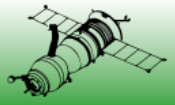
Las Vegas, NV
June 30 - July 3, 2014

Systems Engineering International Standards and Support Tools for Very Small Enterprises

Dr. Claude Y Laporte, Ronald Houde and Joseph Marvin

Presented by Claude Y Laporte
Project Editor of ISO/IEC 29110

July 1, 2014


Content

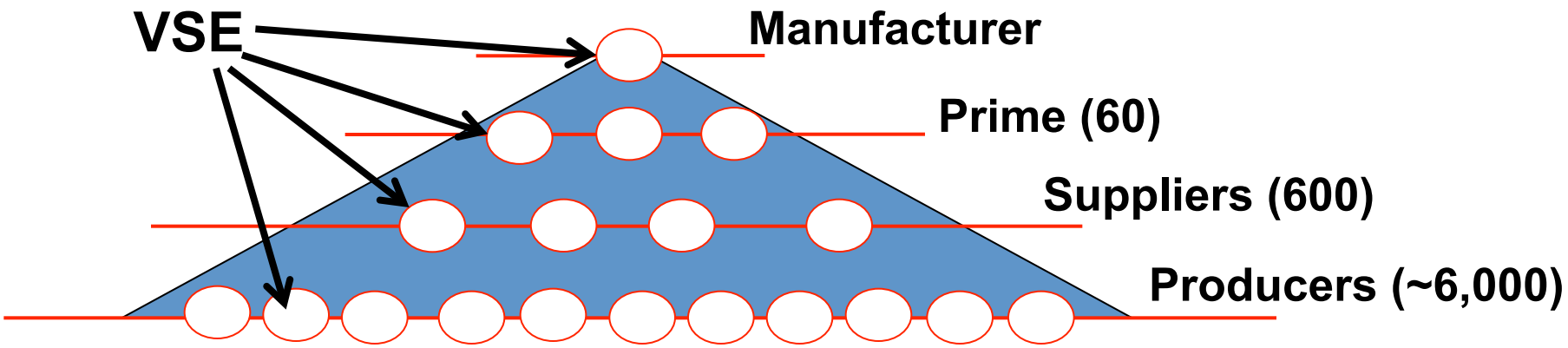
- Importance of Very Small Entities (VSEs)*
- Development of ISO/IEC 29110 Standards for VSEs
- Systems Engineering Profiles for VSEs
- Deployment Packages to Support ISO/IEC 29110
- Examples of application of ISO/IEC 29110
  - Economic Benefits of ISO/IEC 29110
- Next Steps

* **VSEs** = **Very Small Entities** are enterprises, organizations, projects or departments having up to 25 people.

Context

- Most of VSEs cannot afford the resources, in terms of number of employees, expertise, cost and time, nor do they see a net benefit in developing, and documenting life cycle processes
  - Difficulties to implement standards
    - e.g. no resources, no expertise to select out of existing standards appropriate processes and adapt/tailor them to their needs
  - Processes are often improvised
    - Not documented
    - When a member of a VSE leaves, most of the knowledge and expertise may go away

The Importance of VSEs



A defect from one of the producers went into a product and resulted in a loss of over $200 million by the manufacturer

Adapted from (Shintani, Small Settings Workshop, Software Engineering Institute, 2006)

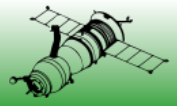
Size of Enterprises

- In Europe

Type of enterprise	Number of employees	Annual turnover (EUR)	Number of enterprises (% of overall)	Number of enterprises
Micro-enterprises	1 - 9	≤ 2 million	92.2 %	19 968 000
Small enterprises	10 - 49	≤ 10 million	6.5 %	1 358 000
Medium enterprises	50 – 249	≤ 50 million	1.1 %	228 000
SMEs, total	87 100 000		99.8 %	21 544 000*
Large enterprises	> 250	> 50 million		
Large enterprises, total	42 900 000		0.2 %	43 000

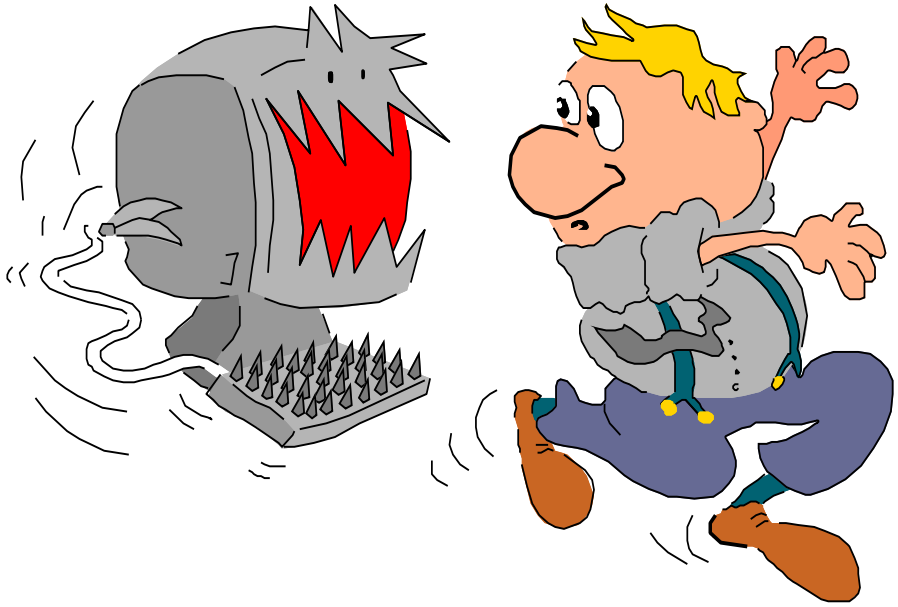
* Independent companies only, excluding legally independent companies that are part of large enterprises.

