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INCOSE Webinar Series

Wednesday 18 May 2016

Product Line Thinking – Applying System Thinking to Product Lines

Alain Le Put
MALP Conseil

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- To explain how INCOSE works, and how to make the most out of INCOSE membership

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Choreography

1. Andy Pickard (your host) will introduce the Webinar and the speaker
2. Alain will speak for about 40 to 45 minutes
3. During his talk, participants can write questions using the Webex Q&A window
4. After Alain completes his talk, he will spend 10 minutes answering questions that he selects from those submitted by the audience
5. Andy Pickard will provide information about upcoming Webinars and then end this session
6. This Webinar is being recorded and will be made available on the INCOSE website to members and employees of CAB organizations

Product Line Thinking
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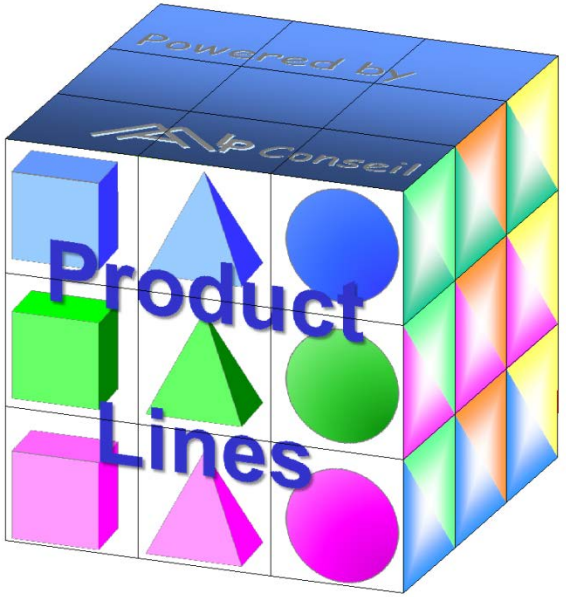
Applying System Thinking to Product Lines



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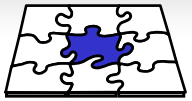
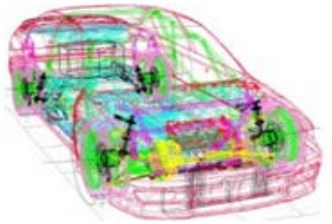


Product Line Thinking

- ❖ **Context**
- ❖ **System Thinking for the implementation of Product Line**
- ❖ **System Thinking when developing in a Product Line**
- ❖ **Product Line Thinking for VSME**
- ❖ **Product Line Thinking**

System Product Line

A Product Line is a set of products and/or services:



- sharing explicitly defined and managed common features

- and variable features to meet the variable needs of specific markets

- It is also a global development strategy able to bring significant benefits for the Customer(s) and the Enterprise.

The Systems Engineering Product Line Handbook

- **Written in 2012, the Handbook is a Reference Document describes:**
  - ***the main concepts,***
  - ***the possible strategy to set up or to improve a Product Line Organization***
- **This Handbook is mainly built on Return of Experience :**
  - ***captured during 4 years in France,***
  - ***From about 20 Industrial representatives from AFIS:***
    - ***Automotive, defense, satellite, nuclear power…***
    - ***Research, Universities…***
    - ***Software solution editors…***

Return of Experience from industry.

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The Systems Engineering Product Line Handbook

- **Translated in English, the Handbook received the 2015 INCOSE award for Product of the Year.**

"The Systems Product Line Engineering Handbook now enables both French & English speaking people around the world to easily learn and quickly benefit from this important best practice."

Systems Engineering Product Line
What's new ?

A lot of experiences gathered since 2012 all around the world.

The International ICOSE Working Group organized about two to three meetings or events a year since its creation in January 2013 in Jacksonville.

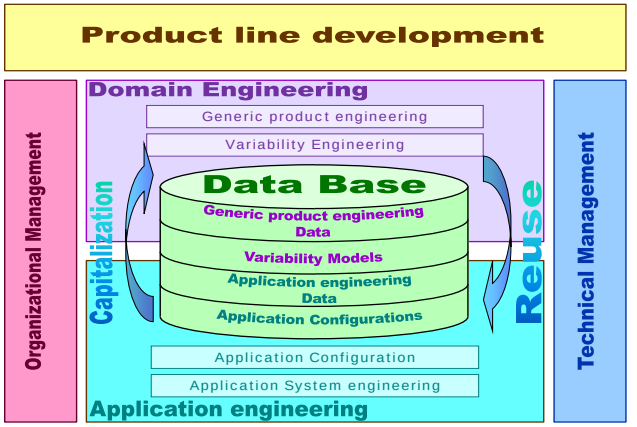
And new returns of experience …

A new consistent Meta Model,

A new capability model,

A method to define and develop variability models,

…



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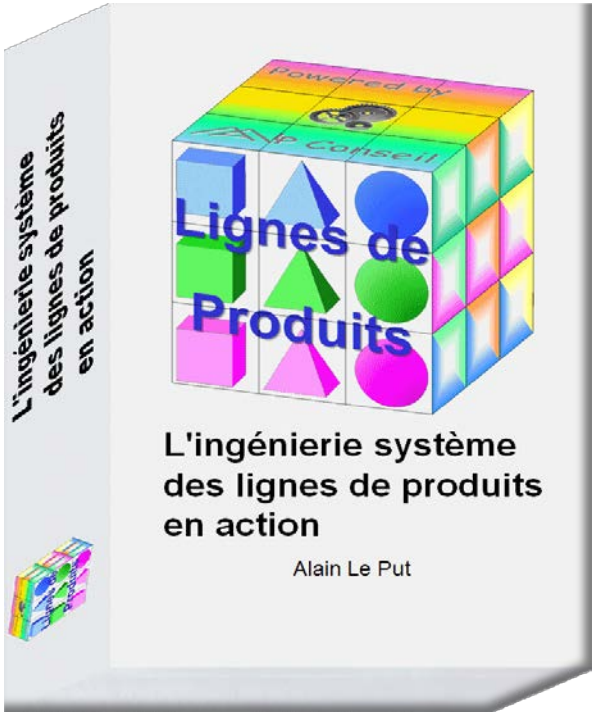
Systems Engineering
Products Line in action

Entirely dedicated to the adoption of efficient Product Lines:



1. Key Concepts
2. Product Line Development
3. Product Line System Engineering
4. Variability Definition and Engineering
5. Management
6. Conclusion: the Success Factors

A new 600 pages version of the Product Line Handbook will be soon available in French.

