

Journée commune des GT Ingénierie des Exigences et Génie Logiciel pour les
Systèmes Cyber-Physiques
Vendredi 18 Janvier 2019,
Maison des Sciences Economiques, Université Paris 1

Les fondamentaux de l'Ingénierie des Exigences

Prof. Camille Salinesi

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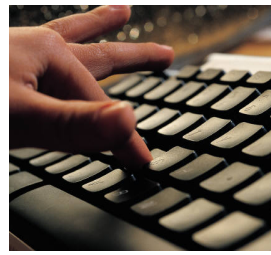
Camille.Salinesi@univ-paris1.fr



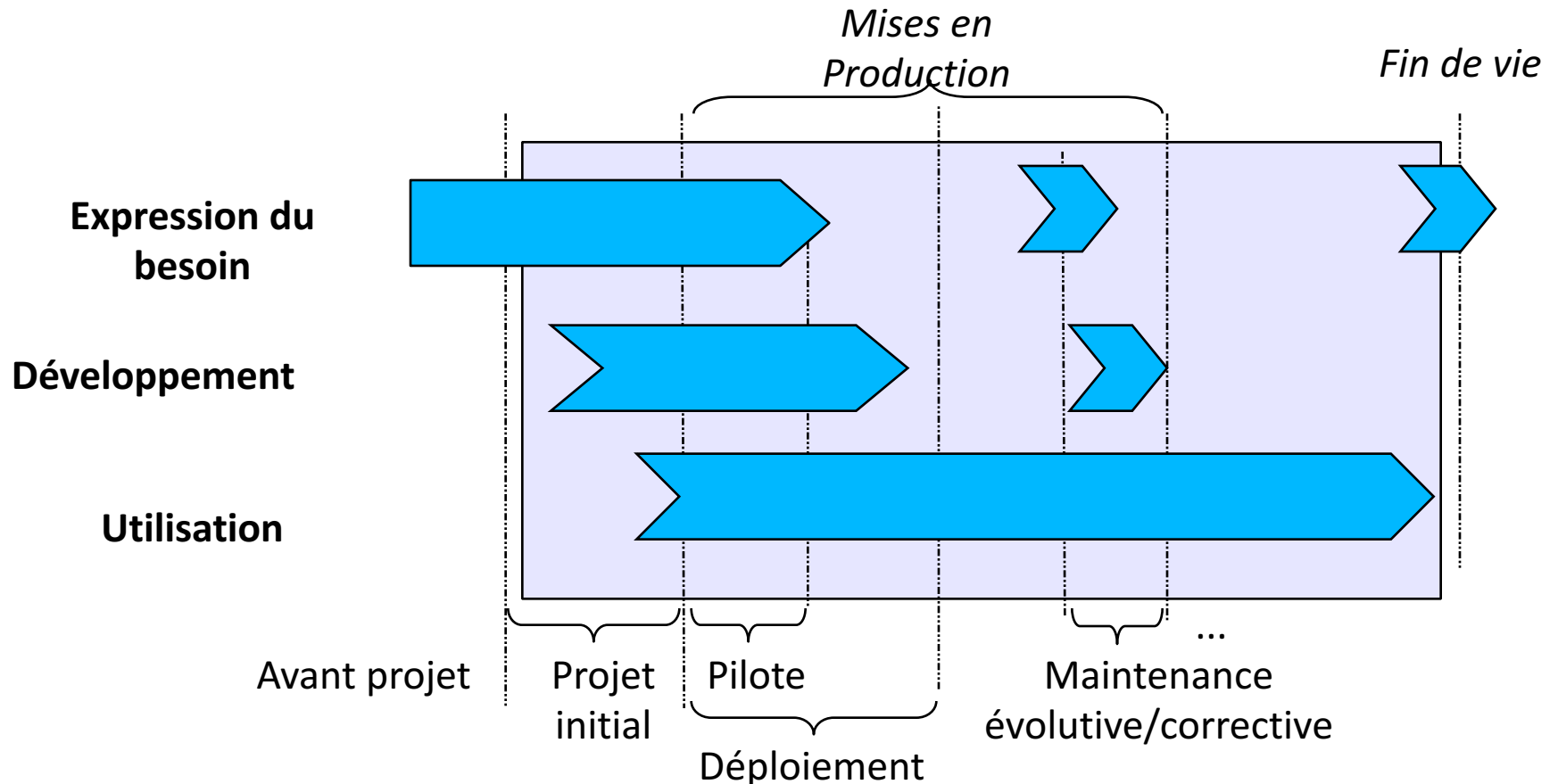
« Exigence » selon IEEE 610.12

- *Condition* ou *aptitude*
- *Requise* par un utilisateur *pour*
 - résoudre un *problème* ou
 - atteindre un *objectif*
- qui doit être rencontrée ou possédée par
 - un *système* ou
 - un *composant d'un système*
- pour satisfaire à
 - un contrat,
 - un standard,
 - une spécification ou
 - tout autre *document composé formellement*

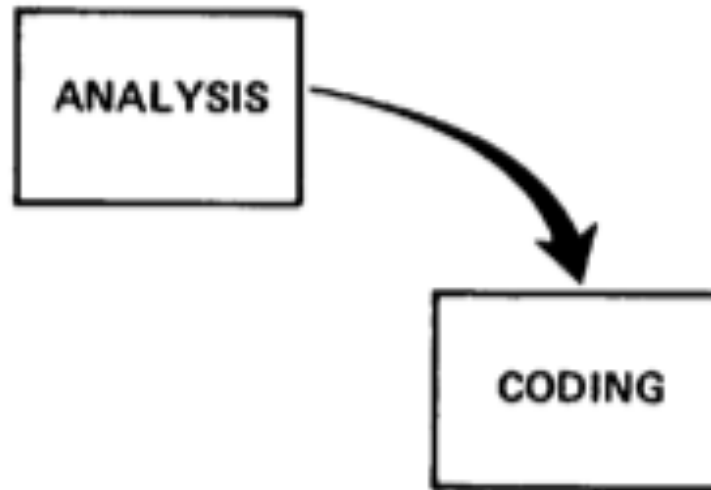
Domaines



Positionnement “*classique*” de l’IE



Winston Royce, 1971



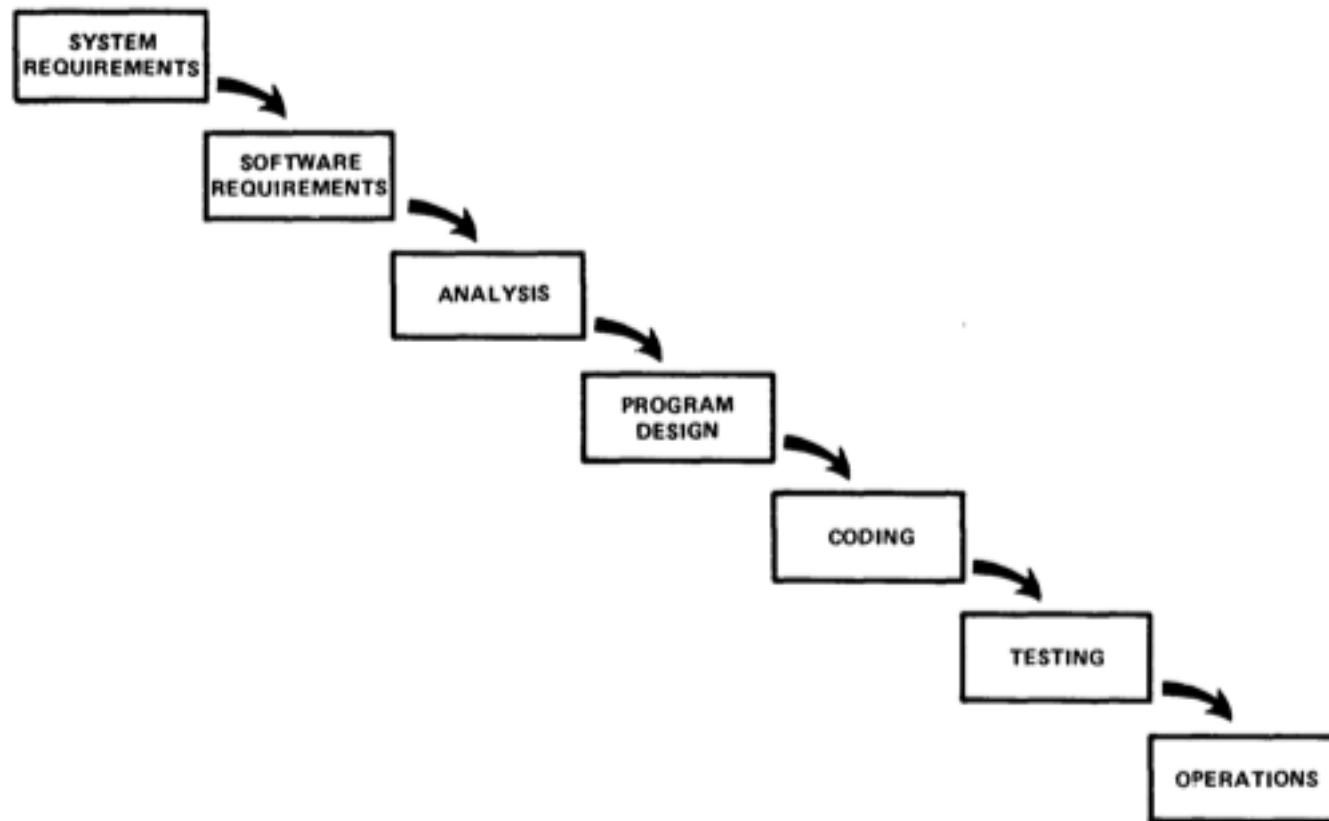
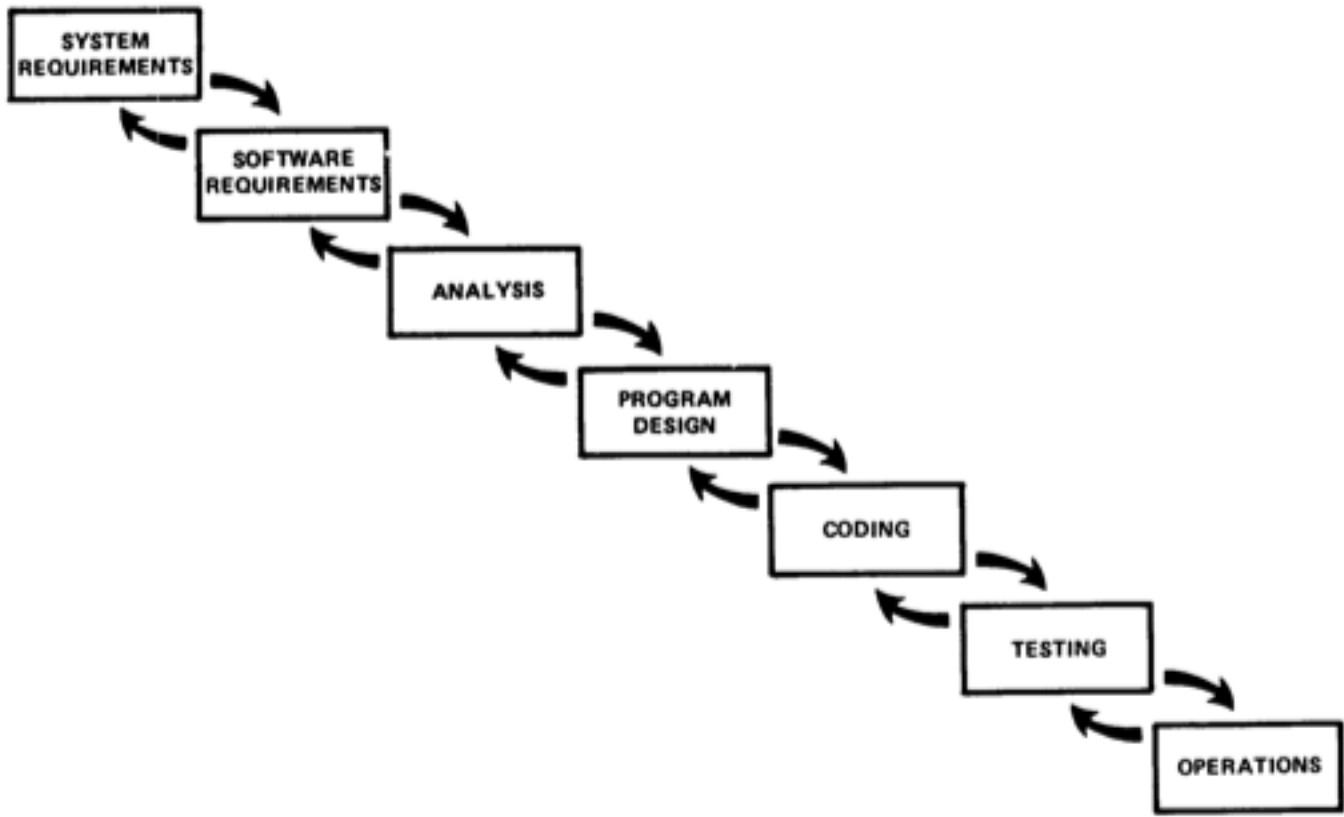


Figure 2. Implementation steps to develop a large computer program for delivery to a customer.