- Micro-enterprises account for 70% to 90% of enterprises in OECD countries (about 57% in USA)


(Moll, ISO Focus+, February 2013)

VSEs reacting to Standards - 1



VSEs reacting to Standards - 2

ISO Working Group 24

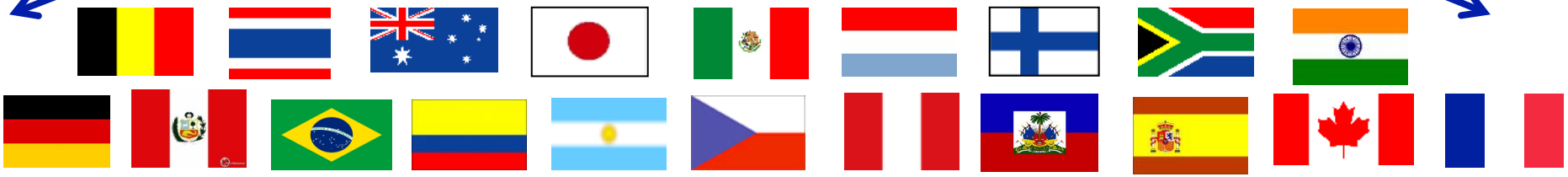
ISO JTC1 IEC
INFORMATION TECHNOLOGY STANDARDS

Joint Committee

Sub committee (SC) 7

Working Group (WG) 24

Standardization of processes, supporting tools and supporting technologies for the engineering of software products and systems.

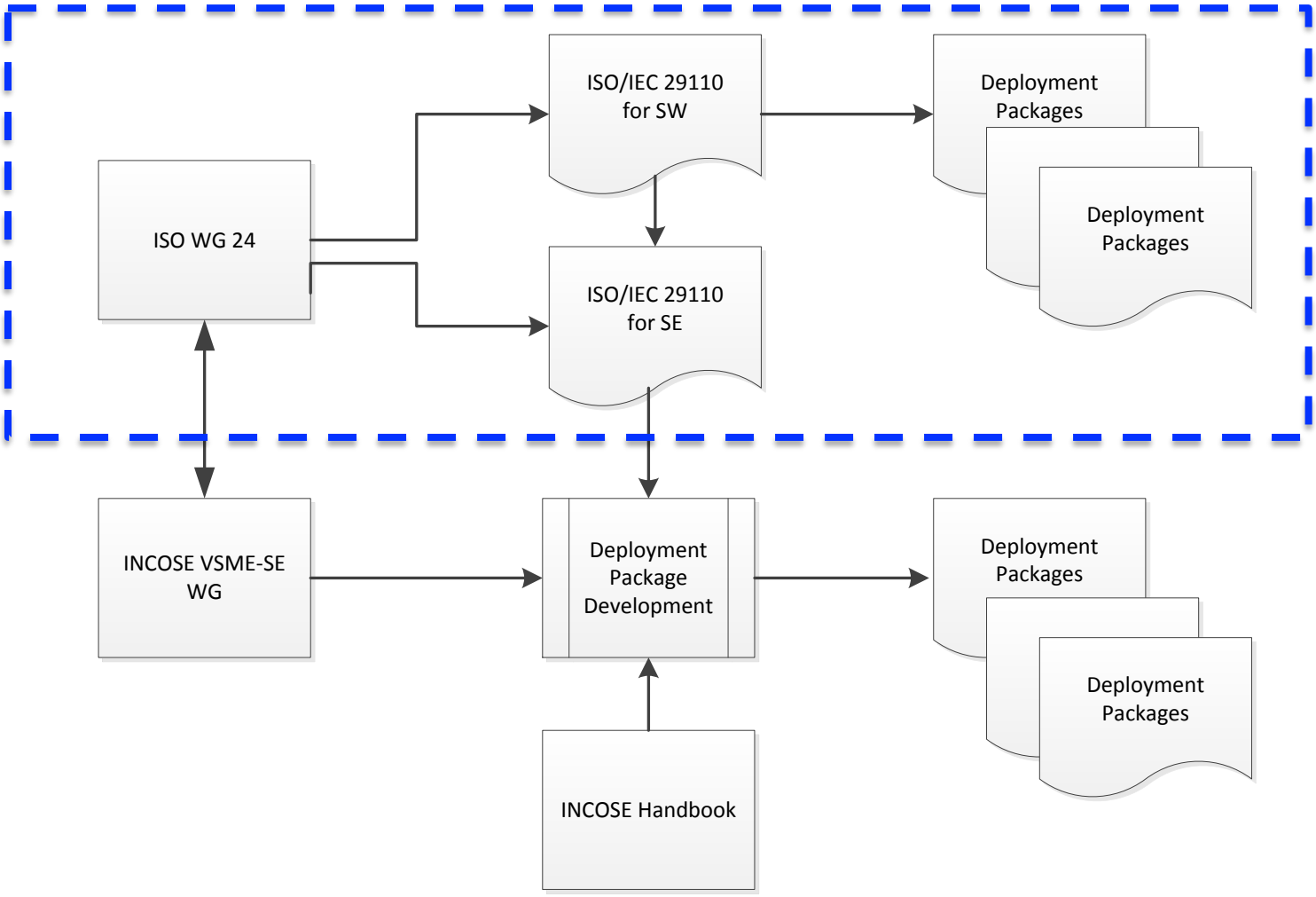


INCOSE International Council on Systems Engineering
AFIS Association Française d'Ingénierie Système
IEEE