Systems Engineering Product Line
What's new in France ?

In France, training courses has been organized with ENSTA ParisTech to deploy Product Lines:

- **A "standard" 3 days training course,**
- **And a comprehensive set of training courses dedicated to VSME :**
  - ***an informative session to catch attention on Product Lines,***
  - ***a high level short training session to bring the VSME managers to make decision,***
  - ***an exhaustive training session to give the knowledge necessary for an immediate implementation.***

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Systems Engineering Product Line - deployment

A lot of return of experience of a new type:

- **Writing a strategic plan,**
- **Simulating return on Investment,**
- **Modelling variability, …**

But also some issues …

People having:

- to face with the Product Line inherent complexity,
- to change their way of thinking,

…

System Thinking for System Engineering

The System Engineering set of processes and methods is not sufficient to develop and understand systems.

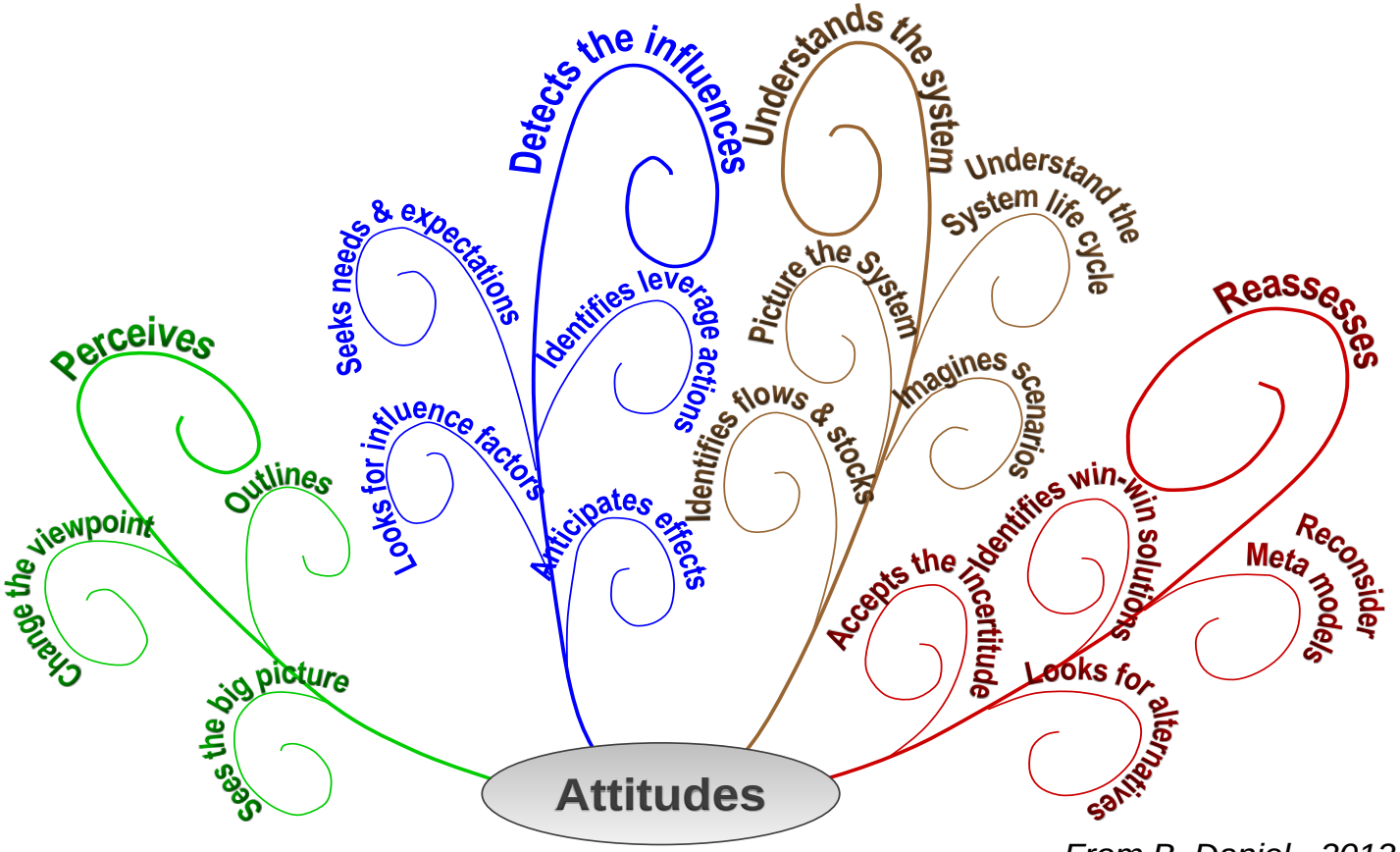
Even if well trained, beginner system engineers will not be able to develop complex systems, but senior system engineers will. In fact they perform the same processes! If we try to understand the fundamental difference between them which enable success, we need to focus on the way of thinking the System.

Guide AFIS, written in French in 2012 by Mrs. Brigitte Daniel.