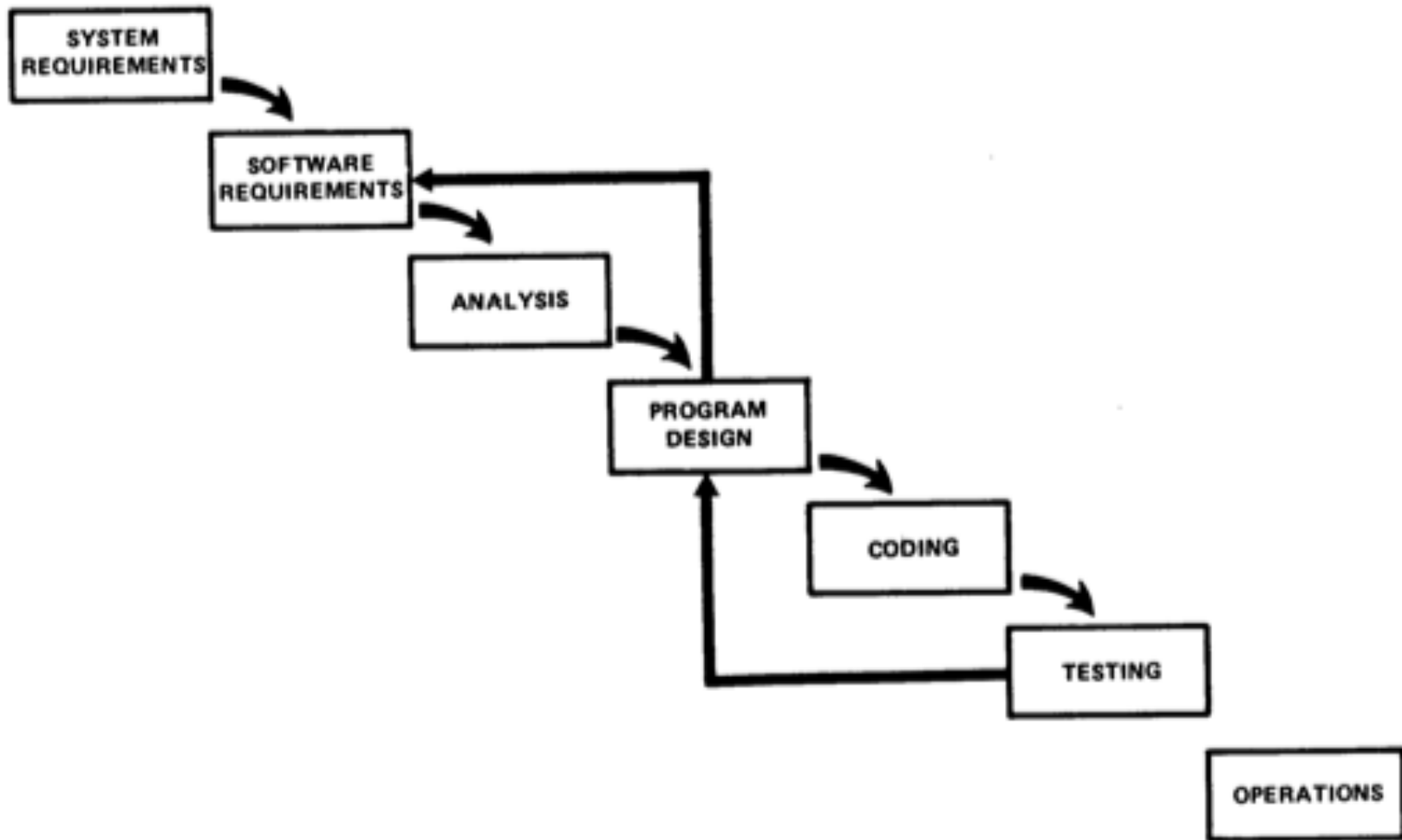
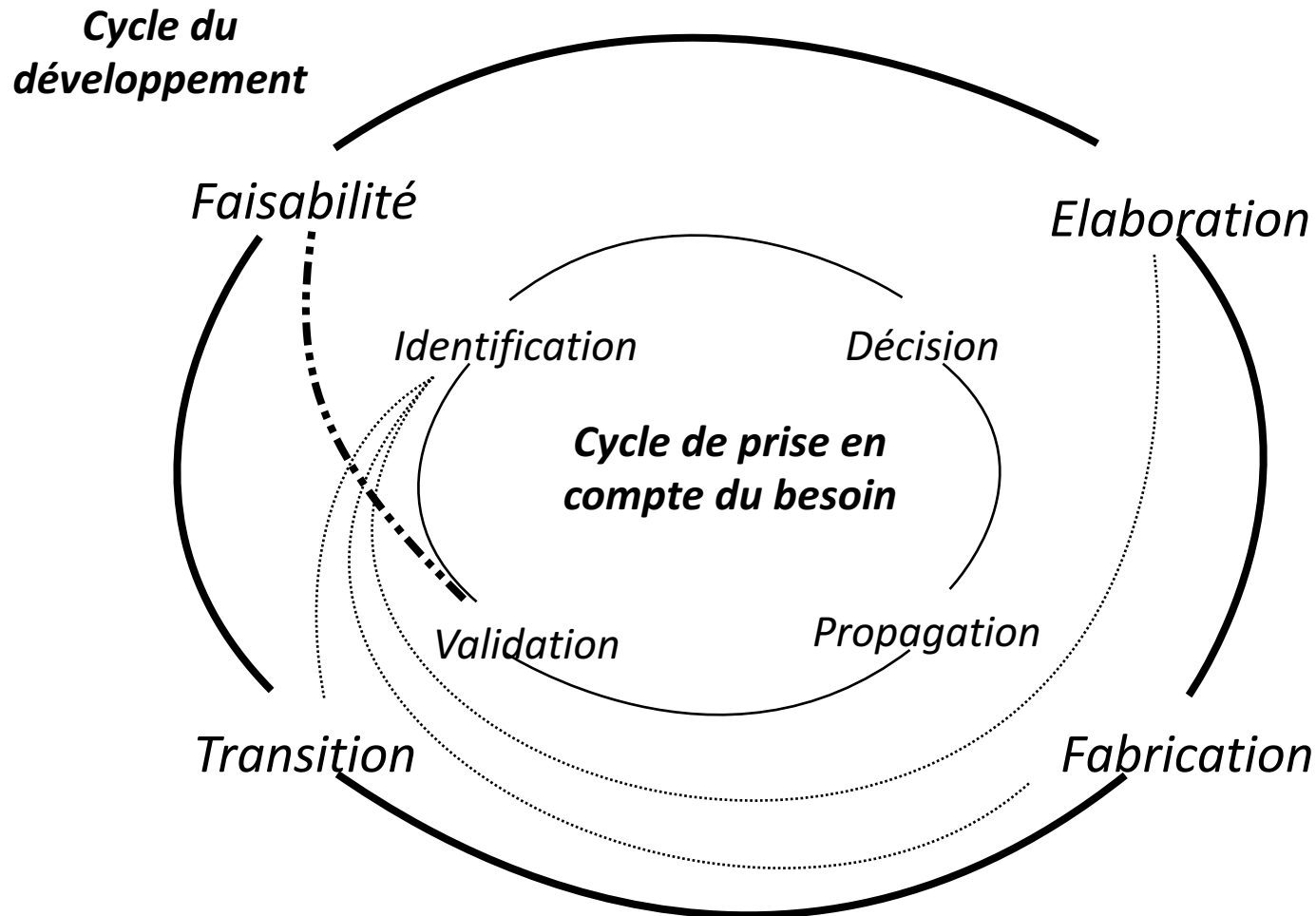
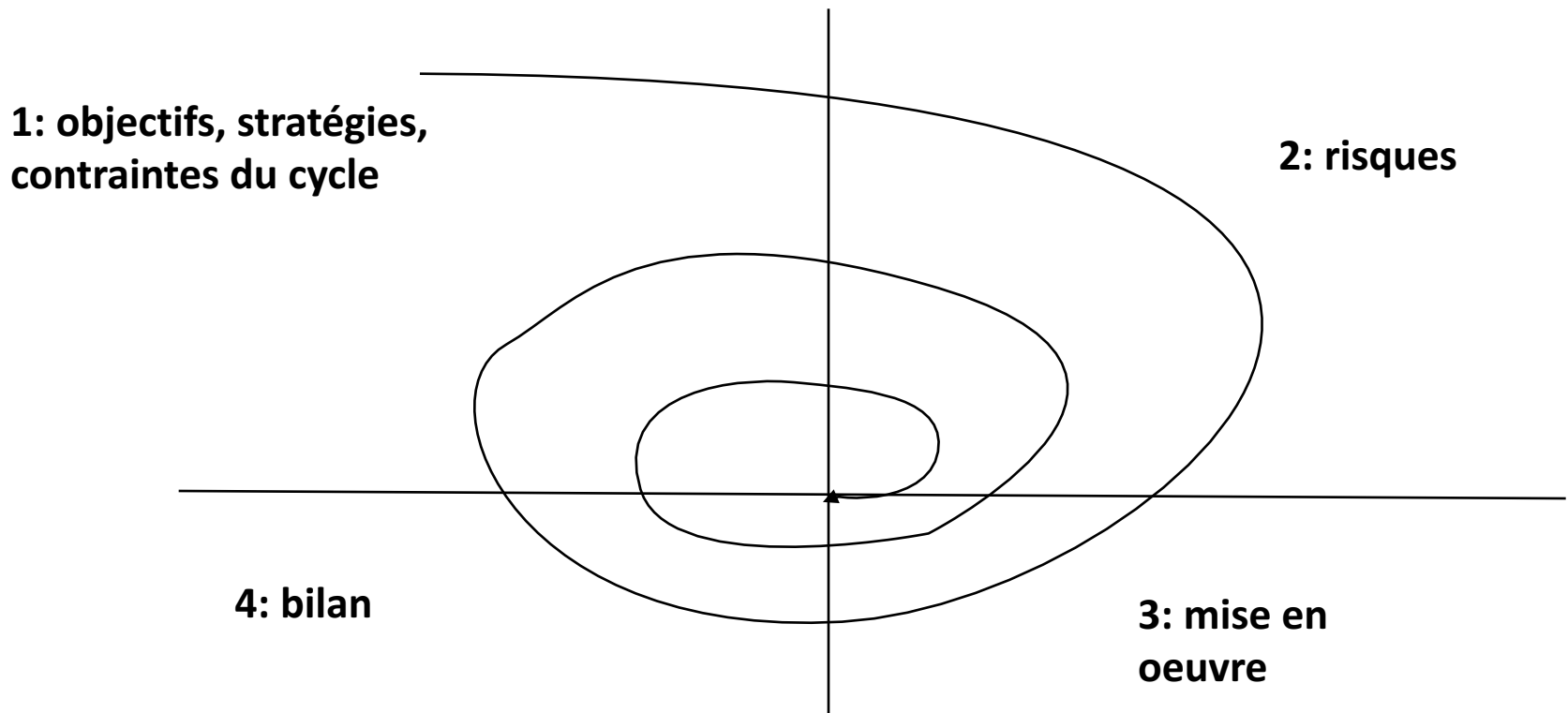


