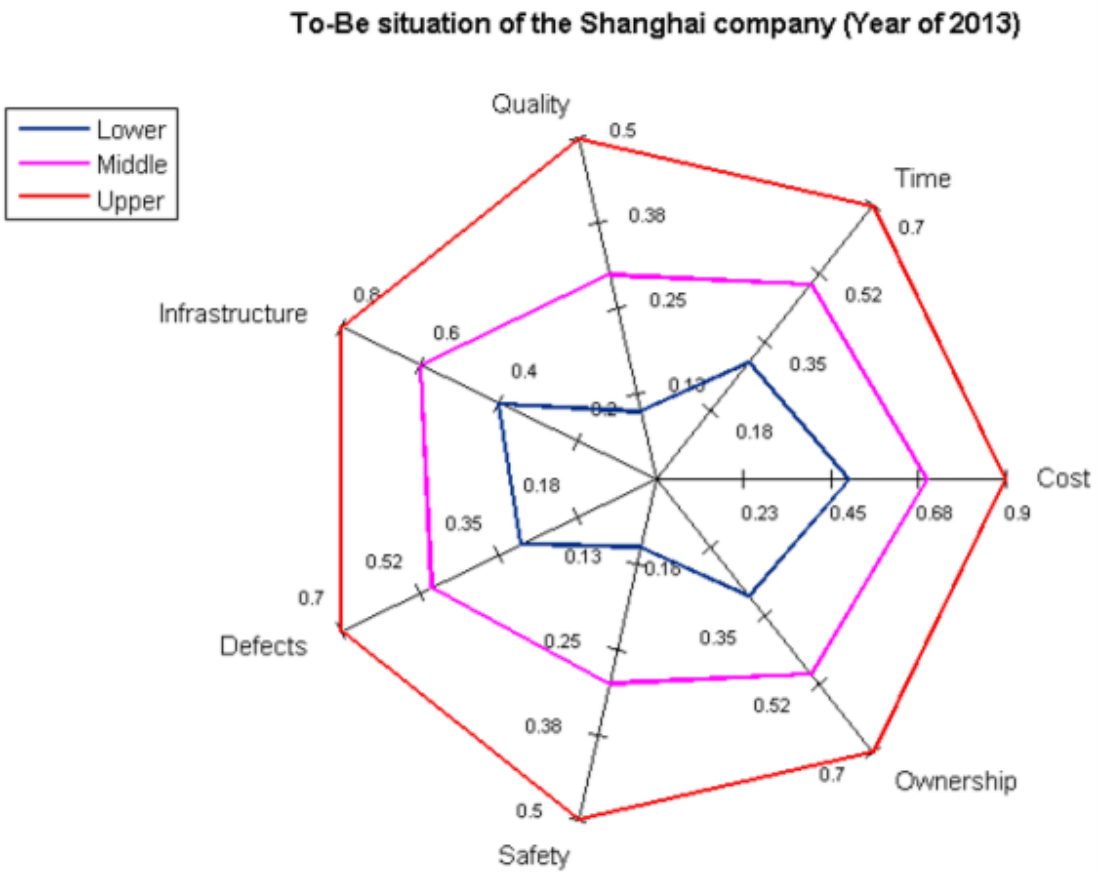
Maturity Analysis: Implementation and Validation of the Proposed Maturity Models(PCMA)

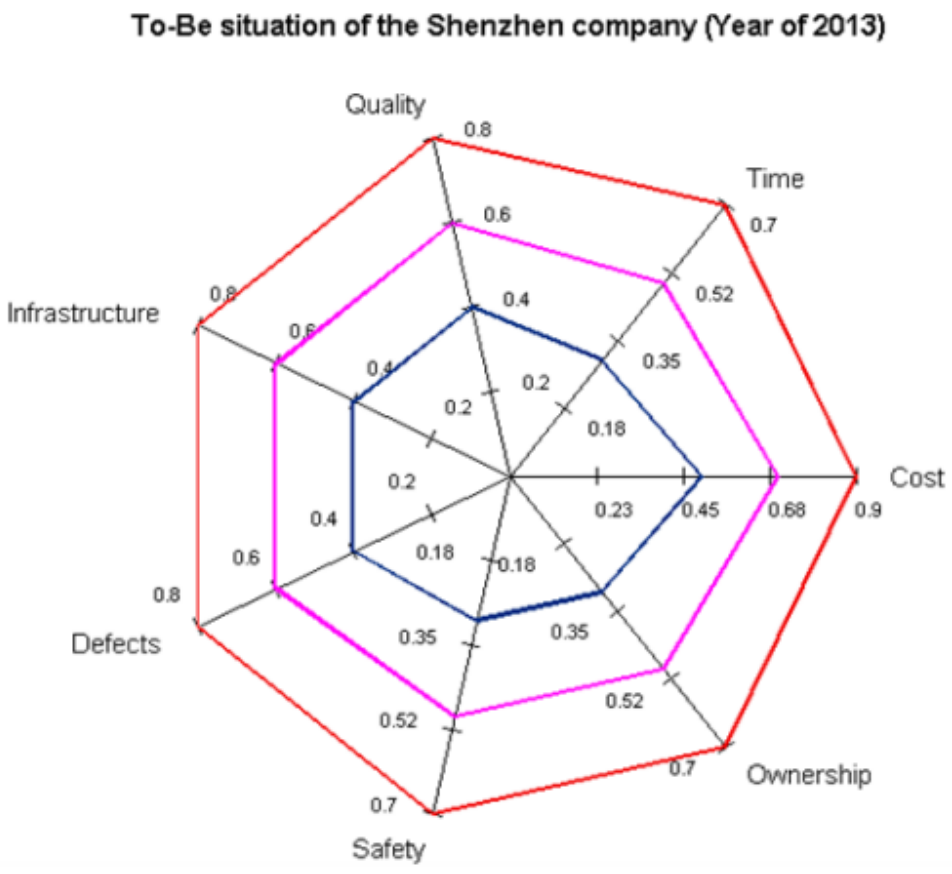
As-Is Situation of Shanghai and Shenzhen Company (Year of 2012)