System Thinking for System Engineering

System Thinking is an approach to problem solving, by viewing "problems" as parts of an overall system, rather than reacting to specific part, outcomes or events and potentially contributing to further development of unintended consequences.

The System Thinking attitudes mind map



From B. Daniel - 2012

STA1. Perceive

STA2. Detect the influences

STA3. Understand the system

STA4. Reassess

System Thinking for System Engineering

Systems thinking can be used as a set of habits or practices, something like a dictionary of system engineer attitudes for:

- **Envisioning a new system,**
- **Understanding an existing system.**

System Thinking is not sufficient to develop a System, but contributes to Knowledge Management and should help:

- **The beginners, to encourage them to identify and solve problems,**
- **The seniors, to remind them the ways to avoid problems.**

A highly efficient "tool" to solve problems …
… Why not use it in the case of Product Lines ?

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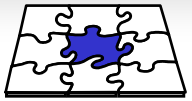

Product Line Thinking

- Context
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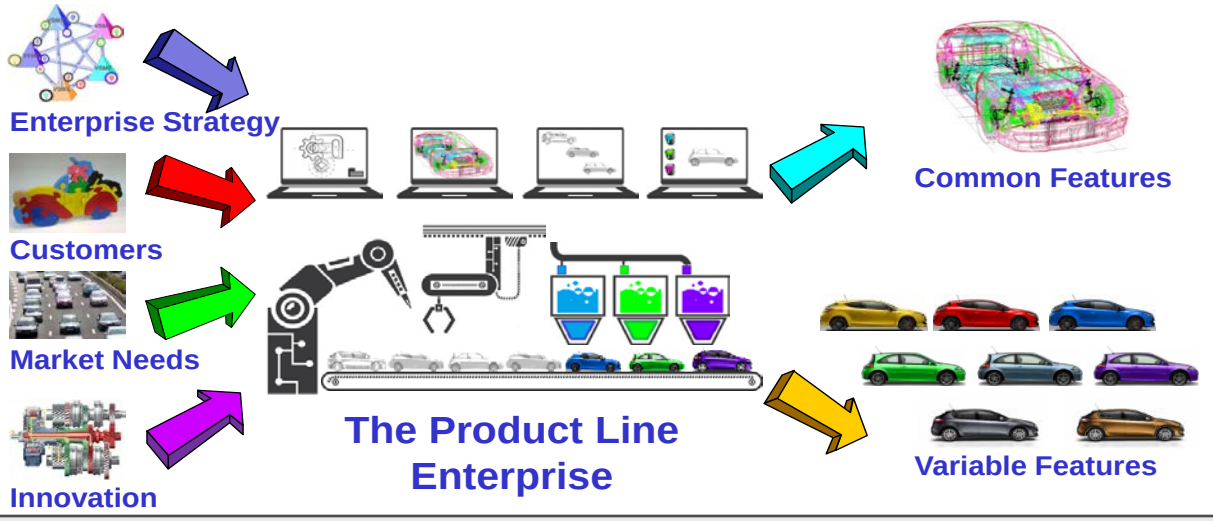
Implementation of Product Line

Let's consider a Product Line as a System to be developed, but:

- **Product Lines add the variability dimension, one concept to Systems Engineering, and thus to its inherent complexity,**
- **a lot of people are "new developers" for Product Lines, even if they are senior system engineers, …**



The implementation strategy needs to be tailored to the industrial and market context.

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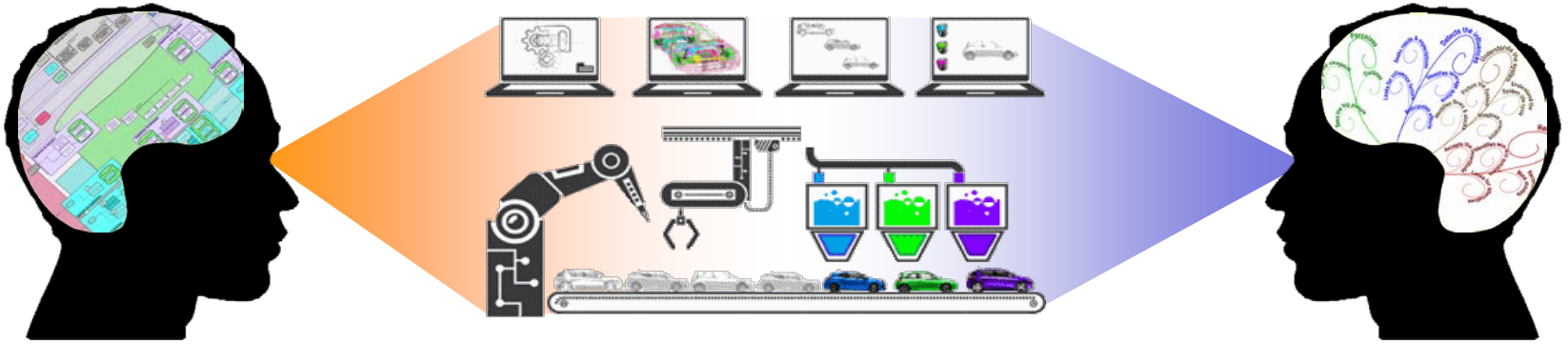
System Thinking
for the implementation of Product Line



System Product Line Engineering

Product Line

System Thinking

What could be the suited attitudes to be taken by the "Product Line Architect"?