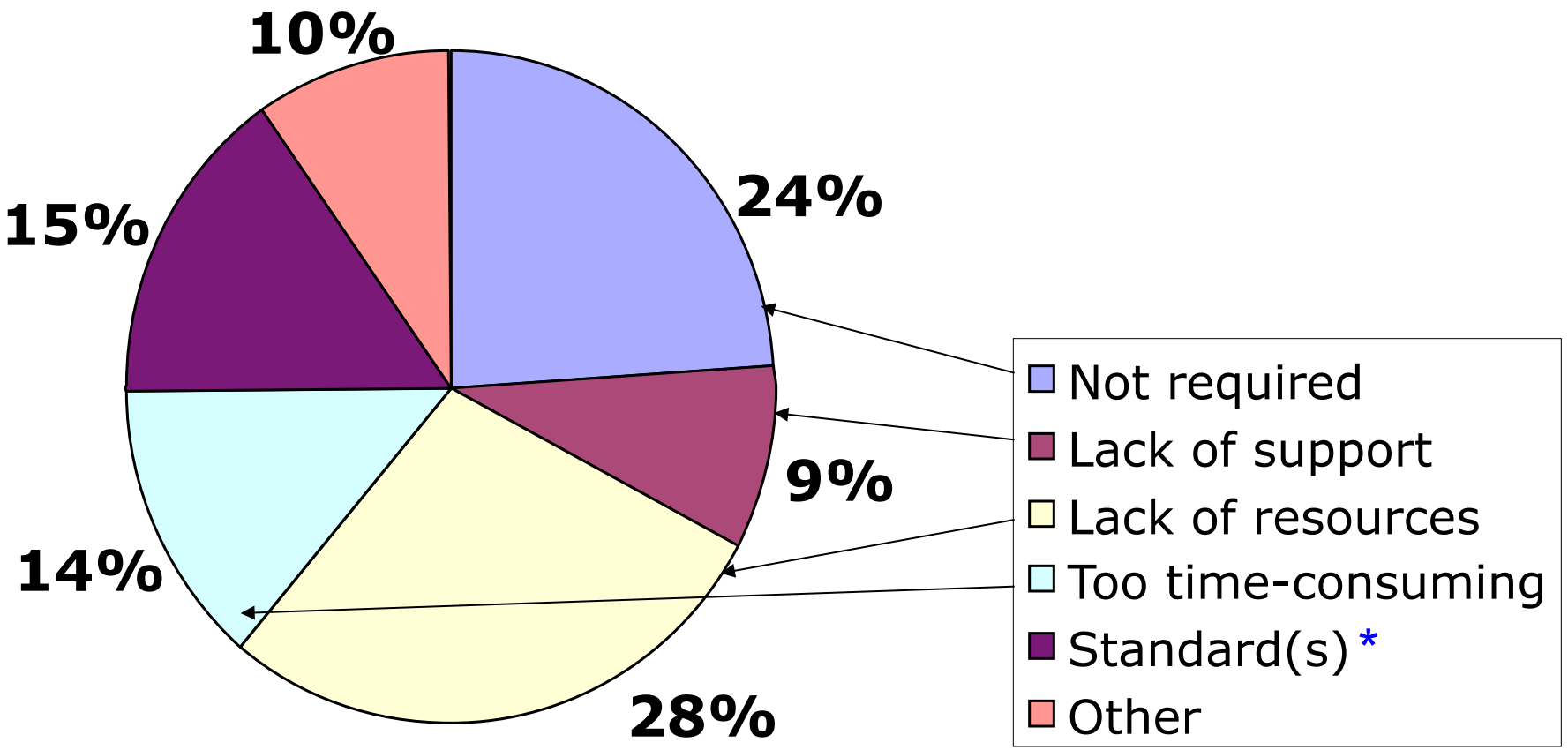
ISO/IEC 29110 Development and INCOSE

- Presentation of Software ISO 29110 at 2008 IS (Amsterdam)
- INCOSE VSE WG established in 2009
- Software ISO 29110 presented to INCOSE Finger Lake Chapter in 2010
- Presentation at 2011 IW (Phoenix) and AFIS (Paris)
- ISO 29110 project for systems engineering (SE) approved by members of ISO (SC7) in 2011
- Presentation of draft SE ISO 29110 at 2012 IS (Rome)
- Development of Deployment Packages with INCOSE VSE WG in 2013
- Publication of SE Basic profile by ISO in July 2014

WG24 – INCOSE VSE WG Collaboration



Why don't VSEs use Standards ?



* Difficult, Bureaucratic, not enough guidance.