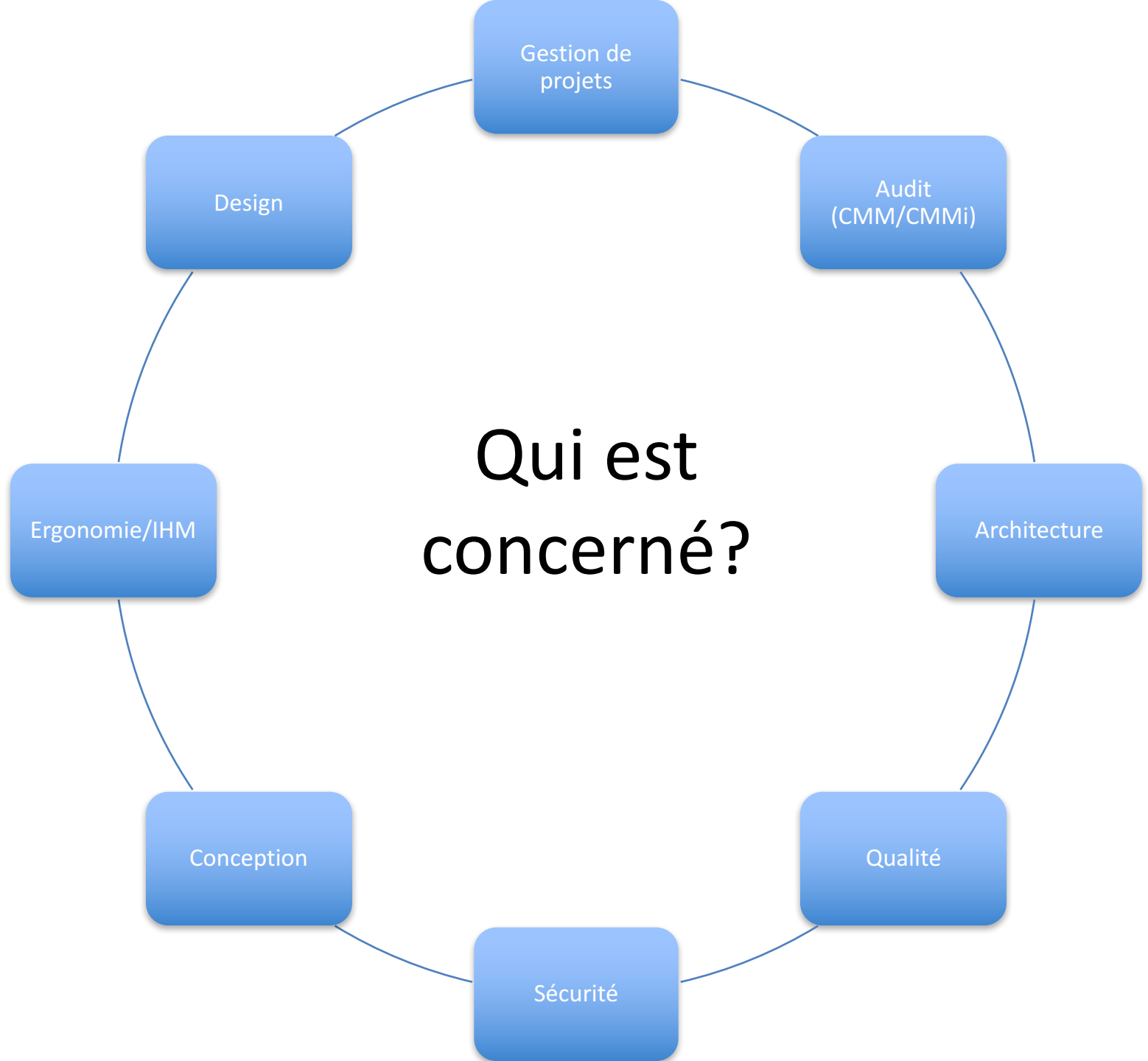
Figure 4. Unfortunately, for the process illustrated, the design iterations are never confined to the successive steps.

Interaction entre les cycles besoin/développement

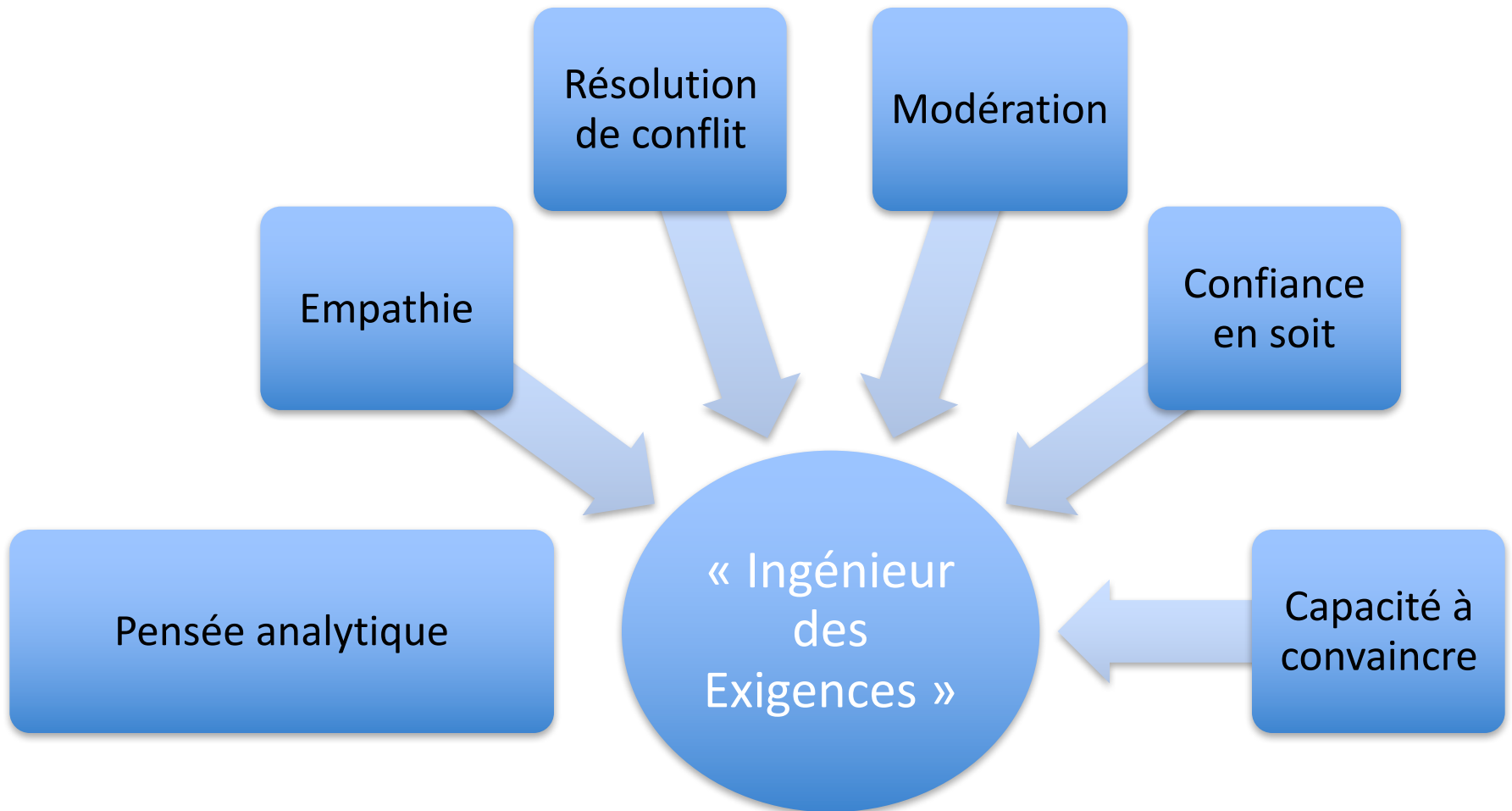


principe de la spirale de B. Boehm 1988





Compétences et qualités du praticien



La *Voix du Client* est une clef essentielle

"If you believe that you know
the requirements better than
the customer,
you are part of the problem,
not the solution."