System Thinking attitudes for the implementation of Product Line

PLTA1. Perceive:

- **Outline, define the Product Line domain: common features and variability,**
- **See the big picture, address all the customers at once to get a global view of needs,**
- **Change his viewpoint, adopt both the Customer Change and the Supplier viewpoints.**

System Thinking attitudes for the implementation of Product Line

PLTA2. Detect the influences:

- **look for business breakthrough (technical and technological innovation).**
- **be aware of the market change and trends (what the customers really want to acquire).**
- **Anticipate effects, analyze carefully the cause-effects loops:**
  - ***the reuse and capitalize loop;***
  - ***the Product Line organization and the needed investment, then the expected benefits.***

System Thinking attitudes for the implementation of Product Line

PLTA3. Understand the system, envisioning a new Product Line, in order to choose the best Product Line architecture or organization:

- **Picture the Product Line organization,**
- **Identify flows & stocks: interfaces between processes, artefacts to capitalize**
- **Understand the Product Line life cycle:**
  - ***Cyclic, to reassess the opportunities periodically,***
  - ***Incremental, several steps to set up the expected organization,***
  - ***and iterative, executed for each application;***
- **Imagine scenarios for: setting up the Product Line, developing the domain products and the applications in the Product Line, changing culture (training, incentive).**

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System Thinking attitudes for the implementation of Product Line

PLTA4. Reassess:

- **Reconsider Meta models: more complex context outside and inside the enterprise, more customers, more stakeholders, explosion of the offer, more complex product,**
- **Accept the incertitude: the context to take into account must be extended to trends, emerging technologies, … as a result, the picture is necessarily more blurred.**
- **Look for alternatives: Product Line or single system engineering; many possible organizations for one Product Line.**
- **Identify win-win solutions: Try to find the best Product Line organization, not necessarily the more mature one, but the most efficient one.**

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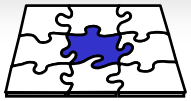
Product Line Thinking for the implementation of Product Line

The main challenges when implementing a new Product Line or improving an existing one is how to have a good view of the context and to choose the best organization of Product Lines;

so the main attitudes are:

- **PLTA2 "Detects the influences"**
- **and PLTA3 "Understands the system".**



Product Line Thinking

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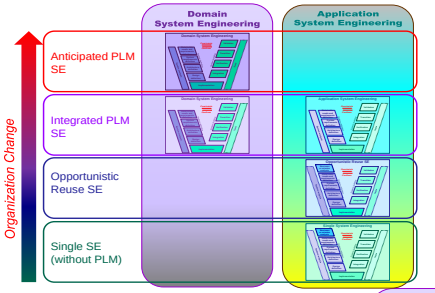
Developing in a Product Line

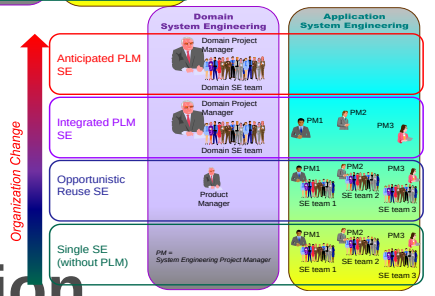
Setting up a Product Line induces many changes in the day-to day way of engineering a system:

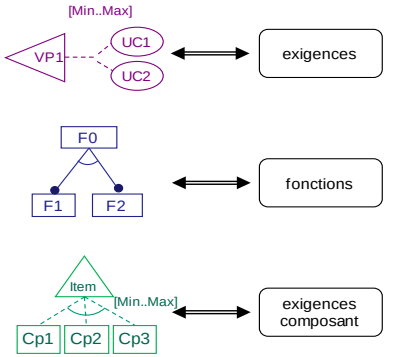
- **systems engineering processes are adapted to the reuse and capitalization strategy,**
- **systems engineering products concerns now the domain and the applications,**
- **organization itself is changing: migrating from multiple projects to a single platform organization, …**

and new processes, new artefacts arise:

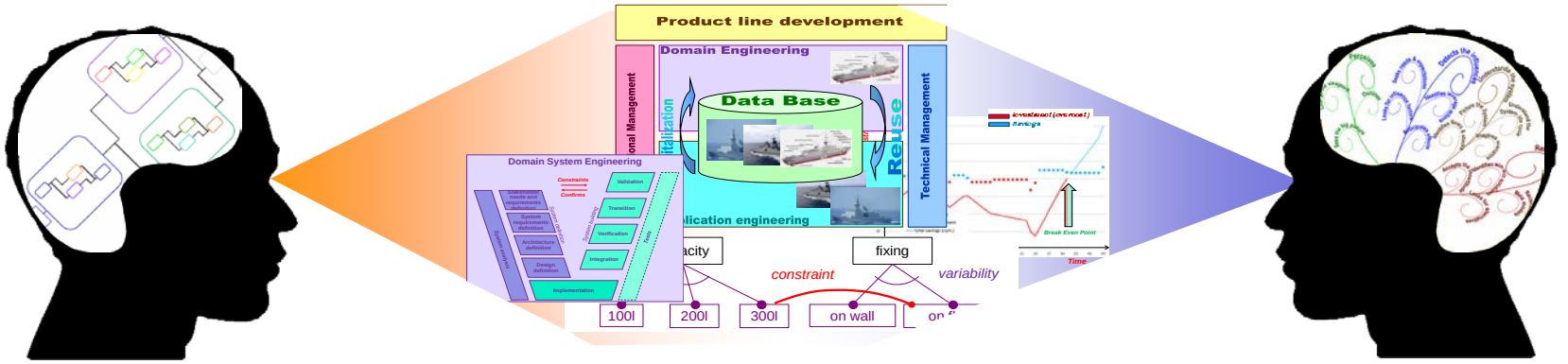
- **variability engineering and the variability model,**
- **capitalization and reuse.**







System Thinking when developing in a Product Line



Developing in a Product Line

Product Line

System Thinking

It is important not to neglect the human obstacles to adopt a Product Lines, including:

- **resistance to change,**
- **resistance to the reuse of products created by others: the well-known "Not Invented Here" (NIH) syndrome,**
- **participants' fear of losing leadership or expertise …**

System Thinking attitudes when developing in a Product Line

PLWA1. Perceive:

- **Outline: understand the defined Product Line domain: common features and variability,**
- **See the big picture: work at the enterprise level, on a platform, not in a single project,**
- **Change their viewpoint:**
  - ***understand the enterprise objective, not only the customer needs,***
  - ***from a personal viewpoint to a collective one***

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System Thinking attitudes when developing in a Product Line

PLWA2. Detect the influences:

- **Look for influence factors: build a team spirit,**
- **Seek the Product Line needs & expectations,**
- **Anticipate effects: a context where everyone is enriched in contact with each other,**
- **Identify leverage actions: as training and coaching,**

System Thinking attitudes when developing in a Product Line

PLWA3. Understand the system, envisioning a new Product Line, in order to choose the best Product Line architecture or organization:

- **acquire a functional view of the Product Line organization.**
- **understand the system engineering artefacts, the assets, the processes inputs & outputs;**
- **understand the Product Line life cycle in order to perform the right activity with the right product configuration.**
- **Imagine scenarios: understand the scenario when developing the domain products and the applications in the Product Line (as a sequence of tasks).**

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System Thinking attitudes when developing in a Product Line

PLWA4. Reassess:

- **Reconsider Meta models:**
  - ***Work on a platform (common to all applications), not in a project team dedicated to one contract execution;***
  - ***Work with more stakeholders, accept compromises;***
  - ***Avoid the NIH syndrome ("Not Invented Here");***
  - ***Work with more complex product: multiple, variable.***
- **Accept the incertitude: the incertitude may be due to the continuous, almost permanent change, either of the process and/or the product,**
- **…**

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System Thinking attitudes when developing in a Product Line

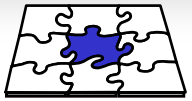
PLWA4. Reassess:

- **the added value is now in developing a reusable generic product (instead of making the best choice for a single application):**
  - ***Choose the best set of variants (and rejecting to specific features);***
  - ***Design the best architecture for the variability model.***
- **the managers have to take into account the cultural aspects and have to find win-win solutions: new motivations as the Enterprise performance ensuring the durability of employment, new values as sharing, incentive objectives which do not disadvantage people who invest.**

Product Line Thinking
when developing in a Product Line

The main challenges when adopting a new Product Line is to accept change; so the main attitudes are:

- **PLWA4 "Reassesses", in order to change the mental map of developers and various stakeholders.**



Product Line Thinking

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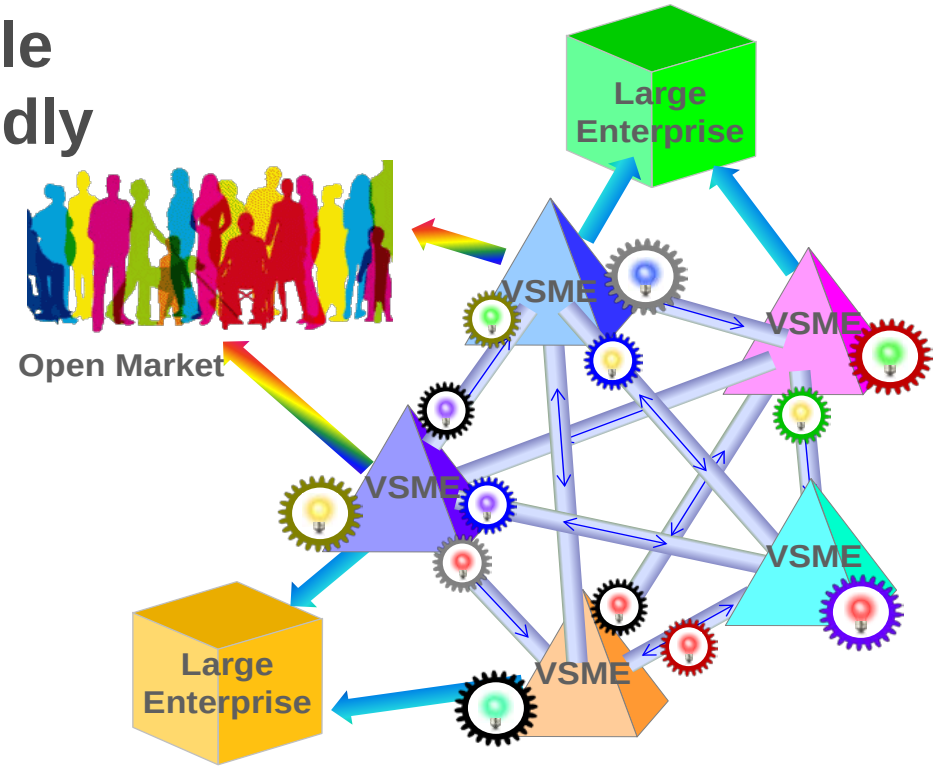
Product Lines: a solution dedicated to VSME

- When regarding the main challenges for VSME, we need to pay attention to their ecosystem made of other VSME, large enterprises, …
- Putting the product at the middle of that ecosystem we state rapidly that to evolve in a changing ecosystem, the product has to satisfy a wider number of various needs.