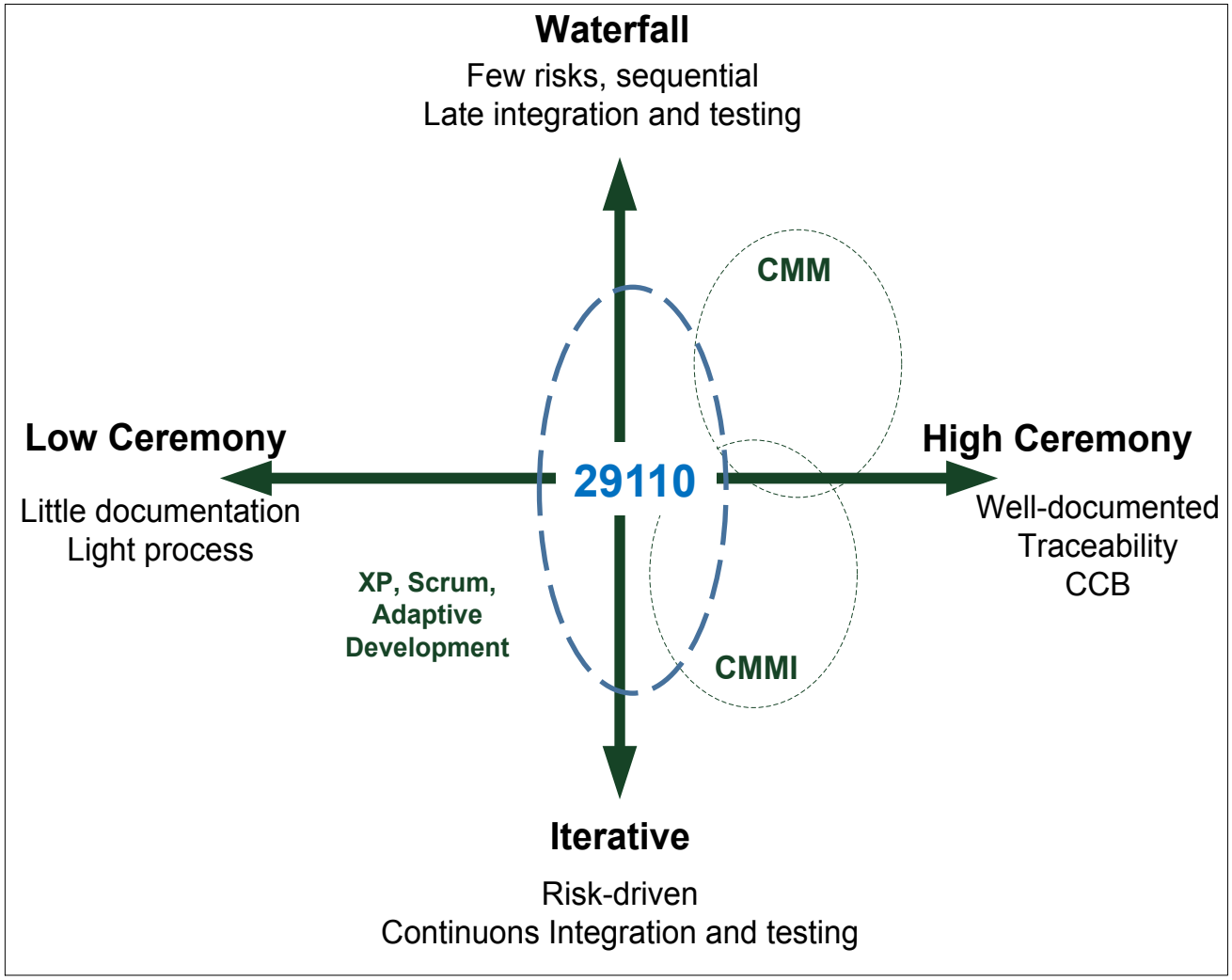
Requests from VSEs

- **Certification and Recognition**
  - Only 18% were certified
    - Over 53% of larger companies are certified
  - Over 74% indicated that it was important to be either recognized or certified
    - ISO certification requested by 40%.
    - Market recognition requested by 28%
    - Only 4% are interested in a national certification
- **Needs Regarding Documentation**
  - 62% were asking for more guidance and examples
  - 55% were requiring 'lightweight' standards that are easy to understand and apply and come with templates.

Strategy of WG 24

1. Used the notion of '**Profile**' to develop a roadmap to meet the needs of VSEs.
   - An 'assemblage' from one or more standards to accomplish a particular function.
2. Focused first on VSEs not developing critical system/software
   - Generic Profile Group
3. Two types of standards, used as the input, for the development of standards and guides for VSEs:
   - **Process standards**, such as ISO/IEC/IEEE 12207/15288, that define the activities required to achieve identified objectives or outcomes;
   - **Product standards**, such as ISO/IEC/IEEE 15289, that define the structure and content of artefacts produced by the processes;
4. Developed a set of documents, targeted at different audiences, to describe and specify the profiles.

Spectrum of Development Approaches



Adapted from (Kroll 2003)

The Generic Profile Group*

- **Entry** - Targets VSEs typically developing 6 person-month projects or start-ups;
- **Basic** - Targets VSEs developing only one project at a time;
- **Intermediate** – Targets VSEs developing multiple projects within the organizational context;
- **Advanced** – Targets VSEs which want to sustain and grow as an independent competitive software development business.

* Developers of non-critical systems/software

ISO/IEC 29110 Family

29110 Overview (TR 29110-1)

For VSEs

29110 Profiles (IS)

Framework and Taxonomy (IS 29110-2)

Specifications of VSE Profiles (IS 29110-4)

Specification - VSE Profile Group m
(IS 29110-4-m)

For Standard producers, tool vendors, methodology vendors

List the Requirements i.e. '**What** to do'

29110 Guides (TR)

Assessment Guide (TR 29110-3)

For Assessors and VSEs

Management and Engineering Guide (TR 29110-5)

Management and Engineering Guide VSE Profile m-n
(TR 29110-5-m-n)