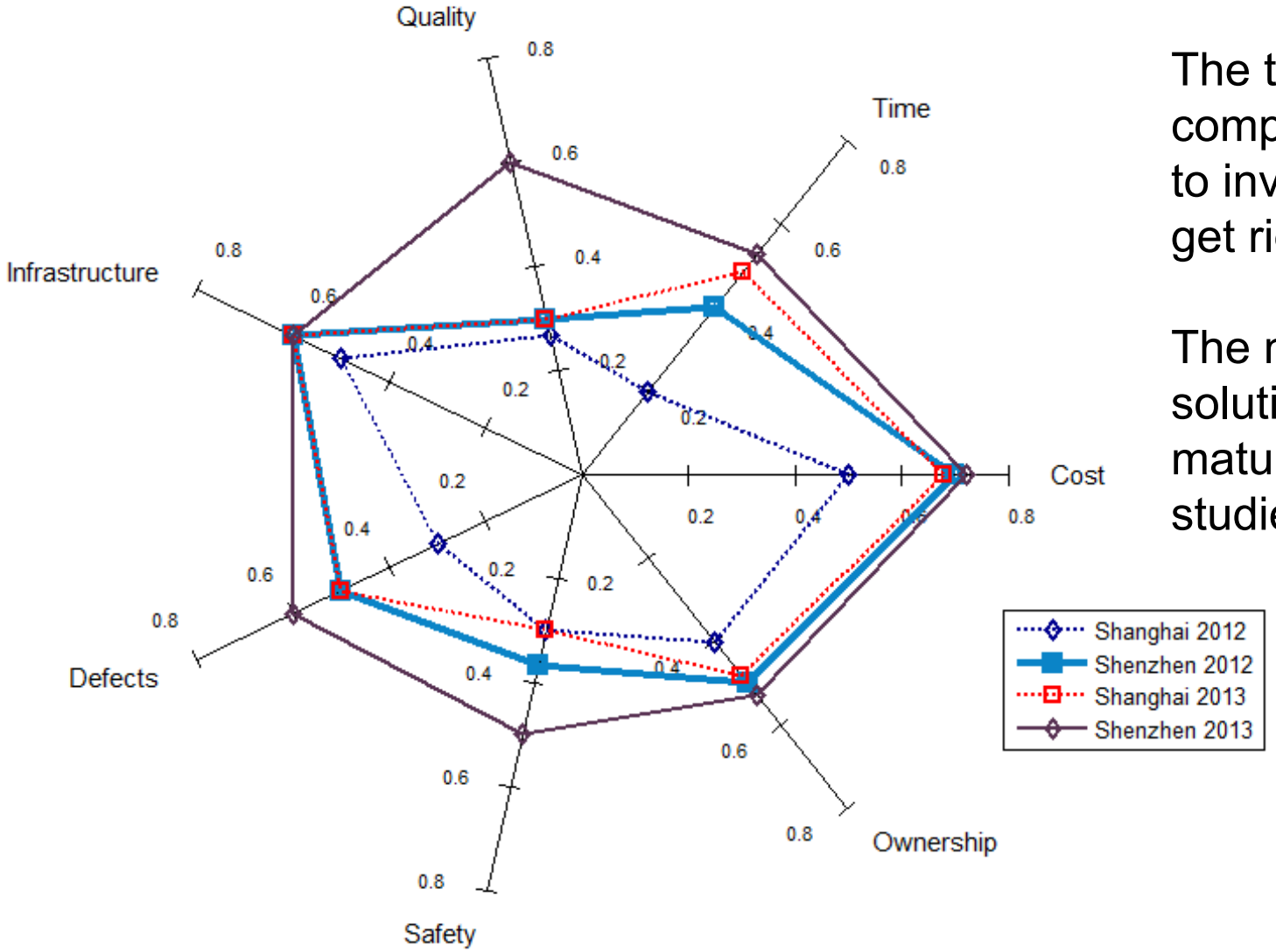
Maturity Analysis: Implementation and Validation of the Proposed Maturity Models(Fuzzy Extended PCMA)





Maturity Analysis: Implementation and Validation of the Proposed Maturity Models(Fuzzy Extended PCMA)

To-Be Situation of the Shenzhen and Shanghai company (Year of 2013 and 2012)

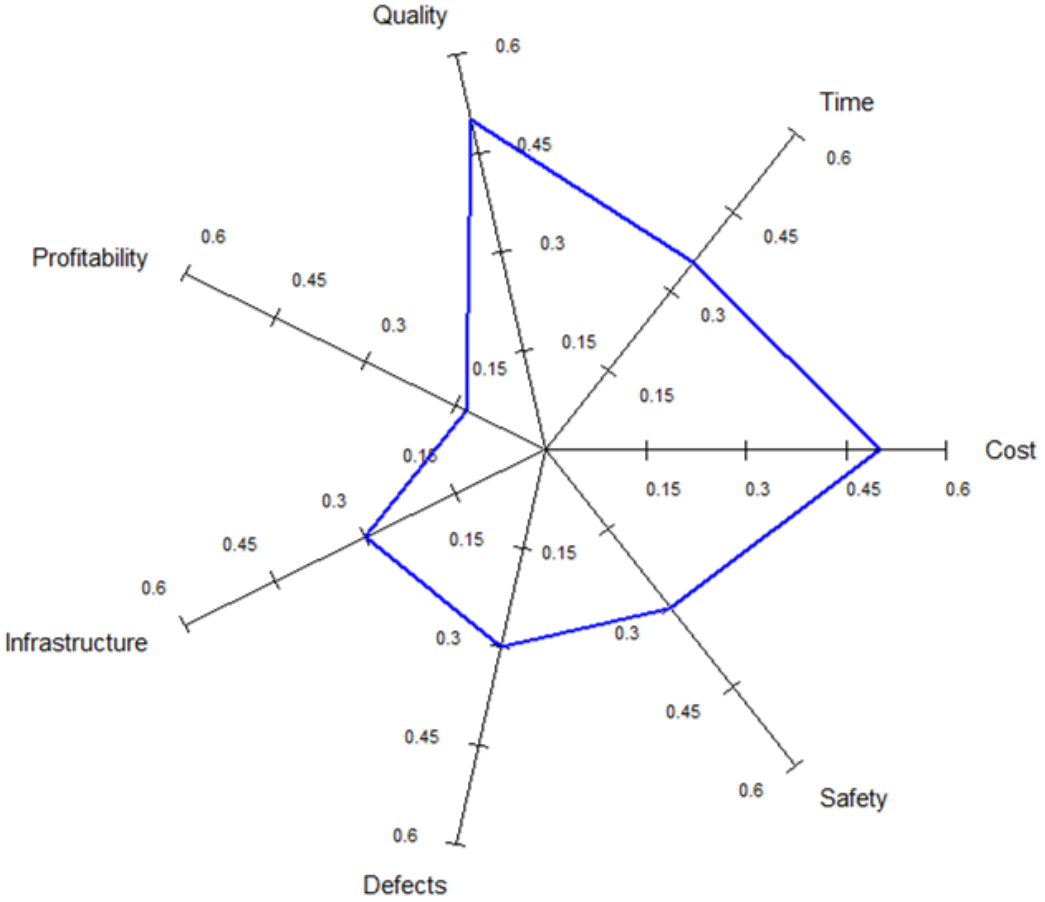


The two industrial control companies are making efforts to invest new solutions and get rid of the old ones.