Product Lines: a solution dedicated to VSME

Thus variability (i.e. Product Lines) proves to be the right solution to:

- **tighten the links with purchasers (large enterprise),**
- **take the control of the product life cycle,**
- **open to other customers, to the market,**
- **create links with other VSME by sharing a common set of products,**
- **evolve on the range of product value.**

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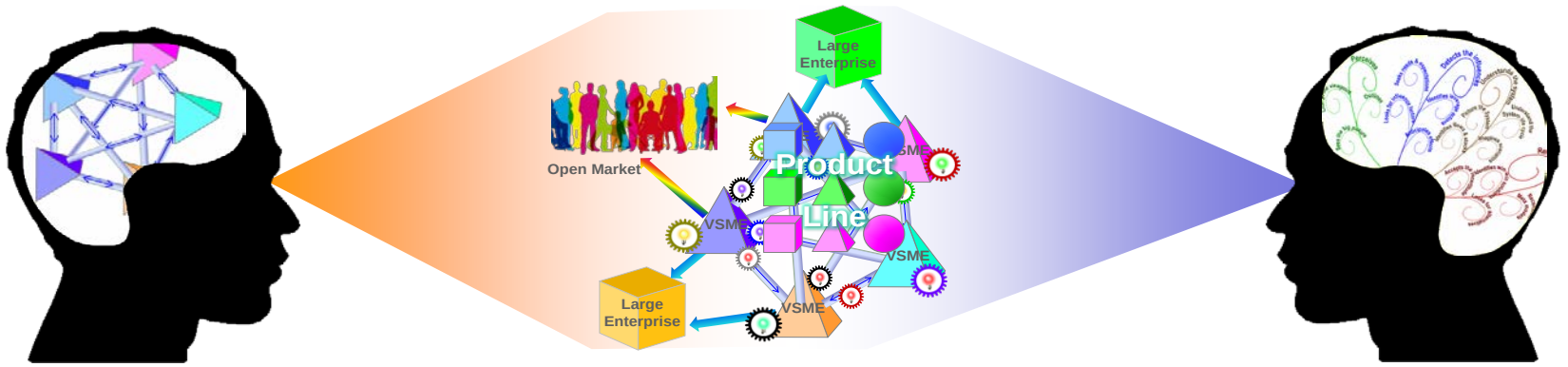
System Thinking
when implementing Product Line in VSME

We need to integrate the VSME ecosystem to the analysis, and consequently to adapt the "Product Line Architect" attitudes when implementing a Product Line in a VSME.



Product Line as a solution for VSME

Product Line

System Thinking

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System Thinking attitudes when implementing Product Line in VSME

PLVSME1. Perceive:

- **Outlines define the actual ecosystem and the expected change.**
- **See the big picture: address all the potential customers and partners of the ecosystem.**
- **Change one's viewpoint:**
  - ***Understand the actual and potential purchaser acquisition strategy;***
  - ***Understand the expectations and the strategy of other VSME in the ecosystem.***

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System Thinking attitudes when implementing Product Line in VSME

PLVSME2. Detect the influences:

- **Look for influence factors: identify what new products may change needs.**
- **Seek needs & expectations: make an inventory of the ecosystem enterprise needs.**
- **Anticipates effect: understand the reciprocity and the complementary offer with other VSME.**
- **Identify leverage actions: create a new cluster or enter in an existing VSME cluster.**

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System Thinking attitudes when implementing Product Line in VSME

PLVSME3. Understand the system. Envision the ecosystem, in order to help defining how Product Lines can enable to adapt to the ecosystem change:

- **Picture the System: the near ecosystem and the large one.**
- **Identify flows & stocks: who needs what product in the ecosystem and who can provide products.**
- **Understand the System life cycle: identify changes in the ecosystem.**
- **Imagine scenarios: how to initialize and to support a strategy for sharing products in the ecosystem or for offering variable products to large enterprises and the open market.**

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System Thinking attitudes when implementing Product Line in VSME

PLVSME4. Reassess:

- **Reconsider Meta models:**
  - ***take the responsibility of the product life cycle,***
  - ***turn to the market: moves from a single business-to-business model to wider business-to-market model.***
- **Accept the incertitude: small partners may be unstable.**
- **Look for alternatives:**
  - ***Plan how to collaborate with other VSME,***
  - ***Plan how to create a larger enterprise by integrating several one … instead of being a concurrent;***
  - ***Plan how to move on the product range of value.***
- **Identify win-win solutions:**
  - ***with acquirer s(large enterprise) and suppliers (VSME);***
  - ***with other VSME of the ecosystem.***

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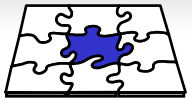
Product Line Thinking
when implementing Product Line in VSME

The main challenges when implementing a Product Line or improving an existing one in VSME is how to have a good view of the ecosystem and to choose the best products to share;

so the main attitudes are:

- **PLVSME1 "Perceives" in order to fit with the expected change of the ecosystem.**



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Conclusion: The Product Line Thinking

What can we learn from these three business cases ?

Product Line **business case**	**Challenge**	Main Product Line Thinking **attitude to adopt**
1) Implementation of a Product Line	Envisioning a new Product Line domain. Defining the best organization Product Line	Detect the influences & Understand the system
2) Developing in a Product Line	To change culture.	Reassess
3) Implementation of Product Line in VSME	To use Product Lines to evolve (or survive) in a changing ecosystem.	Perceive

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Conclusion: The Product Line Thinking

The Product Line Thinking is an approach for understanding Product Line regarded as a System. Product Line Thinking can be used both for:

- **Envisioning a new Product Line, in order to get a good idea of the business and to define the best organization (Product Line Scoping).**
- **Understanding an existing Product Line, in order to adopt it and to work in its organization at best.**

The Product Line Thinking turns out to be really effective to manage the inherent Product Line complexity and uncertainty which does not lead to a single implementation

The Product Line Thinking is to be integrated in the deployment tool set!