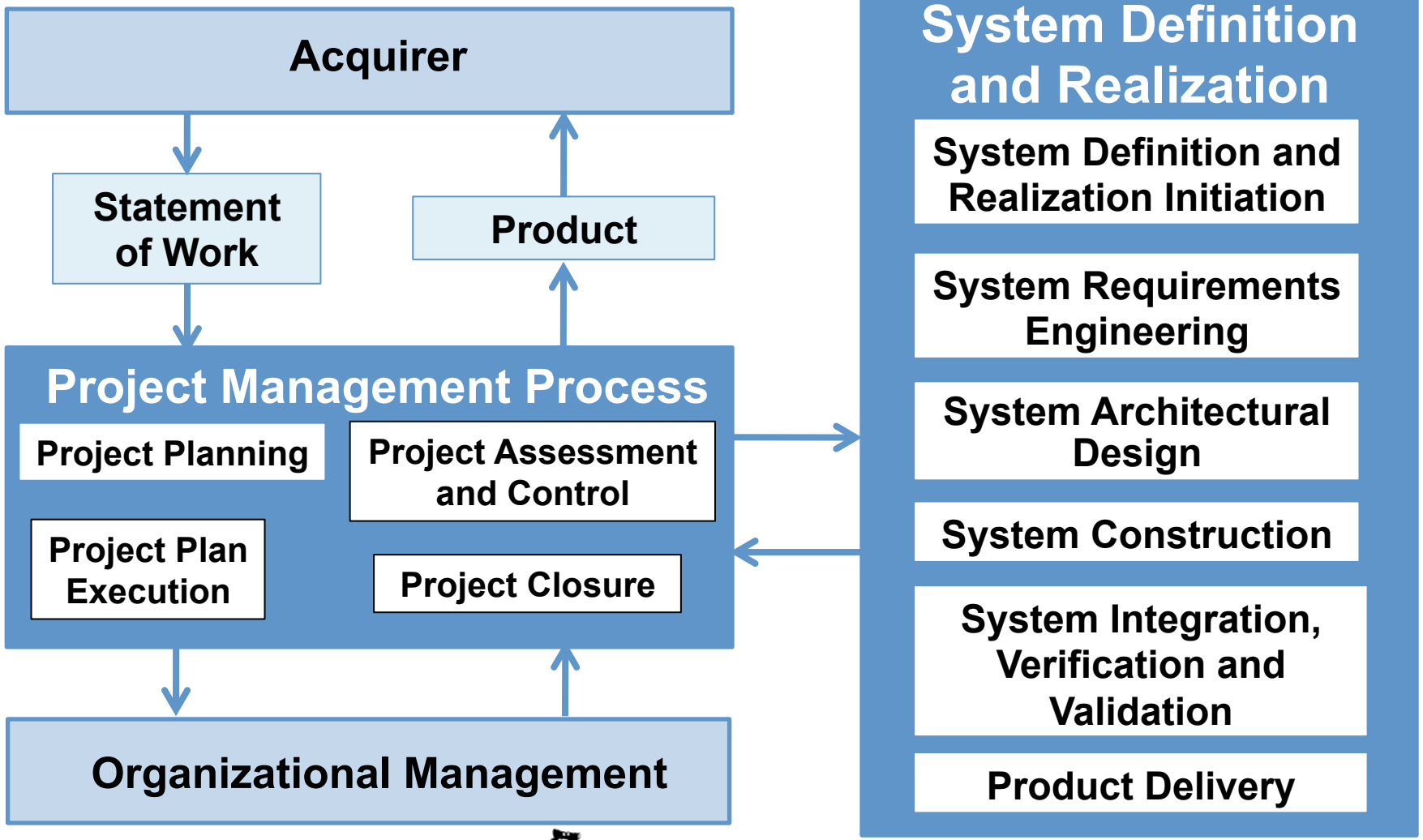
For VSEs

'**How** to do'

ISO/IEC 29110

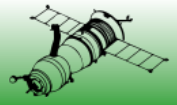
Obtained approval from ISO to make TRs available at no cost

The SE Basic Profile



Two Tasks of the Planning Activity

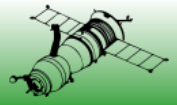
Role	Task List	Input Products	Output Products
PJM TL	**PM.1.1** Review the Statement of Work	Statement of Work	Statement of Work *[reviewed]*
PJM CUS	**PM.1.2** Define with the Customer the Delivery Instructions of each one of the deliverables specified in the Statement of Work.	Statement of Work *[reviewed]*	Project Plan - *Delivery Instructions*