The new introduced PDM solutions can improve the maturity level of the two studied companies

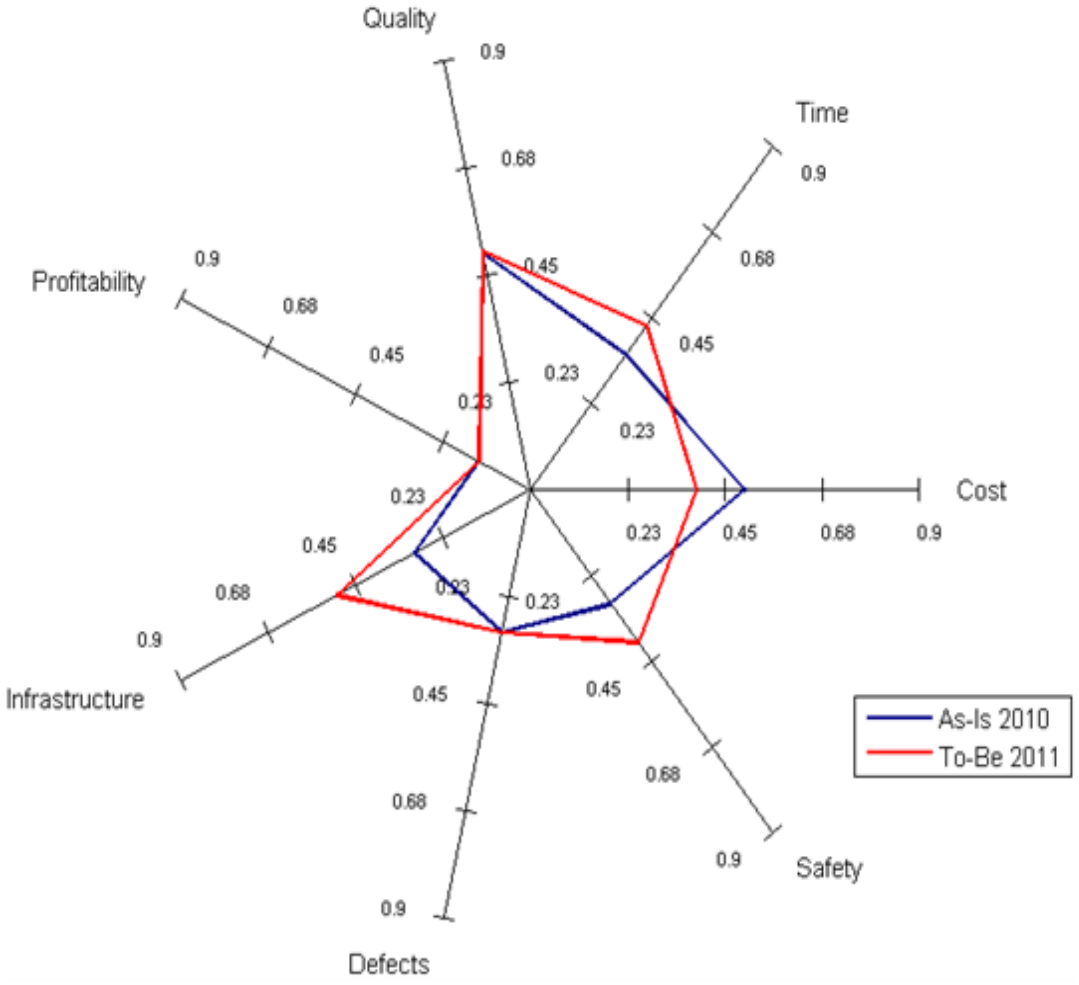
Maturity Analysis: Implementation and Validation of the Proposed Maturity Models(PCMA)

As-Is situation of Chengdu company (Year of 2010)

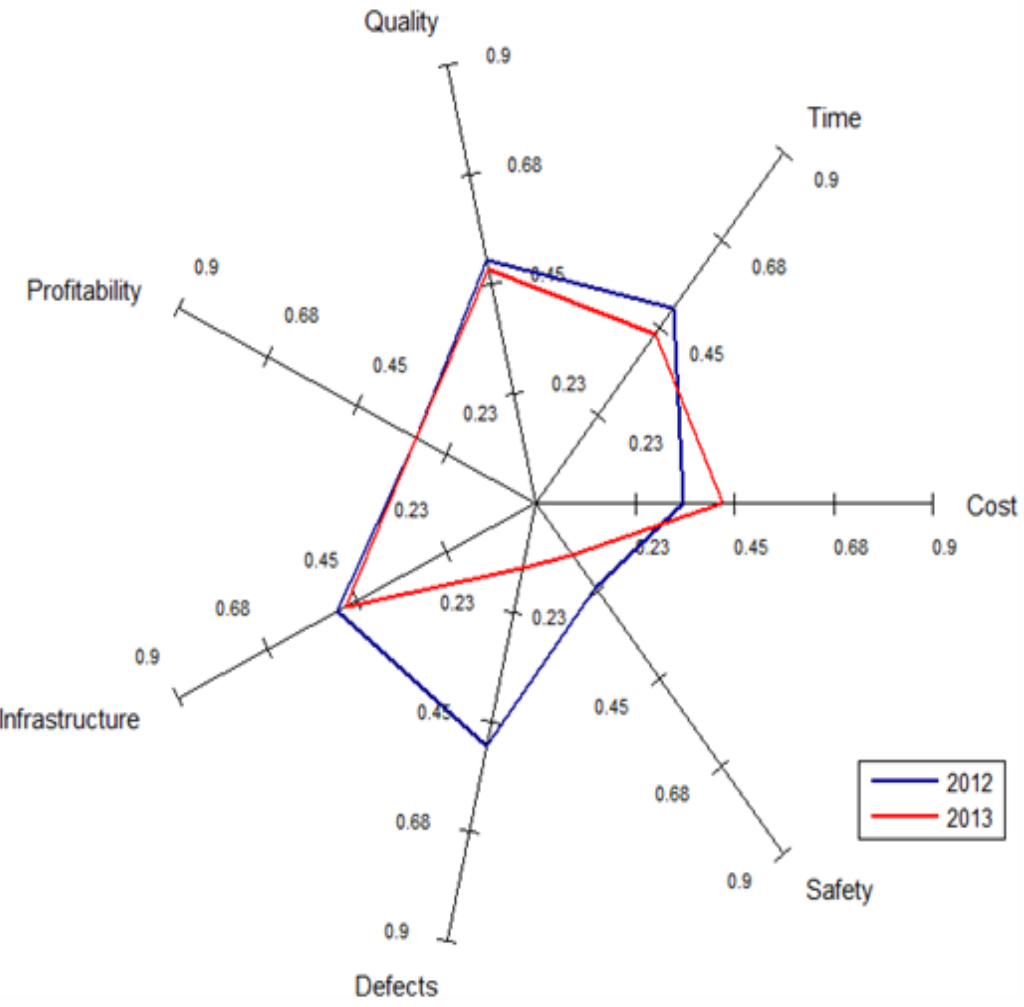


Maturity Analysis: Implementation and Validation of the Proposed Maturity Models(Fuzzy Extended PCMA)

To-Be situation of the Chengdu company (Year of 2011)