Alan Davis



⇒ ***Elucidation***
des Exigences

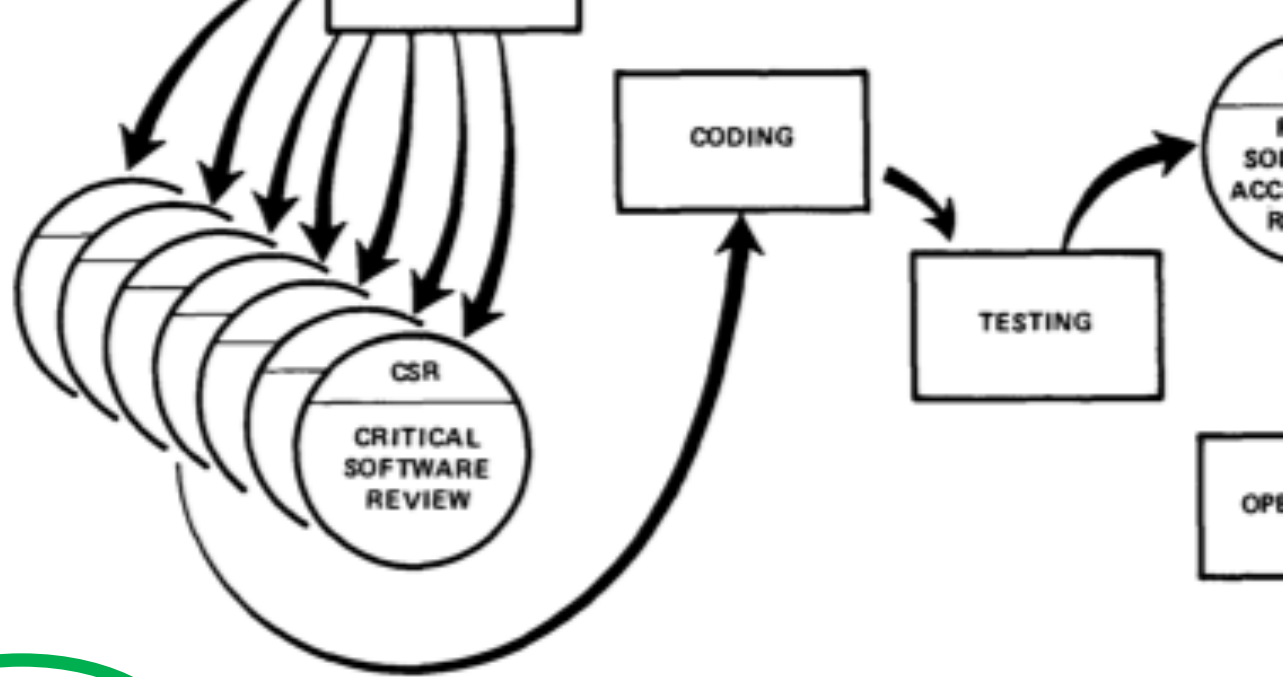
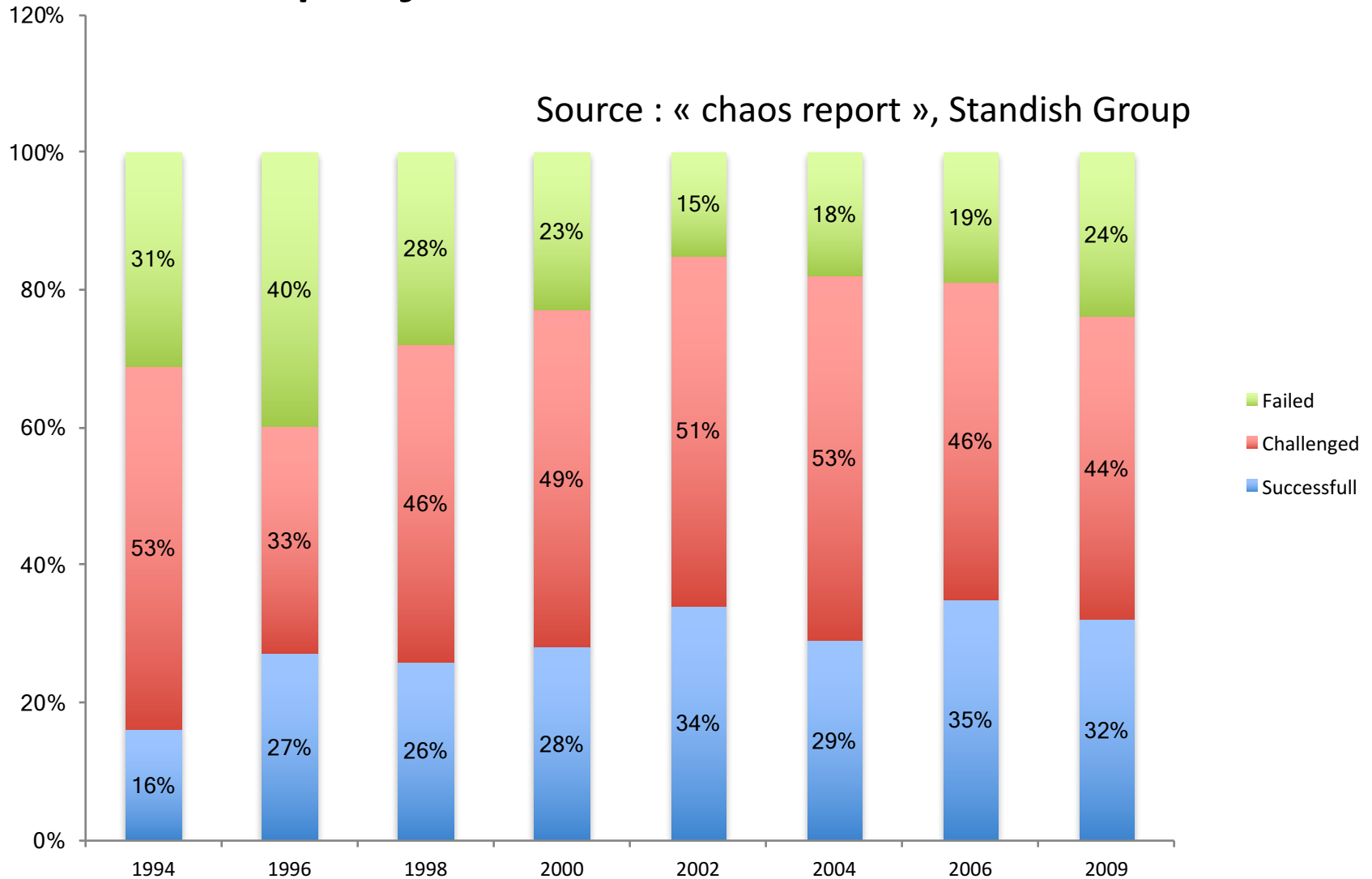


Figure 9. Step 5 **Involve the customer** - the involvement should be formal, in-depth, and continuing.

66% des projets ne sont *PAS des succès*



Quelques *causes*

Problèmes d'écoute des parties prenantes

on ne dit pas ce qu'on pense, on n'entend pas ce qui est dit, etc.

Problèmes de communication

ambiguïté, bruit, homonymes, sous-spécification, complexité, erreurs de traduction (par ex. dans les projets multinationaux), emploi d'une terminologie IE/métier non standard, etc.

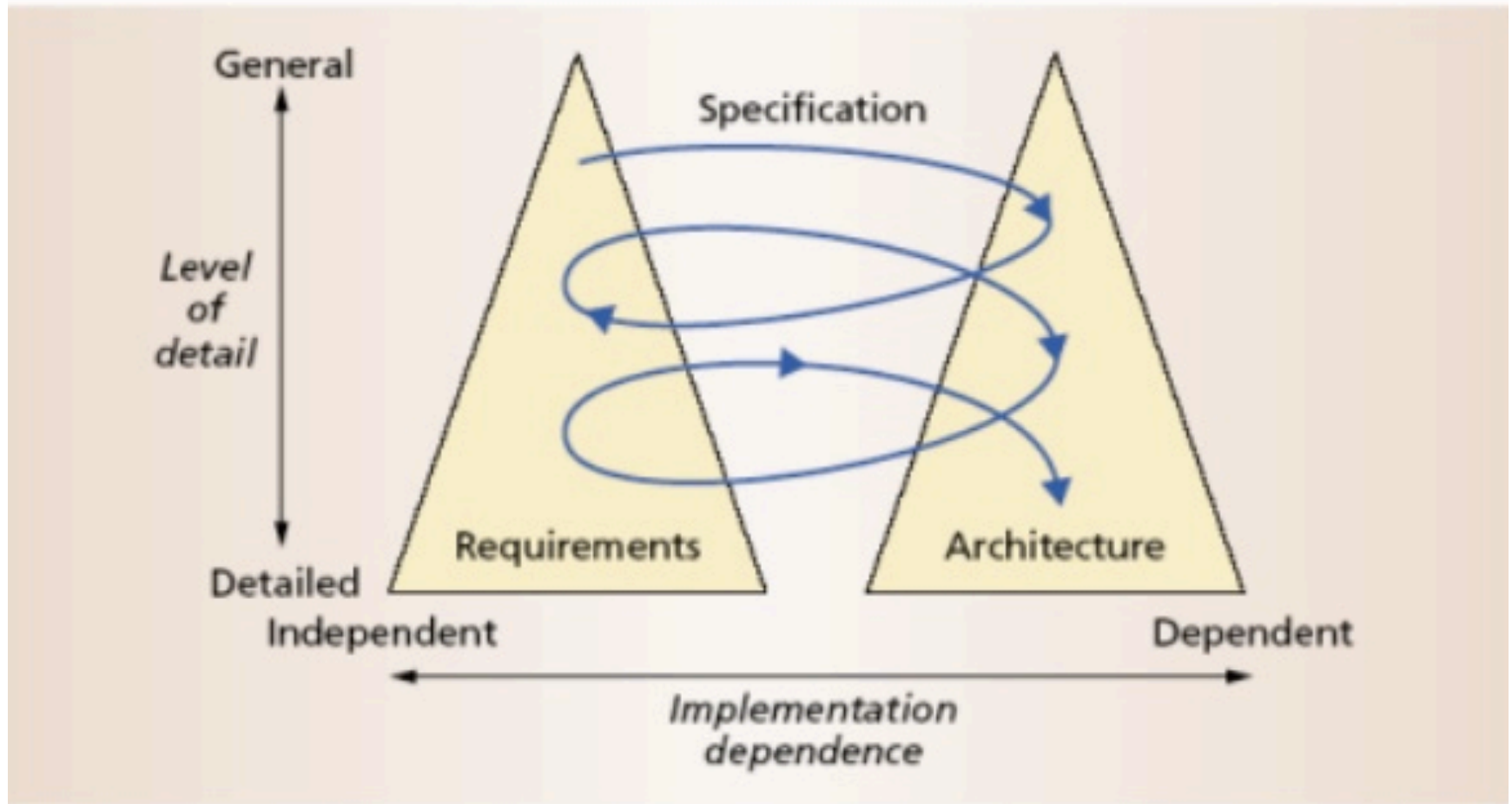
Fautes formelles

sur-spécification, contradictions, incomplétude, incohérence, etc.

Erreurs méthodologiques

pas de validation, pas de vérification, IE cantonnée à l'amont, approche big bang, pas de prise en compte de la maintenance, pas de priorisation, etc.