Document Content

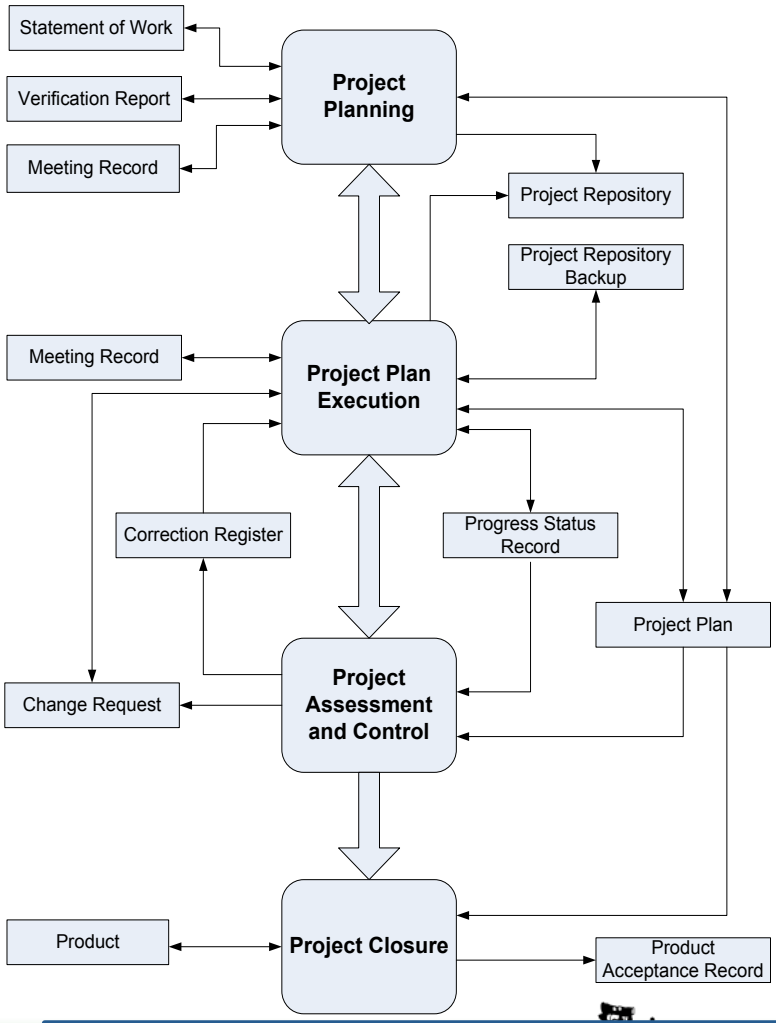
- Change Request

Name	Description	Source
Change Request	Identifies a Software, or documentation problem or desired improvement, and requests modifications. It ***may*** have the following characteristics: - Identifies purpose of change - Identifies request status - Identifies requester contact information - Impacted system(s) - Impact to operations of existing system(s) defined - Impact to associated documentation defined - Criticality of the request, date needed The applicable statuses are: *initiated, evaluated, and accepted*	Customer Project Management System Definition and Relealization