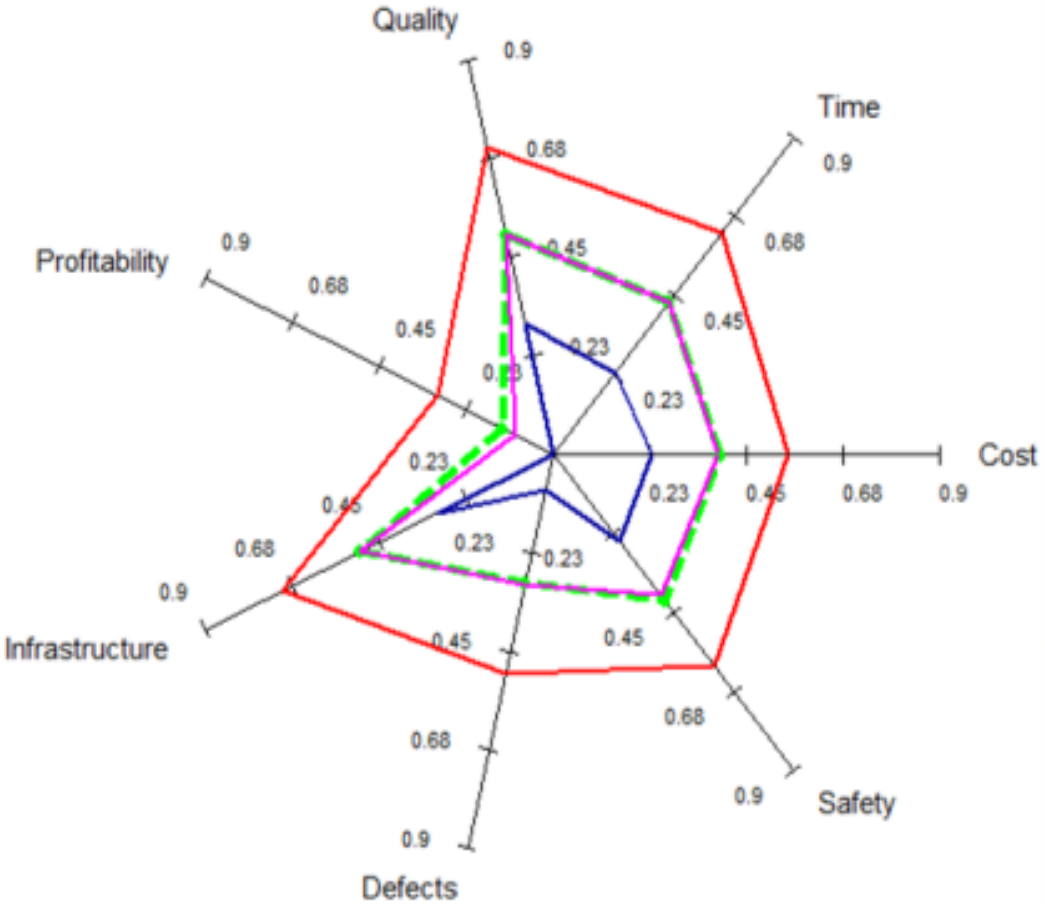


To-Be situation of the Chengdu company (Year of 2012 and 2013)

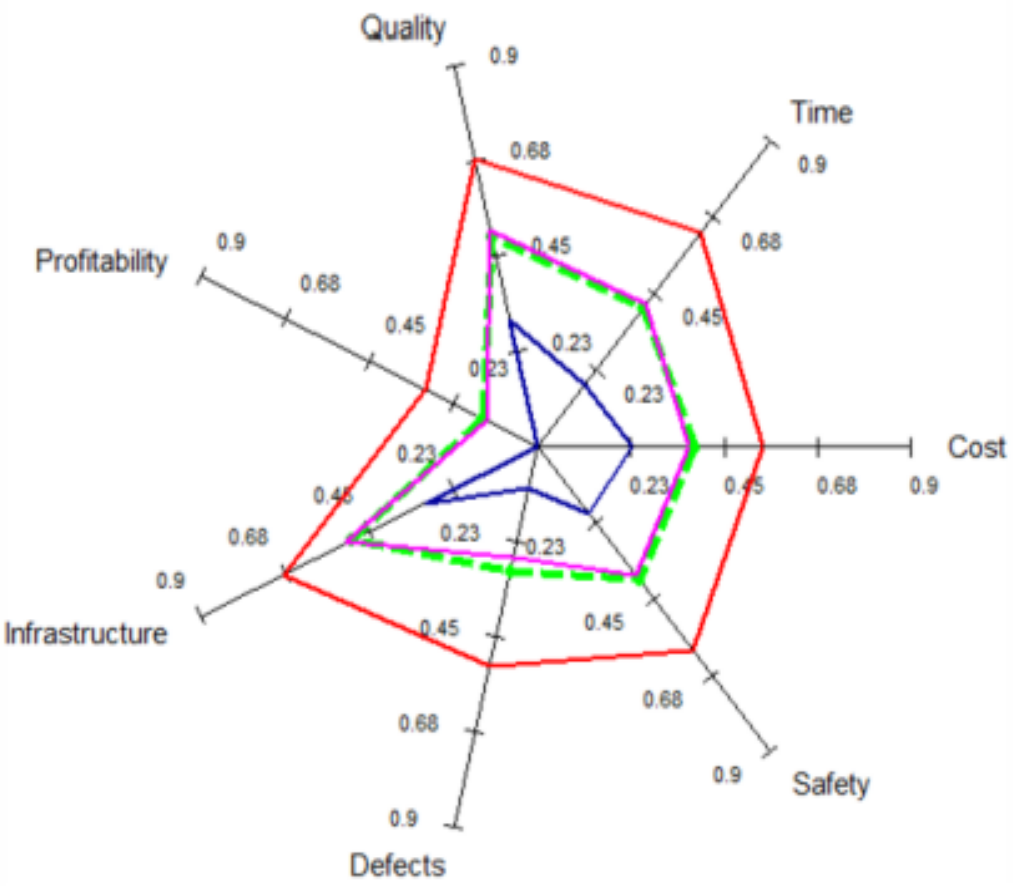


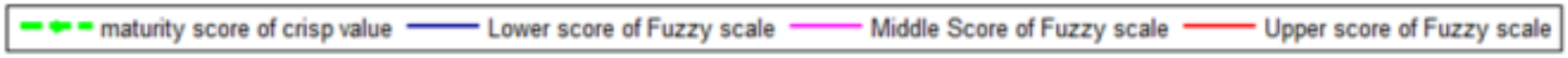
Maturity Analysis: Implementation and Validation of the Proposed Maturity Models(Fuzzy Extended PCMA)

Predicted maturity values of Chengdu company in 2011



Evaluated maturity values of the Chengdu company in 2011





Conclusion and Perspectives of Maturity Analysis

Where AM I?
(Lifecycle System implementation situation)

Present Situation: PLM V1

Future Situation: PLM V2

PCMA maturity model answer the As-Is situation of Lifecycle systems by evaluating the strengths and weaknesses of PLM components

Fuzzy extended PCMA model reduce the efforts that spends on maturity re-evaluation and prediction. The model can ensure the accuracy of the predicted maturity values.

Perspectives:

1. Solving the uncetainty issues;
2. Non-commensurable criteria

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Thanks for your attention

International Journals

1. **H. Zhang**, A. Sekhari, Y. Ouzrout, and A. Bouras. Deriving consistent pairwise comparison matrices in decision making methodologies based on linear programming method. Journal of Intelligent and Fuzzy Systems, vol.27, no.4, pp.1977-1989, Jan. **2014** (ISI)
2. **H. Zhang**, A. Sekhari, Y. Ouzrout, and A. Bouras. Optimal Inconsistency Repairing of Pairwise Comparison Matrices Using Integrated Linear Programming and Eigenvector Methods. Mathematical Problems in Engineering, vol. 2014, Article ID 989726, 16 pages, **2014** (ISI).
3. **H. Zhang**, Y.Ouzrout, A.Bouras, and M.M.Savino. Sustainability consideration within product lifecycle management through maturity models analysis. International Journal of Services and Operations Management, vol.19, no.2, pp.151-171, Jan.**2014** (Scopus).
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5. **H. Zhang**, A. Sekhari, Y. Ouzrout, and A. Bouras. Jointly Identifying Opinion Mining Elements and Fuzzy Measurement of Opinion Intensity to Analyze Product Features. International Scientific Journal Engineering Applications of Artificial Intelligence. Under Revision, **2015** (ISI).