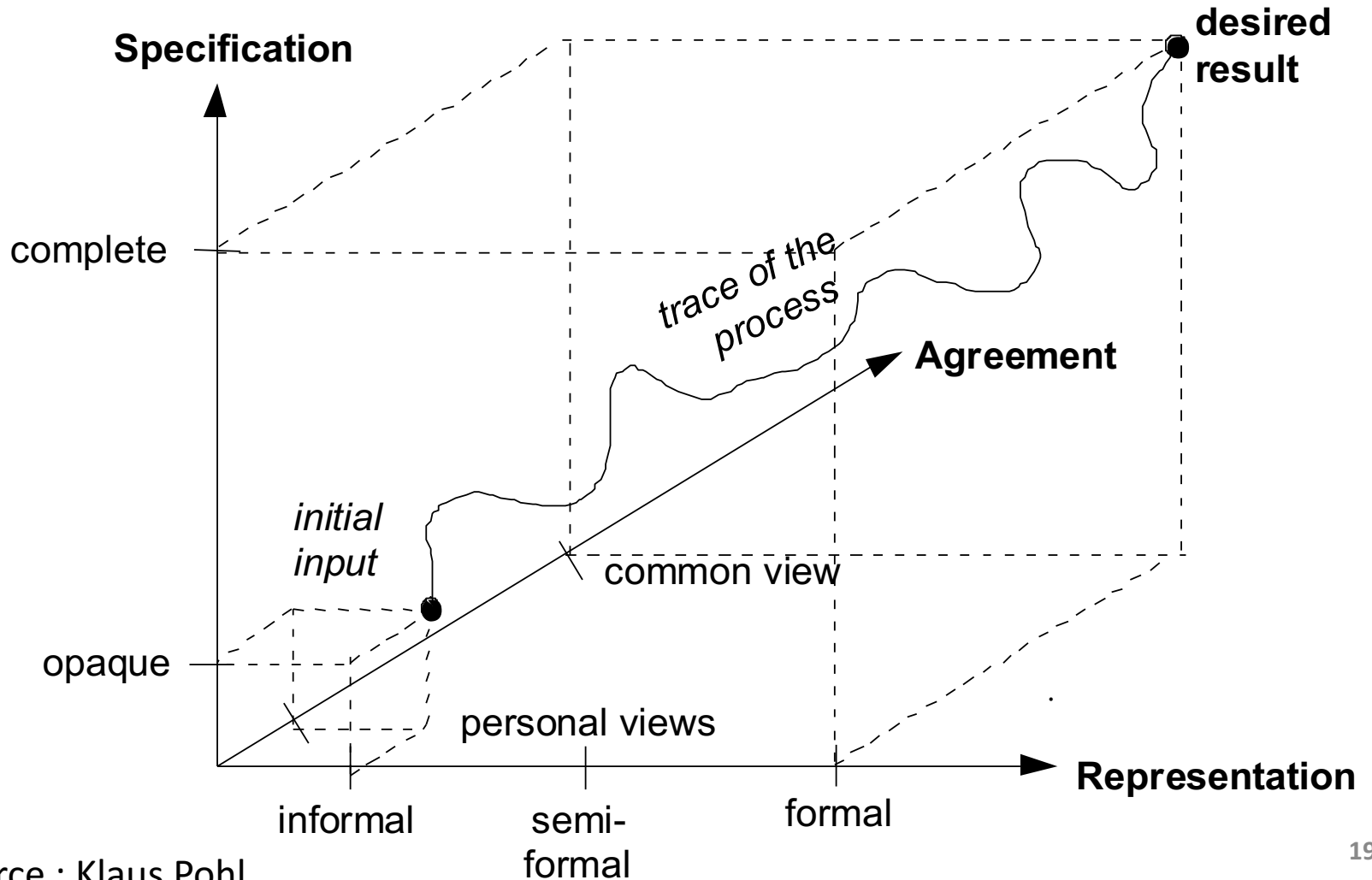
Confusion problème - solution



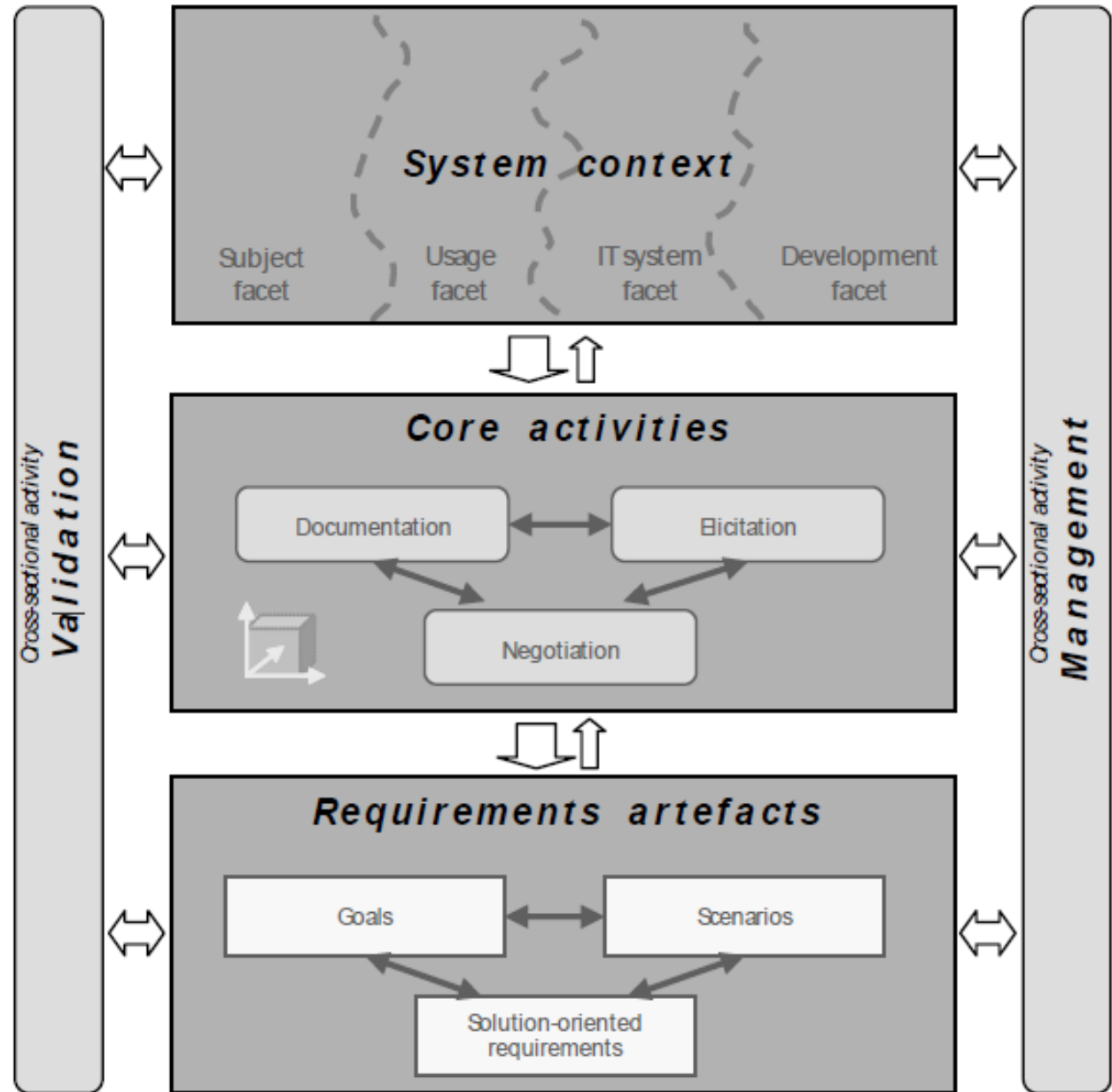
Fondamentaux de l'IE

1. Périmètre du système, contexte, environnement
2. Elucidation
3. Documents de spécification des exigences
4. Description (+/- formelle) des exigences
5. Ingénierie des Exigences basée sur les modèles
6. Validation des exigences et négociation
7. Gestion des exigences (traçabilité, planification, gestion des exigences en configuration, etc)

Démarche de l'IE

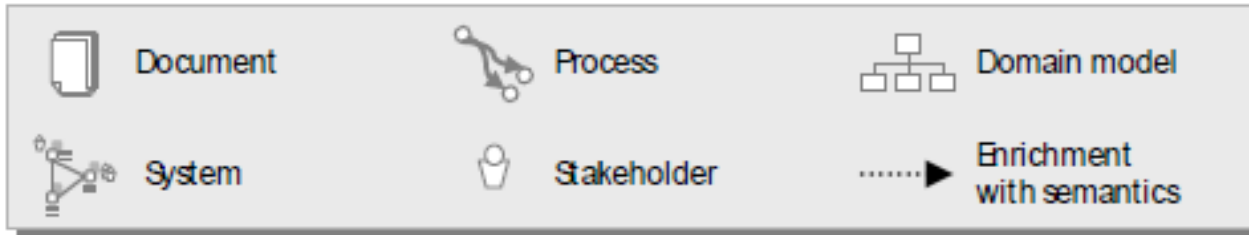


Principales *activités* de l'IE

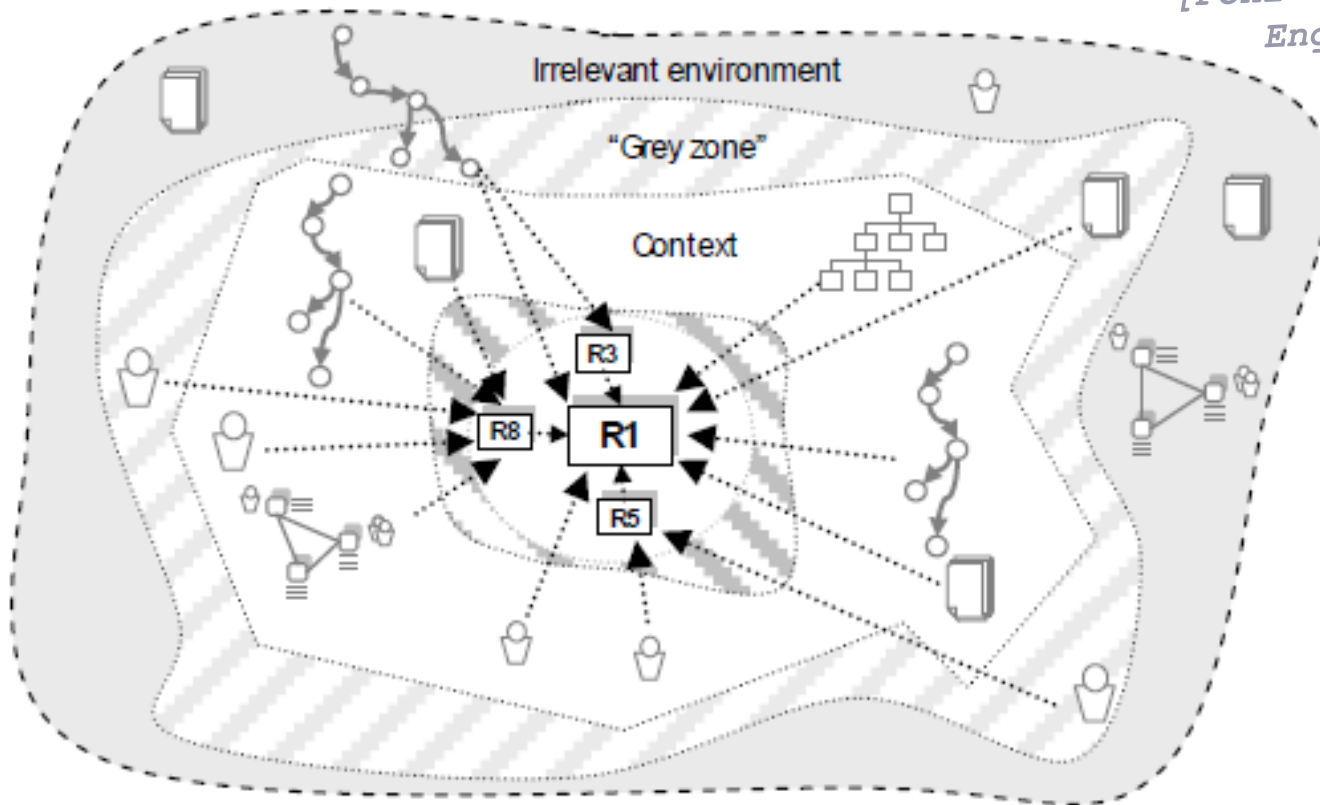


[Pohl 2010]
« Requirements Engineering »
Fig.4.1

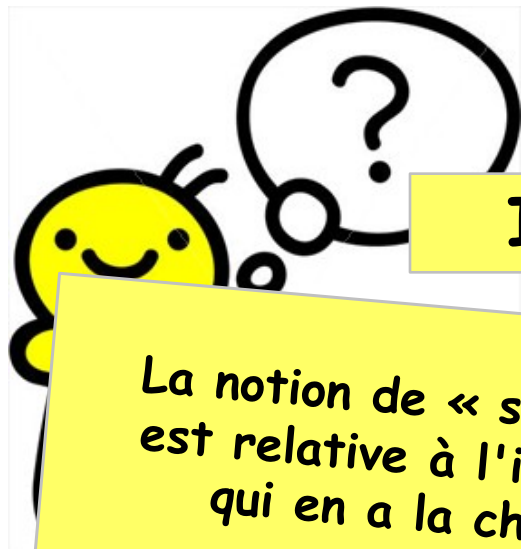
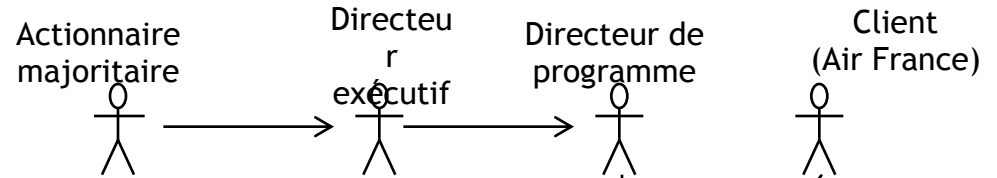
Le contexte d'une exigence



[Pohl 2010] « Requirements Engineering » §5.4



Ou est le niveau « système » ?