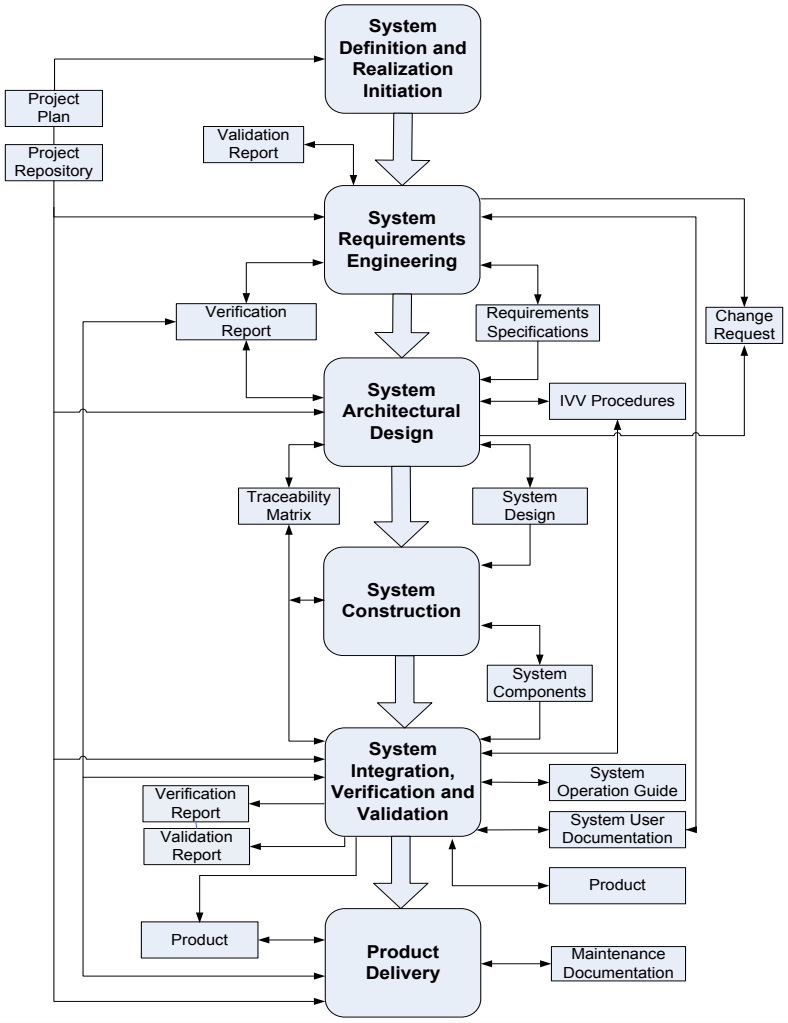




Processes of Basic Profile

Project Management

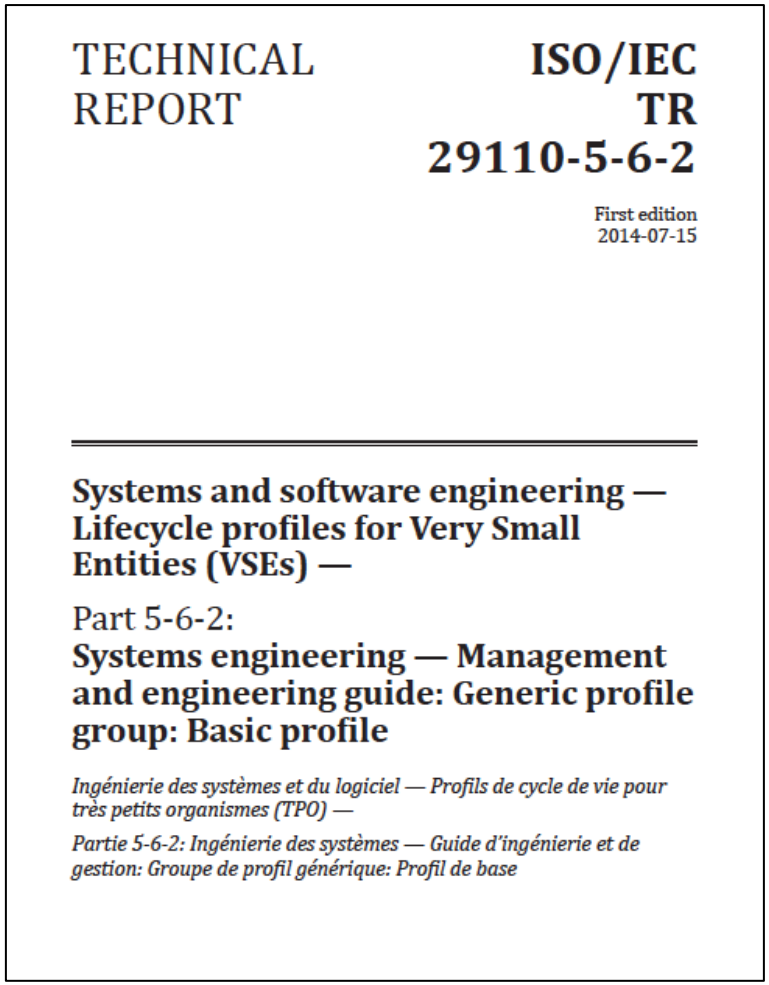


Engineering



ISO/IEC 29110 is not intended to preclude the use of different lifecycles such as waterfall, iterative, incremental, evolutionary or agile

SE Basic Profile



TECHNICAL REPORT

ISO/IEC TR 29110-5-6-2

First edition
2014-07-15

Systems and software engineering — Lifecycle profiles for Very Small Entities (VSEs) —

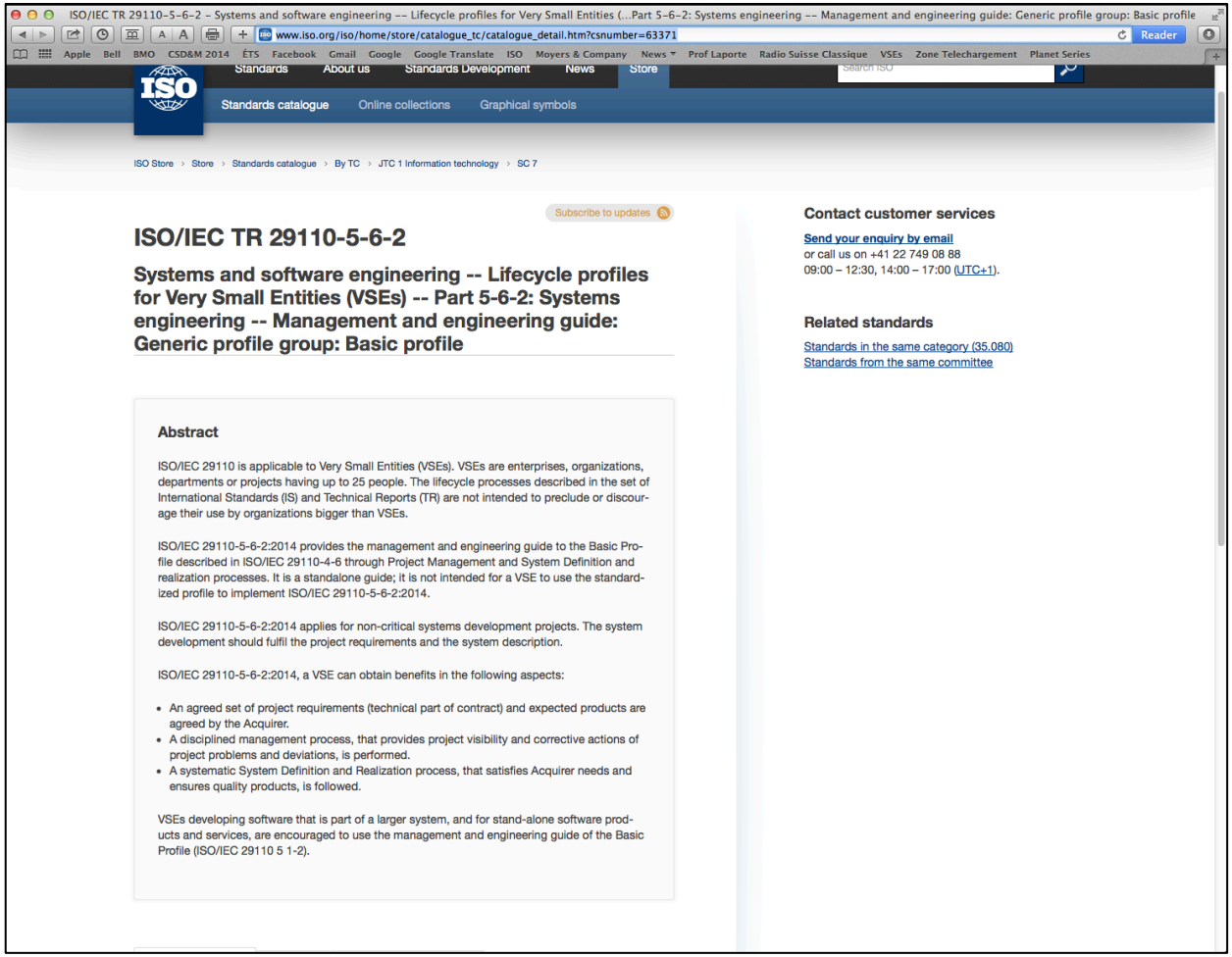
Part 5-6-2:
Systems engineering — Management and engineering guide: Generic profile group: Basic profile