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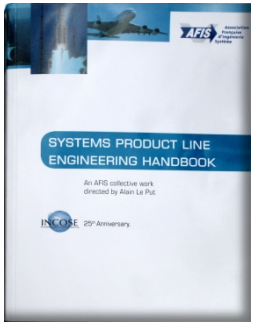
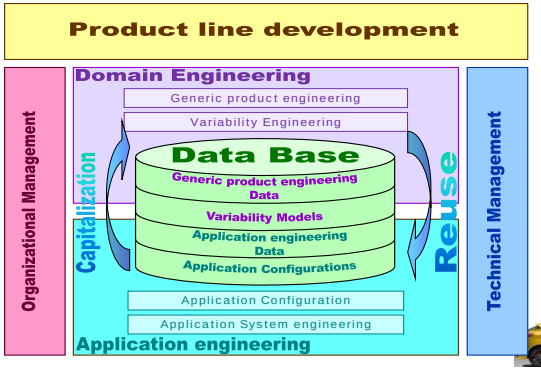
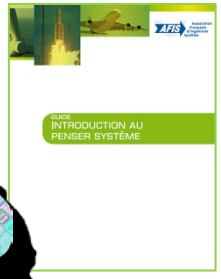
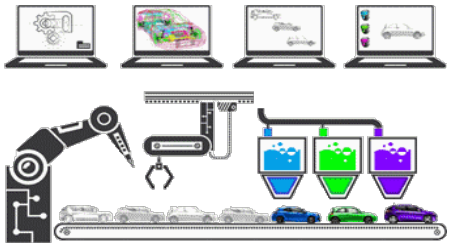
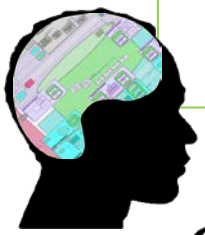
Thank You

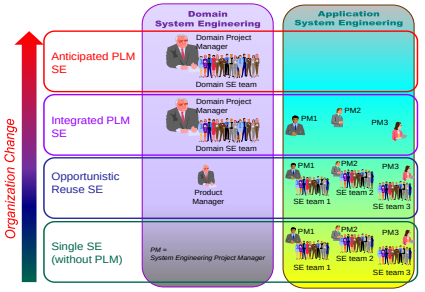


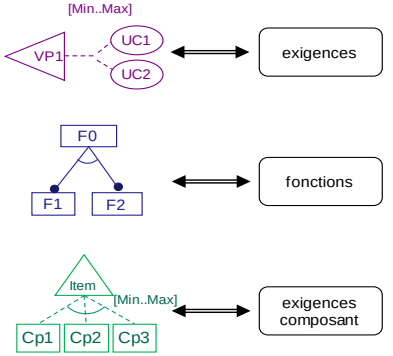


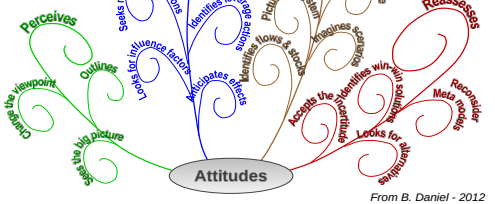






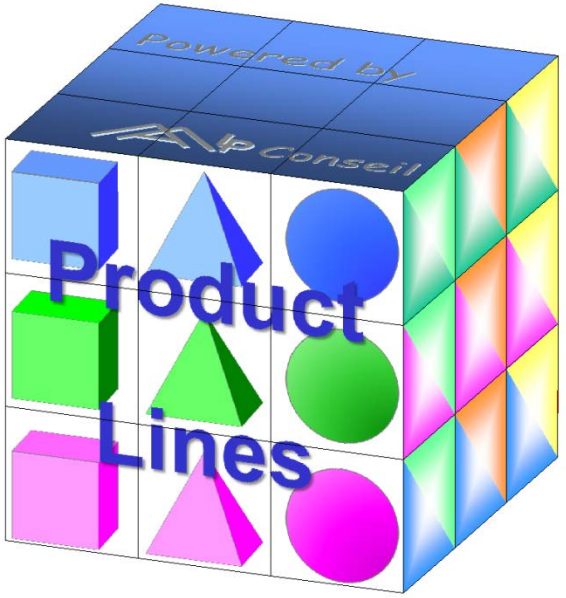






From B. Daniel - 2012

Alain Le Put – MALP Conseil
Contact : alain.leput@orange.fr



Alain Le Put – MALP Conseil

Engineer degree from the high graduate school Ecole Centrale de Lyon (1973) France, retired, creator of the MALP Conseil (consultancy) in 2009.

Alain Le Put spent most of his career in the Thales Group, where he worked as project manager for systems for the Navy.

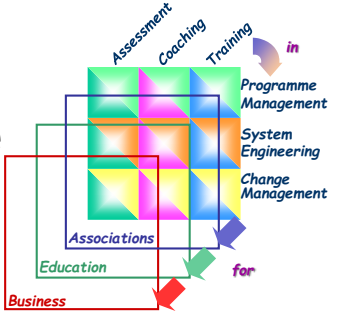
Then he was responsible for process improvement, with the participation to more than 50 assessments including 30 evaluations as a Thales CMMI lead assessor. He taught Project management to some hundreds of Engineers.

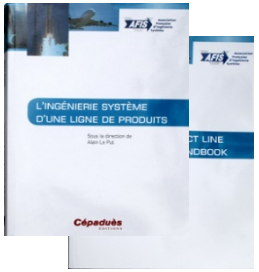
Responsible for System Engineering trade of the Thales Group: he animates the Thales Systems Engineering community (7000 system engineers around the world), he evolved the Thales System Engineering Handbook, and he developed training courses.

He is involved in AFIS and INCOSE: he is the chairman of the Product Lines Working Group, and he participates in several other Working Groups

(Lean, Architecting and Systems of Systems, System Thinking).

He is involved in the Advanced Training in System Engineering of the high graduate school ENSTA ParisTech. He give lectures in several French Universities.





Author of the "System Product Line Engineering Handbook" published by Cépaduès.

As the creator of MALP Conseil, he acts also as a consultant in the Industry.

Thank you for participating!

Questions?

Upcoming Webinars (tentative schedule)

Who	What	When
Transforming to Model-based System Management for the Autonomous Systems Era	Jack Ring	June 15, 2016 at 11am EDT

Invitations will be emailed in advance and informational updates will be placed on www.incose.org
Go to http://www.incose.org/ProductsPublications/webinars for more info on the webinar series, including a way to view the last Webinar and soon – this one!