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1. **H. Zhang**, A. Sekhari, Y. Ouzrout, and A. Bouras. "Selection of Product Lifecycle Management Components Based on AHP Methodologies." In Advanced Logistics and Transport (**ICALT'2013**), pp.523-528, **2013**.
2. **H. Zhang**, A. Sekhari, Y. Ouzrout, and A. Bouras. "PLM Components Selection Based on a Maturity Assessment and AHP Methodology." In Book « Product Lifecycle Management for Society ». A. Bernard et Al, Eds. **Springer**, Book Proceedings from IFIP **PLM'13**, pp.439-448, **2013**.
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4. **H. Zhang**, A. Bouras, Y. Ouzrout, and A. Sekhari, "Fuzzy multi-criteria lifecycle system maturity decision making based on an integrated Fuzzy AHP and VIKOR methodology," International Conference on Computational Science and Technology (**ICCST'2014**), pp.1-6, **2014**.
5. A. Bouras**, H. Zhang,** A. Sekhari and Y. Ouzrout. "Identifying Opinion Mining Elements Based on De-Pendency Relations and Fuzzy Logic." In 17th International Conference on Artificial Intelligence (**ICAI'15**), Las Vegas - USA, July **2015** (Accepted**)**.

Journée Nationale du GT EASY DIM 2015

Modèles de maturité et Projet d'entreprise

Lundi, 29 Juin 2015, Université Lumière Lyon 2 – IUT de Bron

Papier 4

Titre : Augmentation de la productivité des projets de R&D sous fortes contraintes via les méthodes agiles et les systèmes intelligents

Par : ***Florian Pereme****, Virginie Goepp*

Institution : Laboratoire ICube, INSA de Strasbourg

Papier & Présentation

Augmentation de la productivité des projets de R&D sous fortes contraintes via les méthodes agiles et les systèmes intelligents

Florian Pereme

Laboratoire ICube, INSA de Strasbourg

Version Françoise

La R&D (Recherche et développement), en contexte industriel, subit des changements profonds considérables. Ces derniers sont poussés par des systèmes d'information de plus en plus volumineux et massivement disponibles, les courants open source et open Innovation, ainsi que les marchés historiquement « producteurs » comme l'Asie qui se dote d'une capacité de recherche et d'innovation de plus en plus concurrentielle[1].

Ainsi, la nécessité de pouvoir raccourcir les temps de mise sur le marché (« time to market ») en apportant des solutions technologiques de plus haut niveau devient une question primordiale. Une chaine complète d'innovation, va de l'identification d'un besoin à la mise sur le marché d'une solution levant des verrous scientifiques et ou technologique associés. Son observation permet de constater une limite de la phase de R&D. Cette limite est imposée par un processus classiquement séquentiel qui constitue une phase relativement longue du cycle de vie des produits innovants, pouvant aller jusqu'à une décennie.

L'hétérogénéité des processus de recherche appliquée et de développement de produit, additionnée au décalage de phase dans le temps, ainsi qu'à des entrées/sorties différentes, semble a priori ne pas permettre une inter-connectivité de ces processus autre que le modèle séquentiel actuel. Le sujet de cette thèse CIFRE porte sur l'interopérabilité des processus hétérogènes complexes, par un alignement stratégique opérationnel, dans le but de pouvoir augmenter la productivité des projets de R&D dans un contexte industriel fortement contraint par les contenus, les coûts, la qualité et les délais. Ainsi, nous prenons en compte :

- Les méthodes itératives (grounded theory, modèles Agiles, cycle de möbius)[2] issues des pratiques industrielles qui ont démontré leur intérêt dans l'acquisition rapide de valeur d'un produit.
- Les cycles courts qui en plus d'être une base des concepts des méthodes agiles sont également un pilier du Lean, plus particulièrement du Lean software développement[3].

Ces approches semblent donc être des leviers d'augmentation de valeur d'un produit en réduisant les durées de conception, tout en garantissant un haut niveau de contenu (qualité et satisfaction du besoin).

Cette application à un processus complet, caractérisé par la transformation d'entrées en sorties à valeur ajoutée, se complexifie dans le cas de la R&D. En effet, dans la volonté de créer des itérations nombreuses et des cycles courts le processus de R&D ne peut être défini comme un seul processus linéaire. Il se pose dès lors la problématique de rendre des systèmes hétérogènes interopérables. Il s'agit de répondre aux questions suivantes : Quels peuvent-être les liens potentiels, à quelles étapes de processus paralléliser et rendre communicant deux processus hétérogènes.

Le model CMMI (capability maturity model intégration)[4][5] dans son approche par audit des aires de processus permet d'effectuer une évaluation à la fois quantitative et qualitative de ses propres pratiques de

développement de produits, dans le but de les améliorer, pour aboutir à un système en optimisation permanente.

Dans cette approche les aires de processus audité, n'ont pas forcement de liens les unes par rapport aux autres. Cela offre l'avantage de pouvoir appliquer ce modèle à des processus ou sous parties de processus identifiées comme source de valeurs importantes ou comme nouvelle entrée pour un processus aval.

D'après le modèle CMMI les différents niveaux de maturité sont empilés, il est donc nécessaire de satisfaire tous les critères d'un niveau inférieur avant de vouloir élever son niveau de maturité.

Les hypothèses de nos travaux de thèse sont donc les suivantes :

- Les interactions entre deux sous étapes, de deux processus hétérogènes, ne peut se faire de façon efficiente qu'à la condition que ces deux sous étapes aient le même niveau de maturité.
- La communication entre deux processus hétérogène nécessite une double approche combinant CMMI et « Knowledge management ».

Il s'agit donc, dans ces travaux de thèse, d'identifier dans un premier temps les processus d'interaction entre la recherche et le développement. Sur cette base, un alignement basé sur les niveaux de maturité et la gestion des connaissances efficiente peut être envisagé. Cela permet d'aboutir à un système global de R&D intégrées, capitalisant continuellement la valeur déjà acquise. Dans ce cas des itérations nombreuses de cycles courts entre la recherche et le développement sont possibles.

Une fois cet alignement effectif, la prise en compte des contraintes contextuelles de coût qualité et délai, peut être intégré dans le pilotage des processus.

English Version

In industrial context R & D (Research and Development) departments, have to face deep changes. Those changes are driven by larger and highly connected information systems, open source and open innovation streams, and finally historical "makers" market like Asia which establish a competitive research and innovation capacity[1] .

Thus, the need to shorten the time to market by providing high level technology solutions becomes a key issue. A complete innovation chain covers all phases, from customer need identification to the introduction of a product solving technical or scientific locks on the market. Its observation reveals the limits of the R & D process. These limits are determined by a usual sequential process which is a long phase of innovative products life cycle, up to a decade.