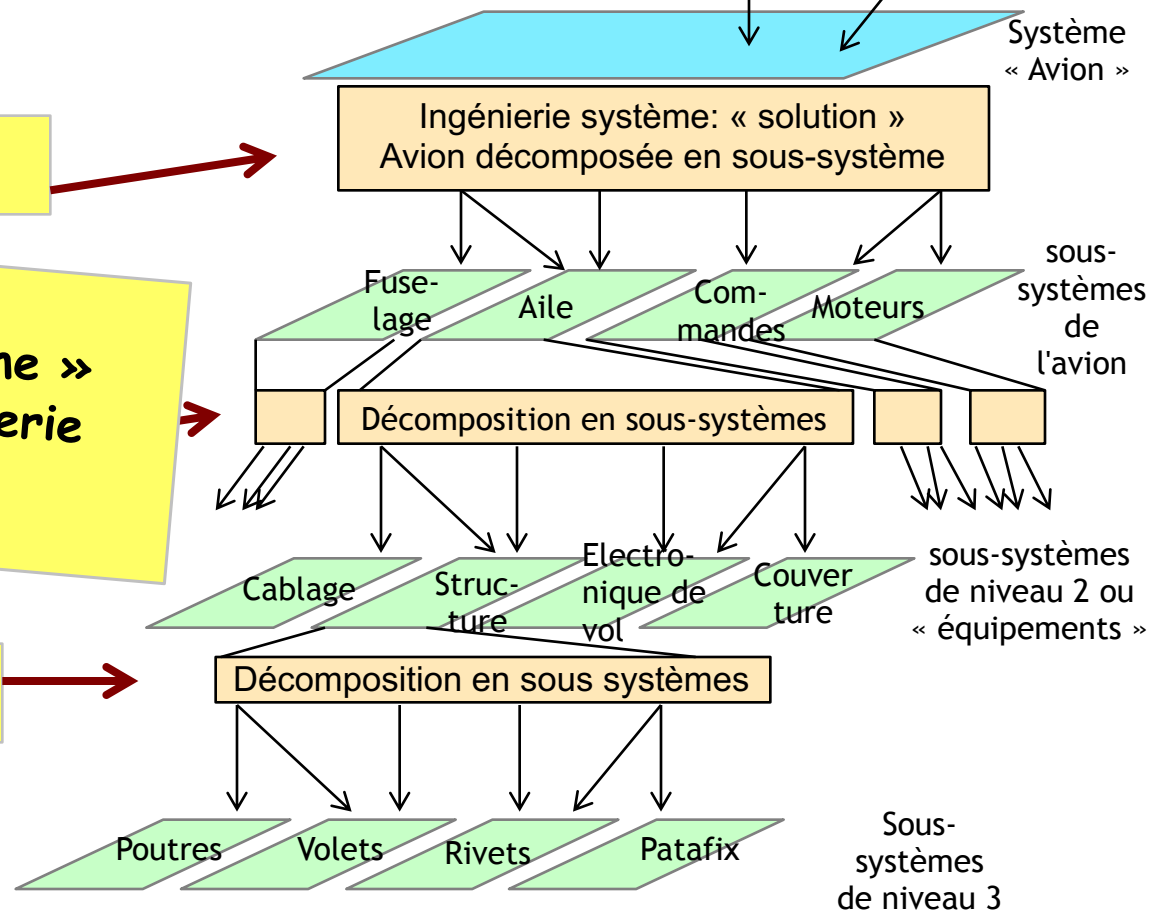


Ici

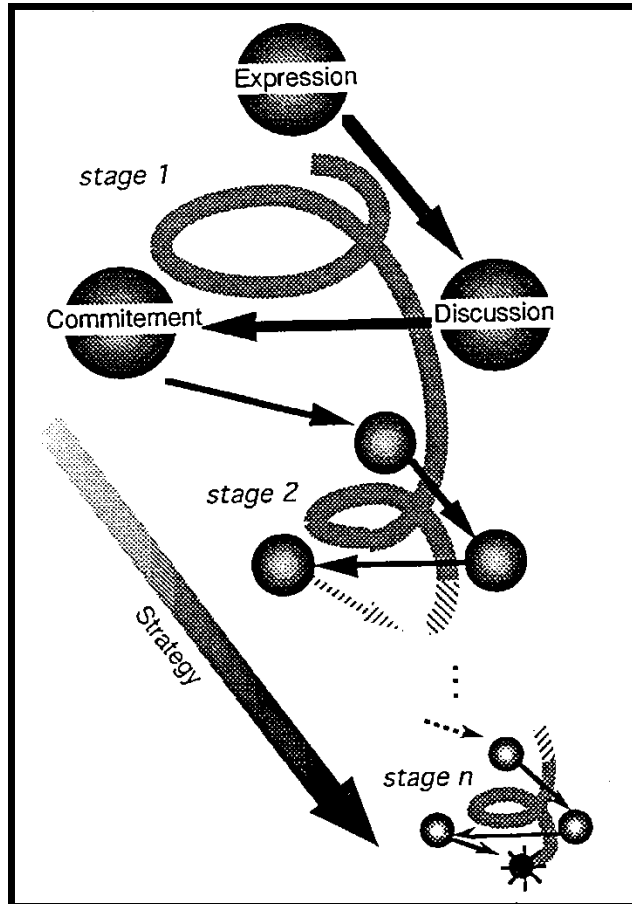
La notion de « système » est relative à l'ingénierie qui en a la charge.

Là

Et encore là



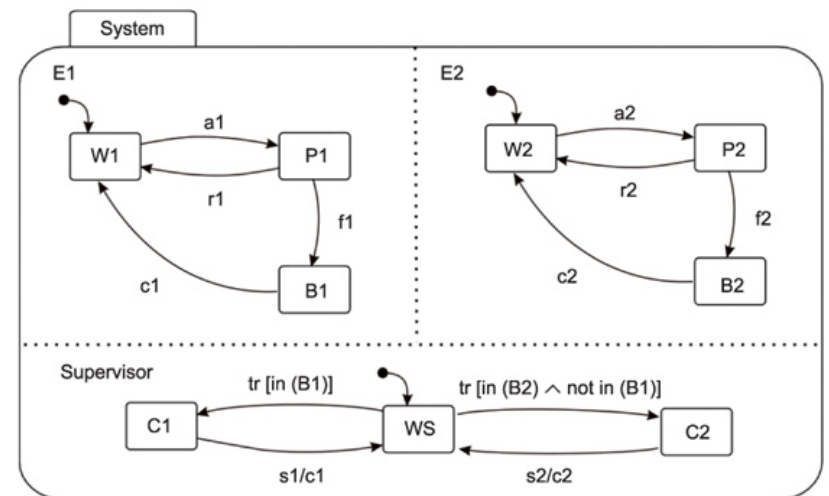
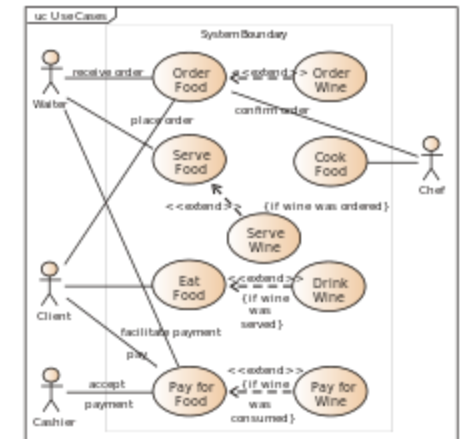
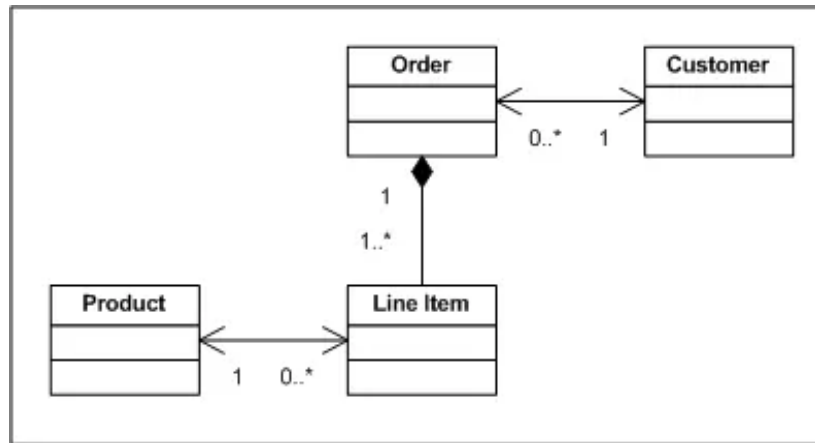
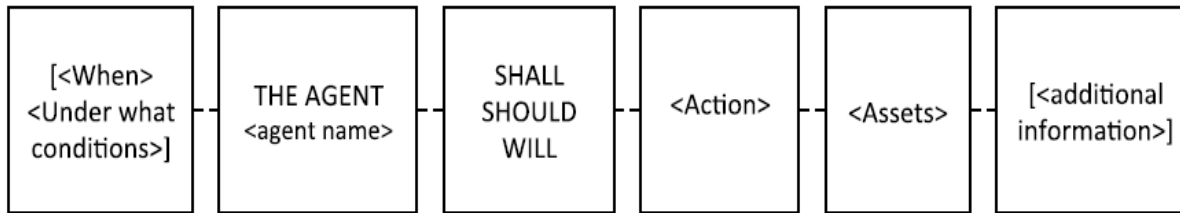
“enquiry cycle”



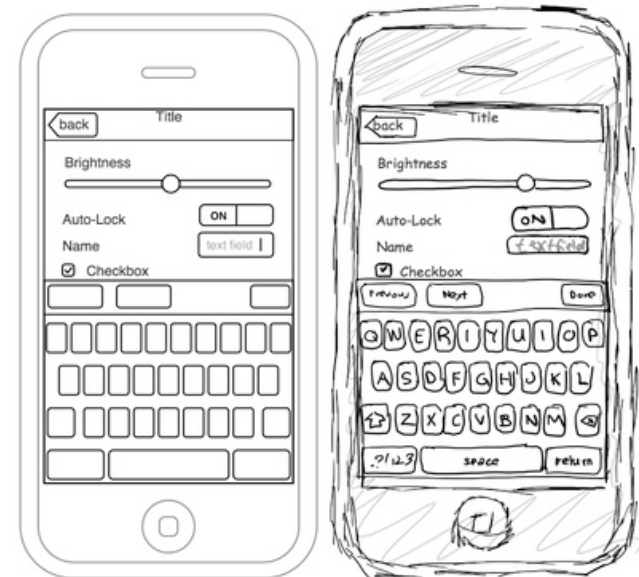
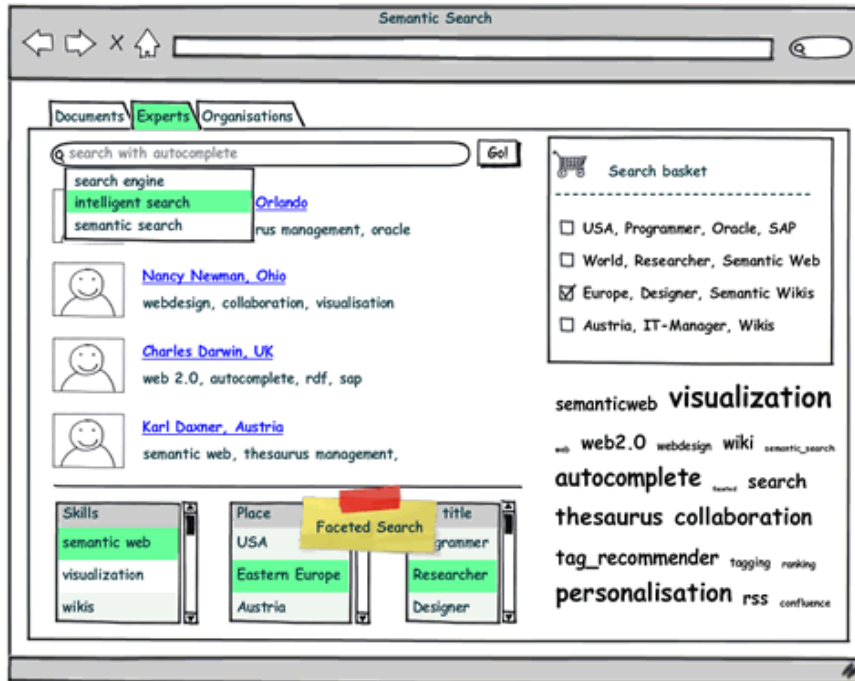
Source : A. Anton, C Potts

- Expression
 - Documentation des exigences
 - Buts
 - Scénarios
- Discussion
 - questions
 - réponses
 - problèmes ouverts
- Engagements
 - Demandes de changement