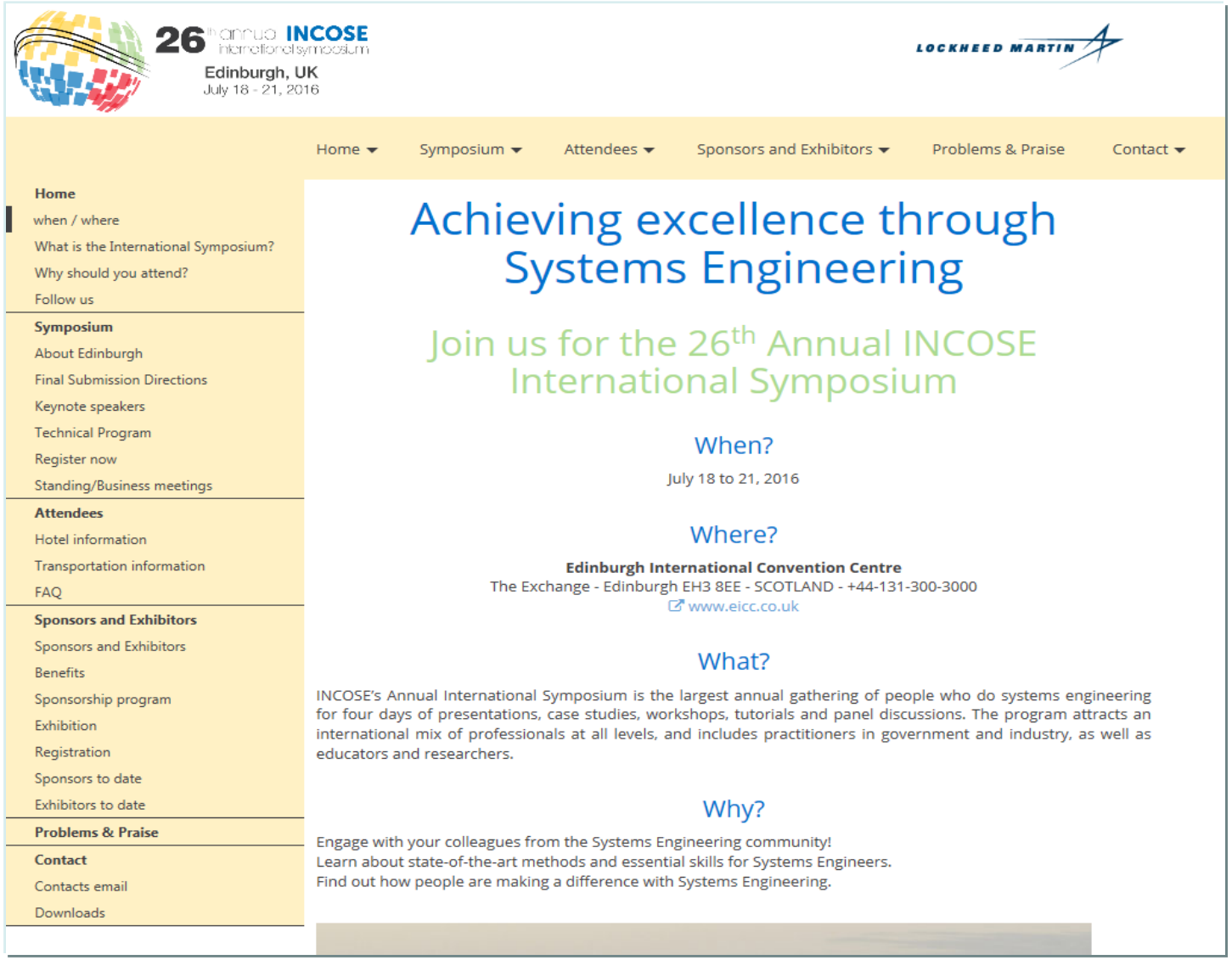
Information on the webinars is now being posted in INCOSE Connect, in the INCOSE Library area, at https://connect.incose.org/Library/Webinars/Pages/INCOSE-Webinars.aspx . Joining instructions will added around two weeks before the webinar is scheduled to take place.

2016 INCOSE International Symposium

http://www.incose.org/symp2016/home

Edinburgh, UK
July 18 – 21 2016

Early Registration closes on 29 May 2016!



SERC Talk, 1 June 2016

How Do Models Help SEs Deal with Complex, Networked, Socio-Technical Systems?
Babak Heydari, Assistant Professor, Stevens Institute of Technology

Abstract: https://t.e2ma.net/click/ys6cm/eh8ayc/ayatld

Date: Wednesday 1 June 2016

Time: 1pm EDT

Register: https://t.e2ma.net/click/ys6cm/eh8ayc/mbdtld

Upcoming Talks:
August 3: Dinesh Verma, Stevens Institute of Technoloogy: What Were the Top Issues and Opportunities from the SERC Model-Centric Design and Acquisition Forum?
October 5: Gary Witus, Wayne State: What lives at the intersection of MOSA and Set-Based Design?
December 7: Donna Rhodes & Adam Ross, MIT: Why is Human-Model Interactivity Important to the Future of Model-Centric Systems Engineering?

INCOSE Systems Engineering Professional PDU Credit

Please note that you can claim 1PDU credit towards your Systems Engineering Professional re-certification by attending this webinar. The webinars may also apply to the PDU requirements of other organizations, depending on the subject matter

To qualify, you must have attended through at least 75% of the webinar for webinars that last less than one hour, or through 45 minutes of the webinar for webinars that last for 1 hour or longer.

You can also claim credit for previous webinars you have attended; please contact info@incose.org if you wish to know which webinars you attended and if you met the qualification requirements