The heterogeneity of applied research process and product development, added to time phase offset, as well as a different kind of inputs / outputs , seems a priori not allows another process connectivity that the current sequential model . The subject of this "CIFRE" thesis focuses on the interoperability of complex and heterogeneous process, through an operational and strategic alignment, in order to increase the productivity of R & D projects in a strong constrained industrial. context by the contents, costs, quality and lead times. In this optic, we consider:

- Iterative methods (grounded theory, Agile models, Mobius cycle)[2] out coming from industrial practices that have demonstrated their interest in rapid product added value.
- Short cycles that besides being a base of agile methods concepts are also a basics of Lean methods, particularly Lean software development[3].

These approaches appear to be a major way to boost product values by reducing design times, while ensuring a high level of content (quality and customer need satisfaction).

This application to a complete process, characterized by the transformation of inputs into added value outputs, becomes more complex in the case of R & D. Indeed, the desire to create R & D process with multiple iterations and short cycles cannot be defined as a single linear process. The technical lock of making interoperable heterogeneous systems arise and asked the following question: What are the possible linkages and at which stages of the process that makes two heterogeneous processes communicating for a parallel progress.

The CMMI model (capability maturity model integration)[4] [5]in its process areas audit approach allows both quantitative and qualitative assessment of its own product development practices in order to improve them, to finally reach a permanent optimized system.

In this approach the audited processes areas, does not necessarily have links with each other. This offers the advantage of applying this model to process or sub-process parts identified as a source of important added values or as a new entry to a downstream process.

According to the CMMI model the different maturity levels are stacked, it is mandatory to satisfy all the criteria of a lower level before trying to raise his maturity level. The assumptions of our thesis works are the following:

- The interactions between two sub-steps, of two heterogeneous processes, can only efficiently be done if these two sub-steps have the same level of maturity.
- Communication between two heterogeneous processes requires a dual approach combining CMMI and "Knowledge management".

It is therefore in these thesis works, to first identify the interaction between research and development process. On this basis, a maturity level alignment considering also an efficient knowledge management may be intended. This will lead to a global integrated R & D system that permanently capitalized added value. In this case the multiple iterations of short cycles between research and development are possible.

Once this alignment will be performed, managing contextual constraints of cost quality and time, can be integrated into the process control.

[1] C. ©. M. I. of Technology et 1977-2015 All rights reserved, « Innovation Lessons From China », *MIT Sloan Management Review*. .

[2] E. Céret, S. Dupuy-Chessa, G. Calvary, A. Front, et D. Rieu, « A taxonomy of design methods process models », *Inf. Softw. Technol.*, vol. 55, n° 5, p. 795‑821, mai 2013.

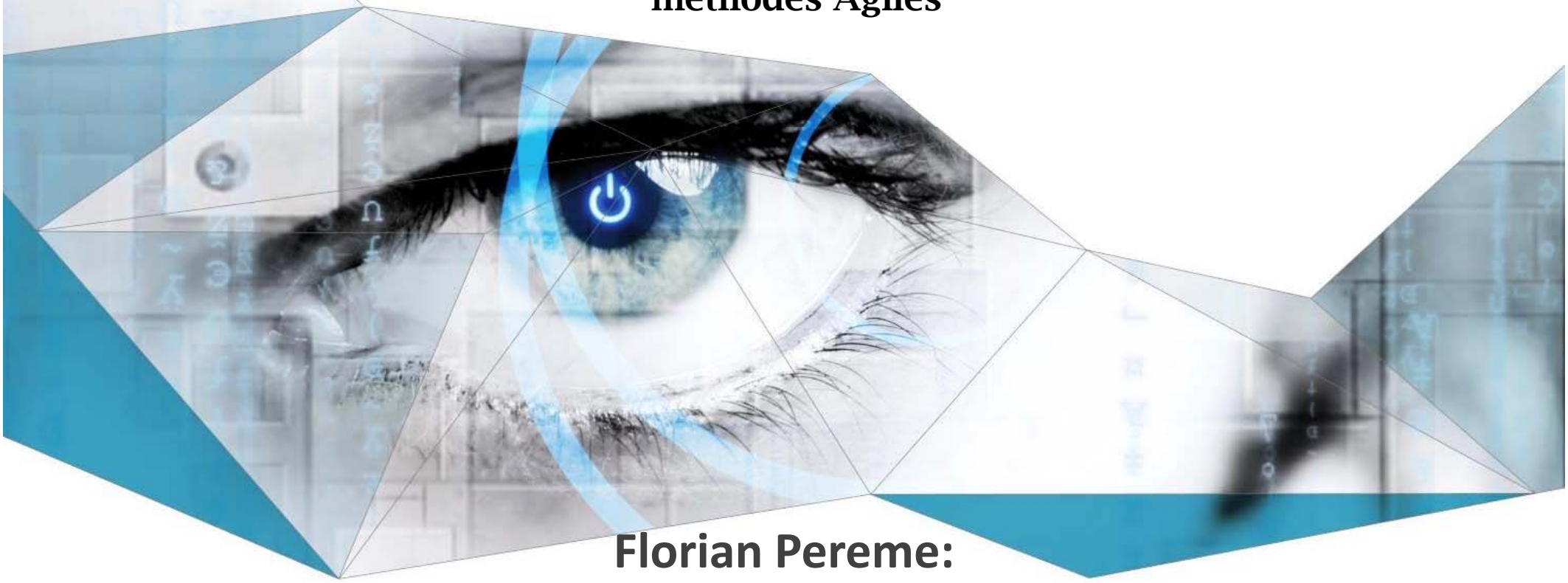
[3] J. Trimble et C. Webster, « From Traditional, to Lean, to Agile Development: Finding the Optimal Software Engineering Cycle », in *2013 46th Hawaii International Conference on System Sciences (HICSS)*, 2013, p. 4826‑4833.

[4] F. Selleri Silva, F. S. F. Soares, A. L. Peres, I. M. de Azevedo, A. P. L. F. Vasconcelos, F. K. Kamei, et S. R. de L. Meira, « Using CMMI together with agile software development: A systematic review », *Inf. Softw. Technol.*, vol. 58, p. 20‑43, févr. 2015.

[5] S. C. P. Team, *CMMI for Development v1. 3*. Carnegie melon university, 2010.

Présentation des travaux:

Augmentation de la productivité des projets de R&D sous fortes contraintes de coût, qualité, délai, via les systèmes intelligents et les méthodes Agiles



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Sommaire

- Contexte
  - Enjeux de l'innovation
  - Cas des société de services
- Problématique
  - Enjeux Industriels
  - Enjeux scientifiques.
- Travaux en cours
  - 1 ère expérimentation, résultats et retour d'expérience.
  - 2 ème expérimentation
- Perspectives

Contexte : Enjeux de l'innovation.

L'Innovation:

Satisfaire un besoin exprimé ou latent par l'apport de technologie encore non exploitée dans le cadre de ce besoin.