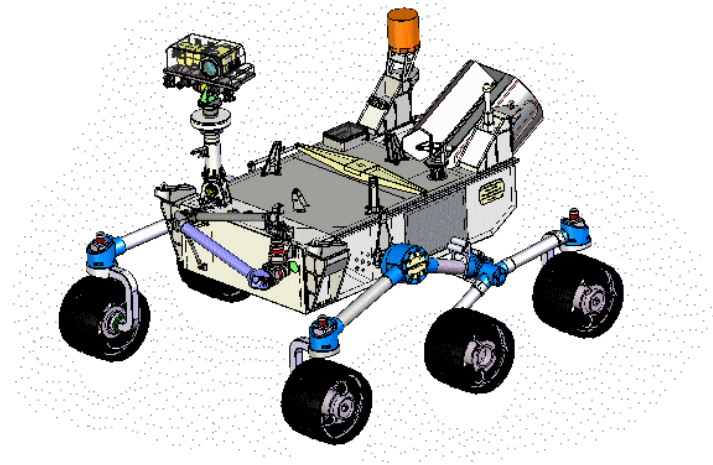
Modélisation : savoir appréhender les exigences sous *toutes leurs formes*



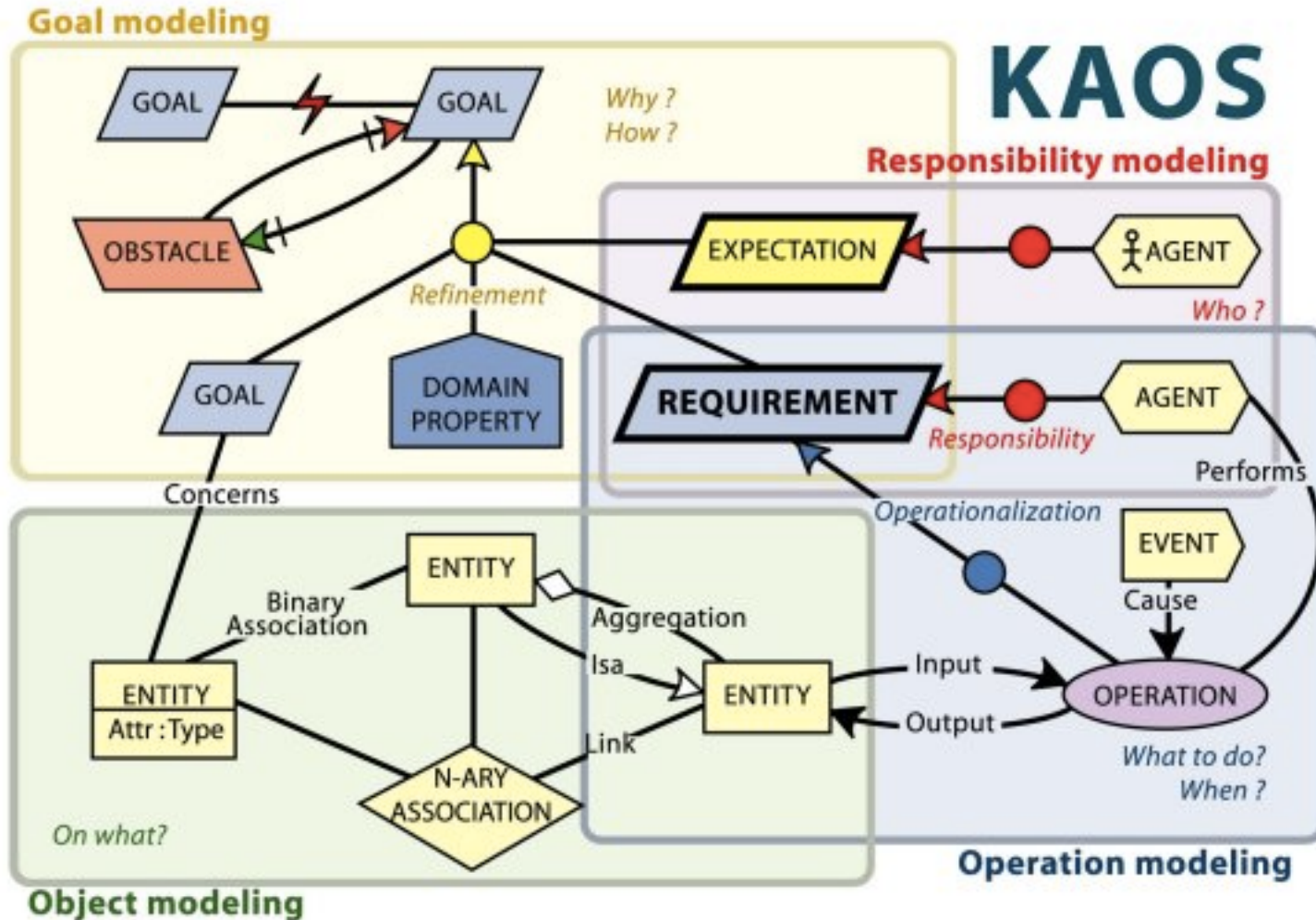
Scénarios, UC, maquettes, prototypes



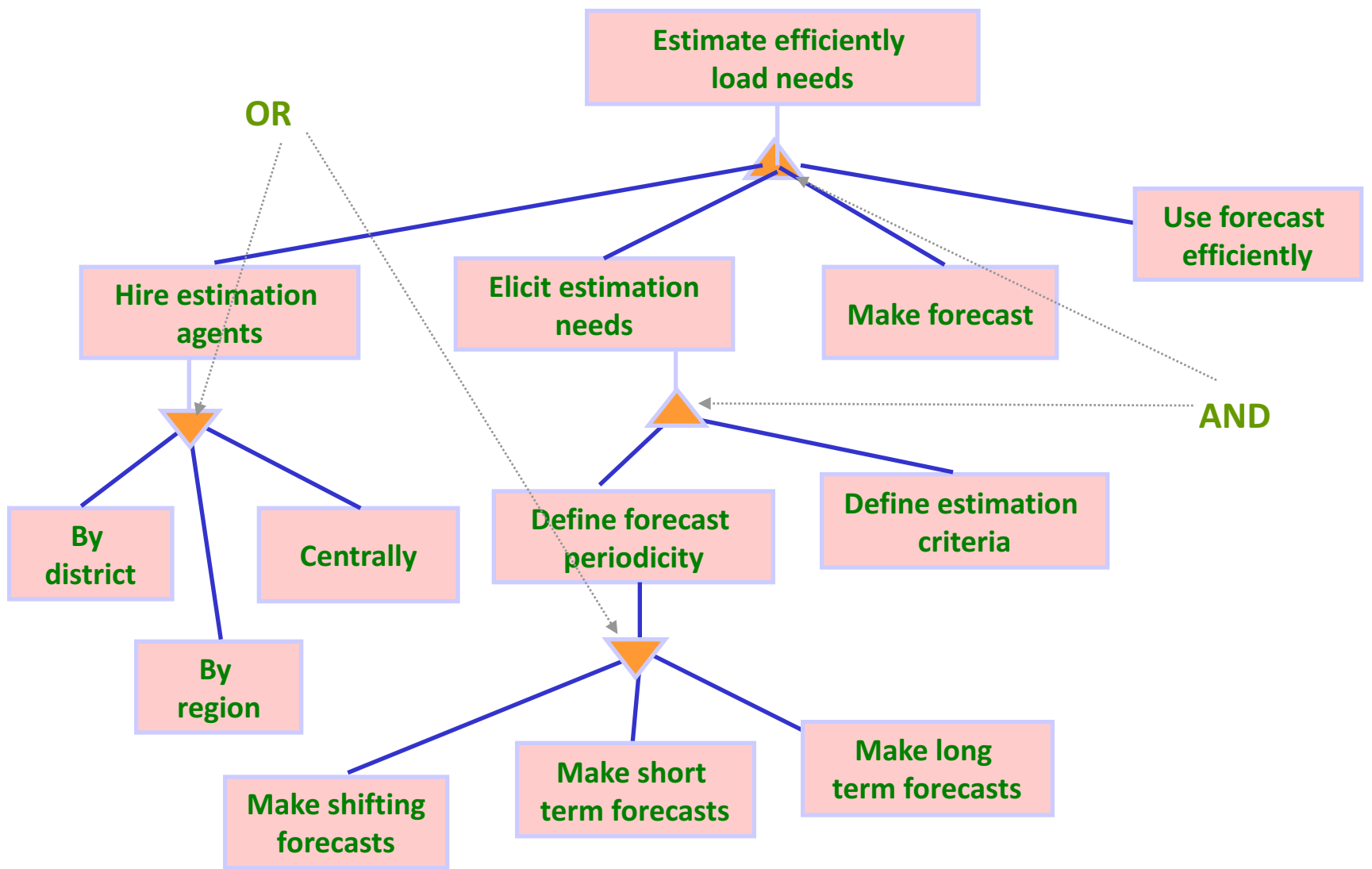
Sources : pedagogie.ac-toulouse.fr
iphoneized.com



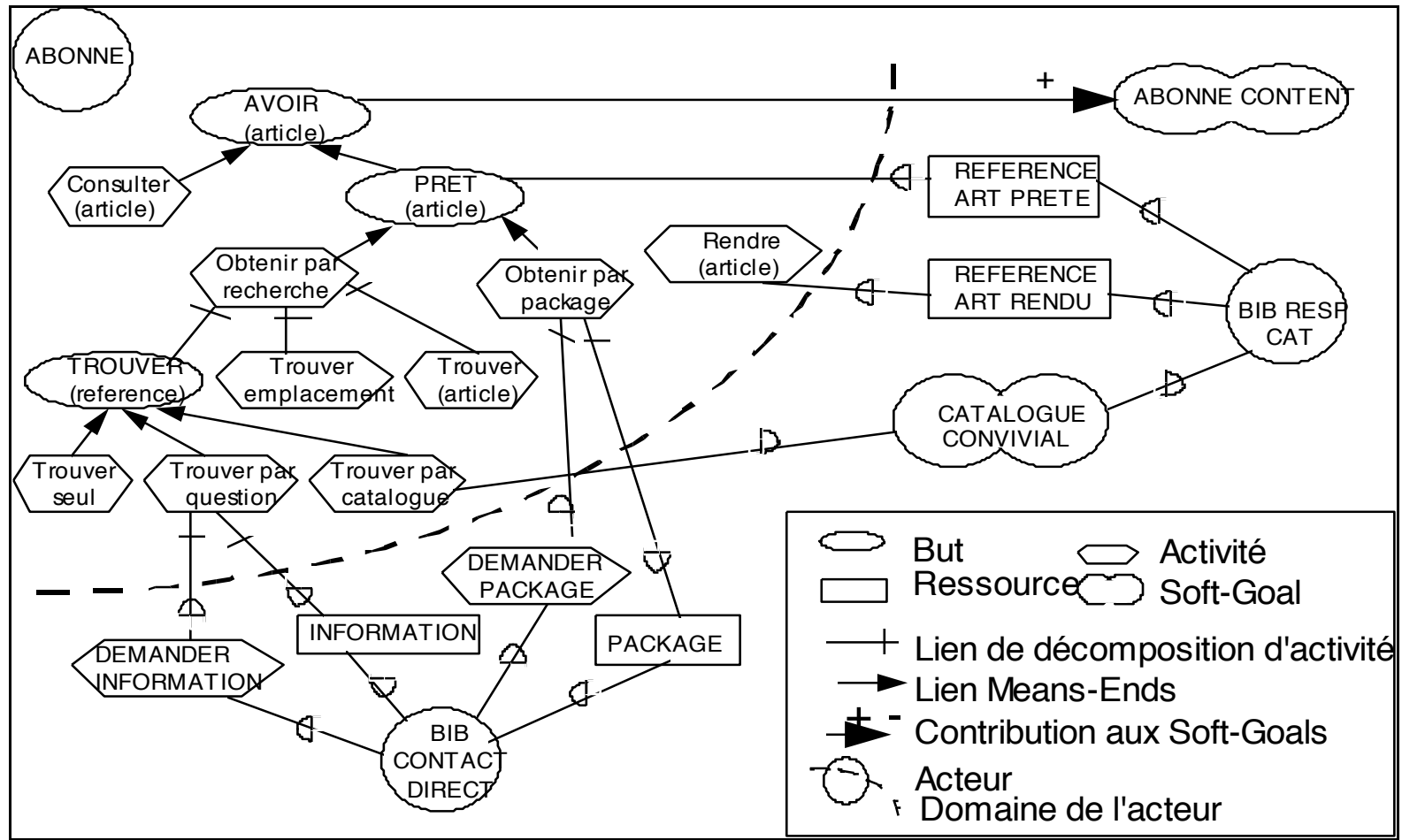
Approche dirigée par les *but*s



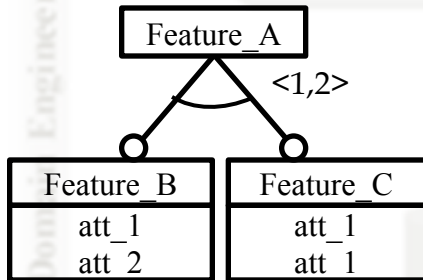
Décomposition ET/OU de buts (KAOS)