	Innovation par transfert	Innovation par assemblage	Innovation de rupture
Open Source			
Marché existant			
Nouveau marché			

L'Innovation:

- Est une nécessité pour conserver un avantage concurrentiel.
- Est un levier pour agrandir son marché.

Contexte : Cas des société de services.

R

&

D

RECHERCHE

Altran Research

Activités de recherche appliquée visant la levée de verrou technologique ou scientifique

DÉVELOPPEMENT EXPÉRIMENTAL

I Project

Concours interne d'innovation, où les lauréats sont accompagnés par des équipes technique et marketing, dans la transformation d'une idée en produit.

Pr[i]me

Co-création, design et modélisation de solution complexe via une méthodologie de rupture

ENGAGEMENTS FORFAITAIRES

Projet au forfait

Livraison d'un produit ou d'un service avec un engagement de résultat (CQD).

Centre de services

Catalogue de services répondant à des besoins récurrents selon un ensemble prédéfini de *work packages* avec un engagement de résultat.

ENGAGEMENTS EN COMPÉTENCES ET MÉTIERS

Assistance technique

Fourniture de support technique, de conseil et d'expertises individuelles au sein des équipes clients.

Centre de compétences

Accès à un référentiel métier multidisciplinaire porté par une équipe, selon un contrat de services intégrant des indicateurs clefs de performance.

Problématique: Enjeux Industriels

Economique:
Rationaliser et piloter des activités de recherche et de développement en mode projet.

Technique/ scientifique:
Diminuer le risque, et augmenter le niveau de confiance dans l'obtention de résultats et de livrables.

Problématique industrielle classique: **Coûts / Qualité / Délai**

Comment l'appliquer à la recherche en industrie?

Problématique: Enjeux Scientifiques

Verrou de processus
La Recherche et le développement de produits, sont des processus divergents.
Comment résoudre une incompatibilité organisationnelle?

Verrou de capitalisation
La création de savoir ne suis pas les mêmes règles entre la recherche et le développement.

Comment réussir le transfert de savoir entre la recherche et le développement ?

Verrou d'alignement
Les enjeux et la chaine de valeur ajoutée entre R&D sont divergents.

Travaux en cours: 1 ère expérimentation

Alignement via un SMQ commun.

Hypothèse:
Le pilotage guidé par une définition commune de la qualité (produit) permet d'aligner les pratiques de processus vers un objectif commun.

Expérimentation:

Cadre
Equipe de recherche Médic@, en vision et traitement par ordinateur en contexte médical.

Objectif
Application de la norme ISO 13458:2003.

Méthode:
Process mapping -> audit -> création de bonnes pratiques pour la mise en conformité

Travaux en cours: 1 ère expérimentation

Résultat:

Taux de conformité à la norme avant: 17%
Taux de conformité à la norme après: 30%

Productivité avant: Inconnu
Productivité moyenne après: 50%

Analyse:

Les aspects stratégiques et généraux **OK**
Les aspects opérationnels NOK
Système non maintenable et non maintenu.

Une norme ne peut pas aligner des processus aussi divergents

Travaux en cours: 2 eme expérimentation

Alignement par les modèles de maturité

Choix du CMMI.

Hypothèse: Des processus hétérogènes et divergents ne peuvent communiquer efficacement qui si les processus liés sont de même niveau de maturité.

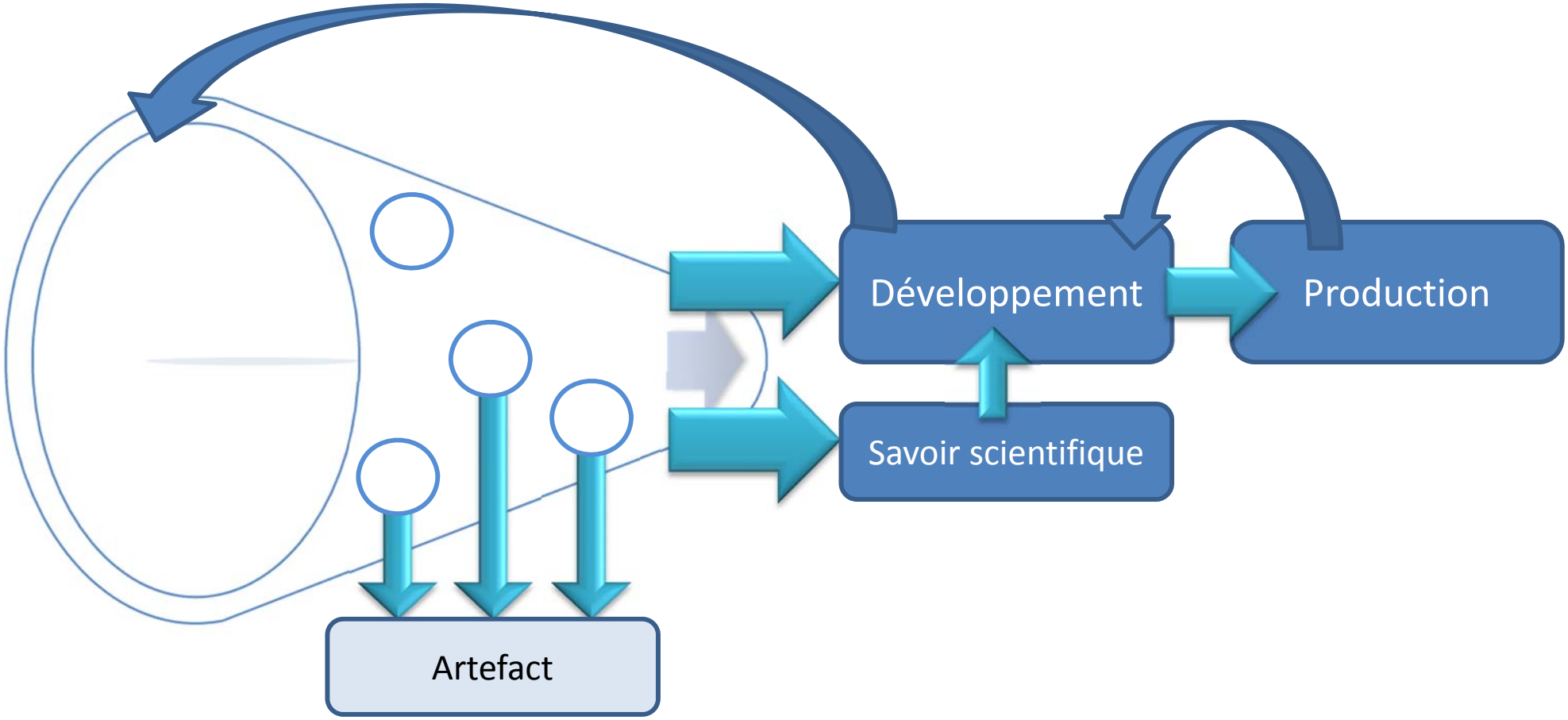
1.) Audit par aire de processus avec la méthode des FPA (Function Point Analysis)

- 1.1) large panel de structures
- 1.2) Benchmark sur les function point
- 1.3) identifier les « recettes du succès »