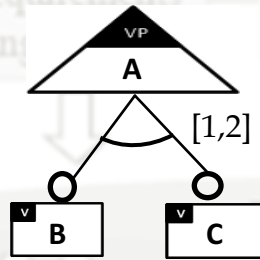
Modèle de dépendances de buts (I*)



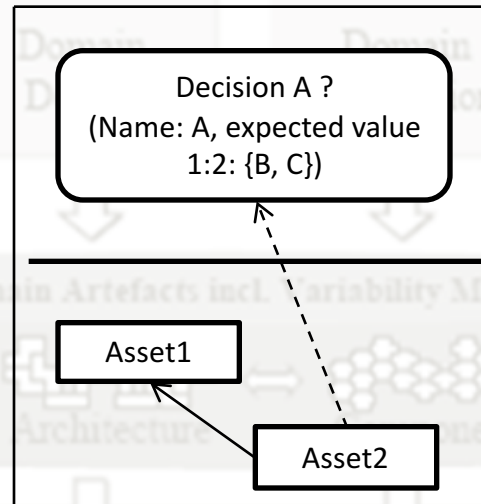
Product Line Models (PLMs)



(Kang et al. 1990,
Czarnecki et al. 2005,
Schobbens et al. 2007,
Michel et al. 2011)



(Pohl et al. 2005)

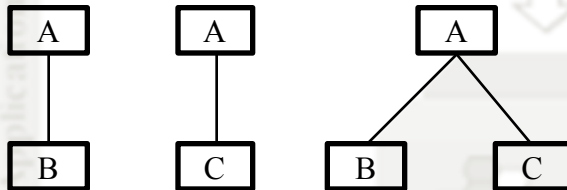


(Dhungana et al. 2006, 2010)

$\text{domain}([A, B, C], 0, 1),$
 $B \leq A,$
 $C \leq A,$
 $A \leq B + C \leq A * 2$

(Salinesi et al. 2010, 2011)

Product Models (PMs)



Decision A = true,
 B = 4,
 C = 9.8,
 Asset1 = 1,
 Asset2 = 1

P1 = {A, B, C}
 P2 = {A, B}
 P3 = {A, C}

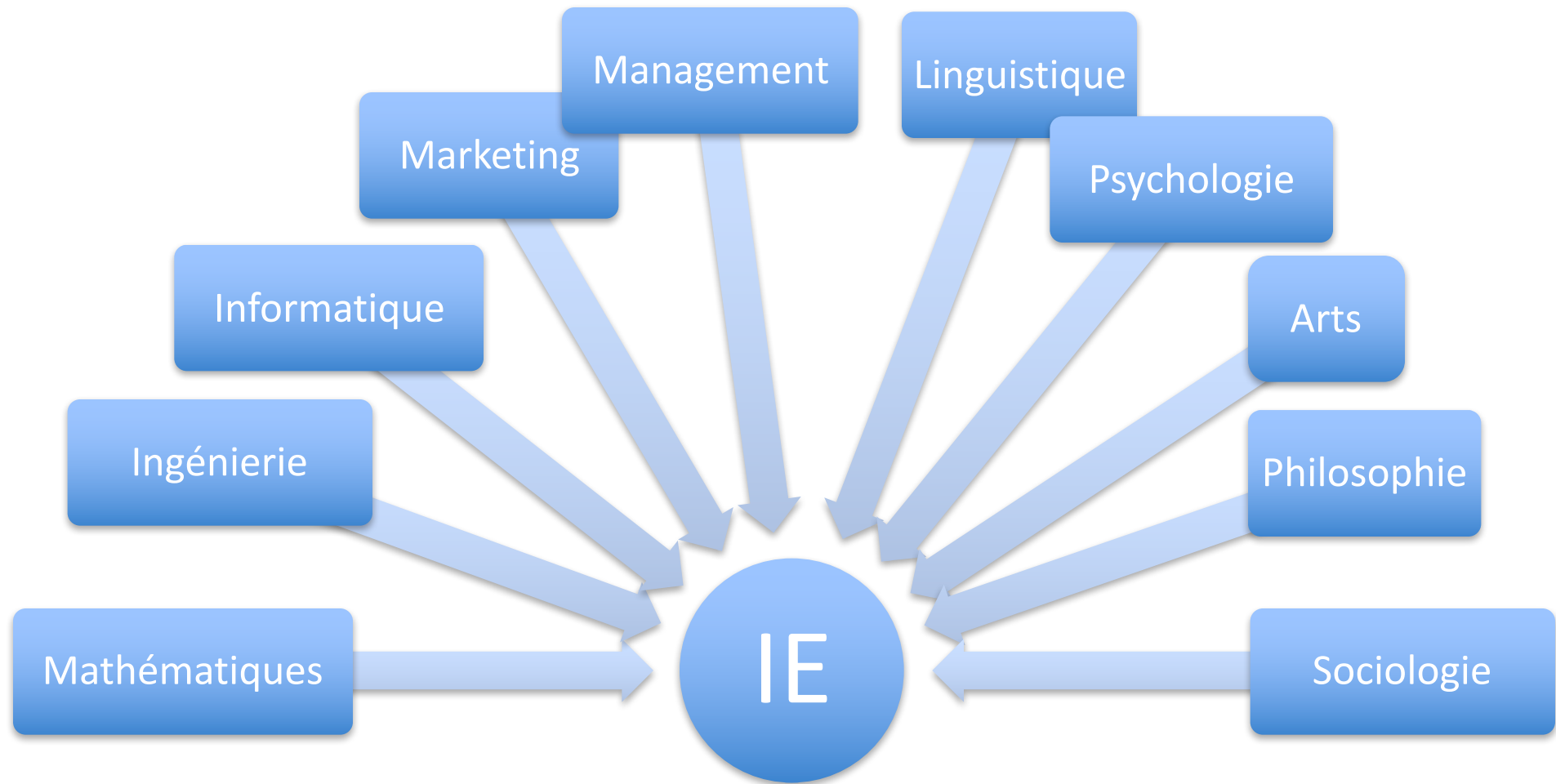
Thèmes de recherche IE

- **Méthodes**: agiles, feature-driven, adaptation, lignes de produits logiciels, conception durable, model driven, approche design thinking, intégration continue, DevOps
- **Gestion des exigences** : évolution, traçabilité, visualisation

Thèmes de recherche IE

- ***Elucidation*** : méthodes d'interview, user-driven RE, feedback utilisateur, fouille de référentiels
- ***Négociation***: résolution de conflit, priorisation
- ***Formalisation*** : NL constraints à méthodes formelles
- ***IE orientée domaine*** : smart cities, SdS, exigences légales, exigences de sécurité, systèmes auto-adaptatifs

Champs disciplinaires



Littérature (*de base*) IE

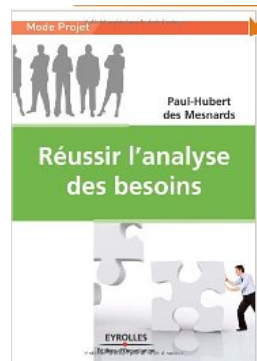
« Ingénierie des Exigences »
S. Badreau
JL Boulanger



Stéphane Badreau
Jean-Louis Boulanger
Préface de Pascal Rogues

DUNOD

« les bonnes
pratiques de l'IE »
AFIS



« Réussir l'analyse des besoins »
P.H. des Mesnards

« Expression des besoins pour le système d'information
Guide d'élaboration du cahier des charges »
Y.Constantinidis, M. Volle



« Expression du besoin et
cahier des charges
fonctionnel : Elaboration et
rédaction »
J.B. Bouissière



« Analyse des besoins :
La gestion de projet par
étapes, 1e étape »
H. Marchat

Littérature (de base) IE (en anglais)

- Requirements Engineering: Fundamentals, Principles, and Techniques by Klaus Pohl
- Mastering the Requirements Process: Getting Requirements Right (3rd Edition) by Suzanne Robertson and James Robertson
- Requirements Engineering: A Good Practice Guide by Ian Sommerville and Pete Sawyer
- Exploring Requirements: Quality Before Design by Donald C. Gause and Gerald Weinberg
- User-Centred Requirements Engineering by Alistair Sutcliffe
- Requirements Engineering: From System Goals to UML Models to Software Specifications by A. van Lamsweerde
- Requirements Engineering: Processes and Techniques (Worldwide Series in Computer Science) by Gerald Kotonya and Ian Sommerville
- Discovering Requirements: How to Specify Products and Services by Ian Alexander and Ljerka Beus-Dukic
- More About Software Requirements: Thorny Issues and Practical Advice by Karl Wiegars

...

Littérature (*scientifique*) IE

- ICSE : International Conference on Software Engineering (A+)
- TSE : IEEE Transactions on Software Engineering (A+)
- RE : IEEE International Conference on Requirements Engineering (A)
- REJ : Requirements Engineering Journal, Springer (A)
- REFSQ : Requirements Engineering Foundations for Software Quality (B)

KEYNOTE SPEAKERS

Disruptive Change in Requirements Engineering Research

Wednesday, August 22nd, 2018 - 8:45



Dr. Jane Cleland-Huang will address the challenges and opportunities introduced by disruptive change in the current requirements engineering landscape. Sea changes in the way practitioners develop software, along with advances in Artificial Intelligence algorithms and the ubiquity of social media environments have created a goldilocks opportunity for innovative creativity that potentially touches every aspect of requirements engineering research. Coupled with passion and vision, these advances revitalize our ability to address open requirements challenges in new and meaningful ways.

Beyond DevOps: Finding Value through Requirements

Thursday, August 23rd, 2018 - 9:00



Dr. Gail Murphy. The DevOps movement enables the more frequent delivery of changes to a software system. Adopting DevOps practices is seen as enabling the ability to get more done. But is the more that is getting done actually of value to the end user or to the producing organization? In this talk, I will explore how the ideas of value streams are being applied to software development and how the requirements community is key to enabling an increased focus on the delivery of value.

Requirements Engineering in the Age of Societal-Scale Cyber-Physical Systems: The Case of Automated Driving

Friday, August 24th, 2018 - 11:00



Dr. Krzysztof Czarnecki. Societal-scale cyber-physical systems (S-CPS) are computer systems controlling physical entities using sensors and actuators, with intelligence provided by software and data, and deployed at a large scale. Over the next few decades, these systems are poised to transform entire sectors of our life, including energy, healthcare, and transportation. Automated vehicles are a prime example of such systems: they are computers on wheels that run on data while communicating with smart infrastructure and each other.

Requirements engineering (RE) has a key role to play in this transformation and in achieving the positive effects S-CPS. I will argue that RE for S-CPS should be data-driven, continuous, and values-based. While these directions have already been identified in the RE field, this talk will exemplify their role for automated driving and point to open questions and future research opportunities. An important theme throughout this talk will be safety assurance, which is an immediate major challenge for engineering of these systems, and RE has also a key role to play in addressing it.

De l'exigence au composant