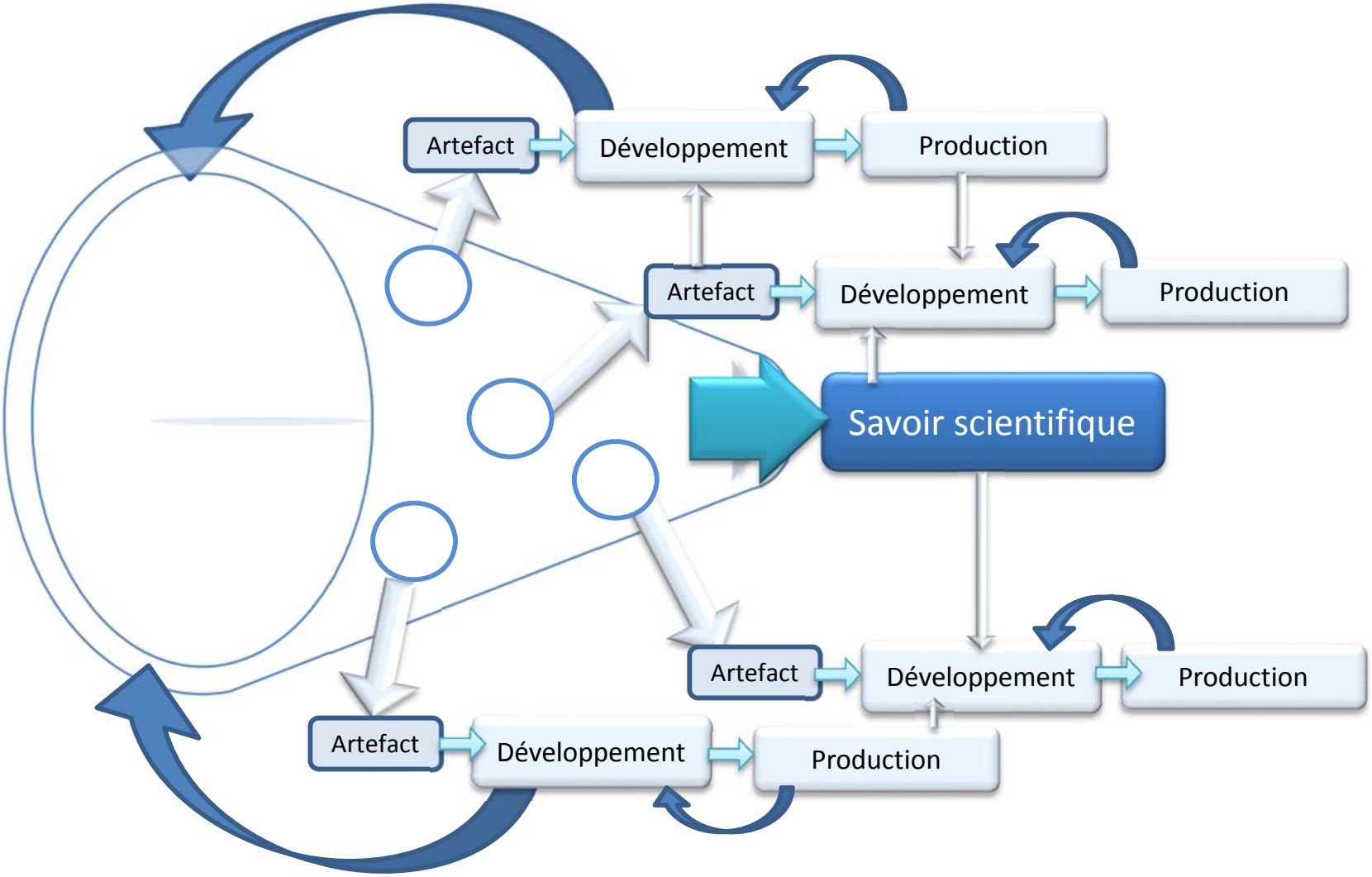
2) Mapping des processus liés

- 1.1) identification de la chaine de valeur
- 1.2) alignement par le niveau de maturité
- 1.3) itération dans plusieurs structures sur différents produits

Travaux en cours: 2 ème expérimentation

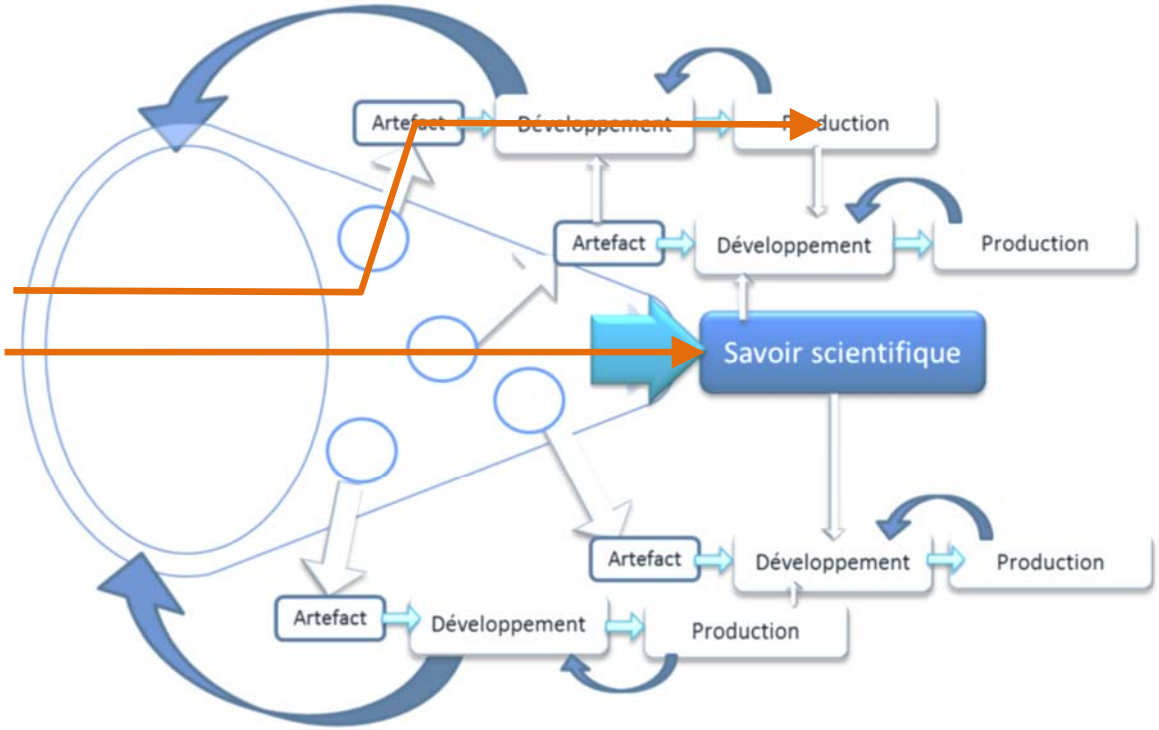


Travaux en cours: 2 ème expérimentation



Travaux en cours: 2 ème expérimentation

- Les chaines de valeur identifiées
  - Savoir
  - Savoir faire
  - Maquette/Prototype/Produit



Perspectives

Définition d'un modèle spécifique à l'alignement des projets R&D

Harmonisation des expérimentations

Merci de votre attention.