Ingénierie des systèmes et du logiciel — Profils de cycle de vie pour très petits organismes (TPO) —

Partie 5-6-2: Ingénierie des systèmes — Guide d'ingénierie et de gestion: Groupe de profil générique: Profil de base

http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=63371

SE Basic Profile



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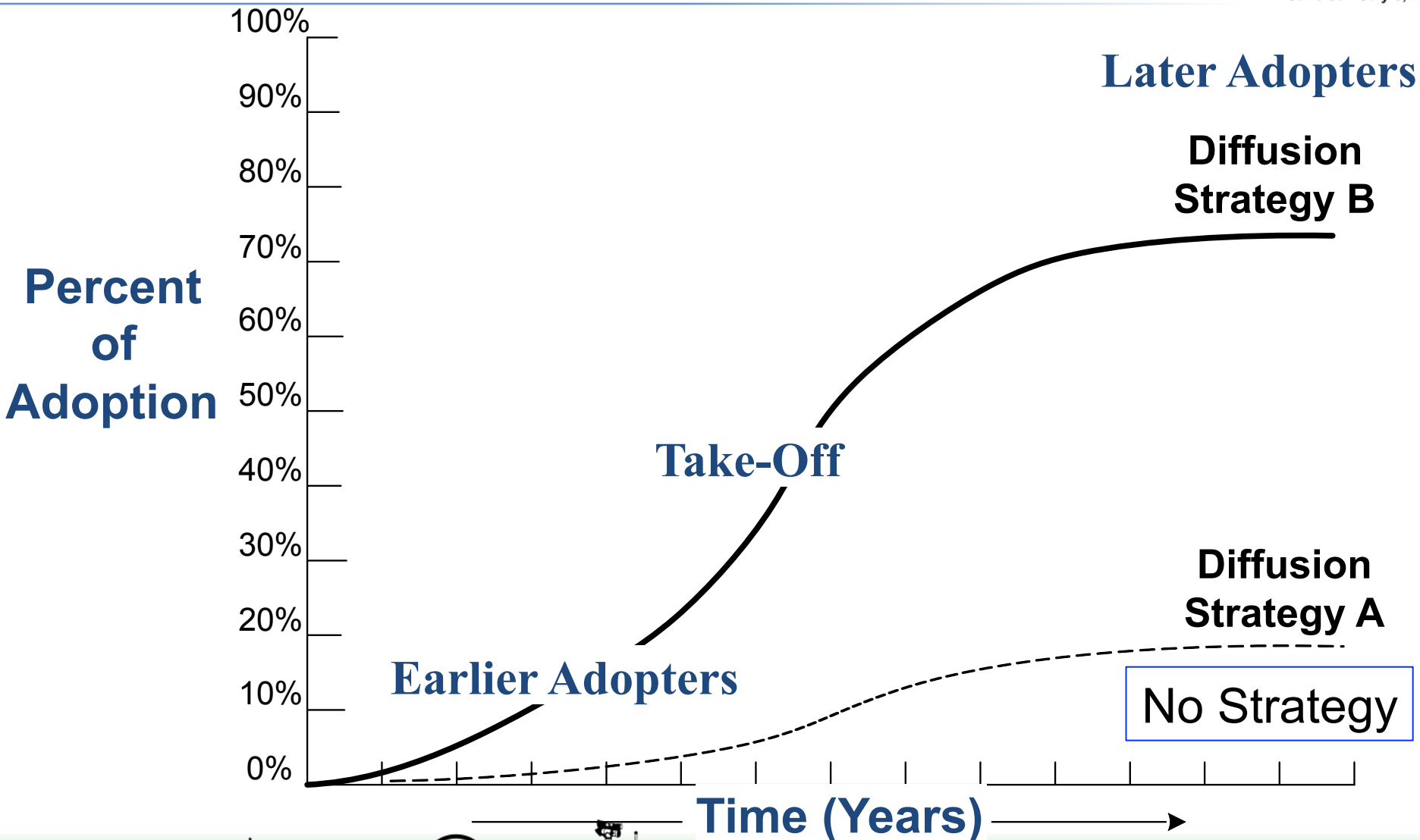
Diffusion/Adoption of ISO/IEC 29110



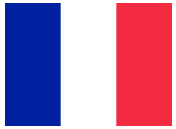
Network of Support Centers for VSEs

- **Objectives**
  - Help accelerate the development of ISO standards for VSEs
  - Accelerate deployment of VSE Standards
  - Accelerate the development and application of Deployment Packages

- Belgium (CETIC)
- Brazil
- Canada (ÉTS)
- Colombia (Parquesoft)
- Finland
- France (UBO)
- Haiti
- Honk Kong
- Ireland (LERO)
- Luxembourg (Tudor Research Center)
- Peru (3 Universities of Lima)
- Mexico
- Thailand (Institute of Software Promotion for Industries)





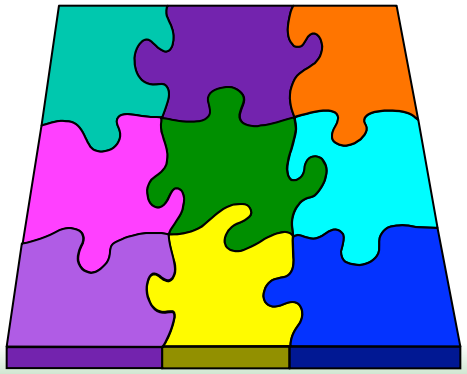




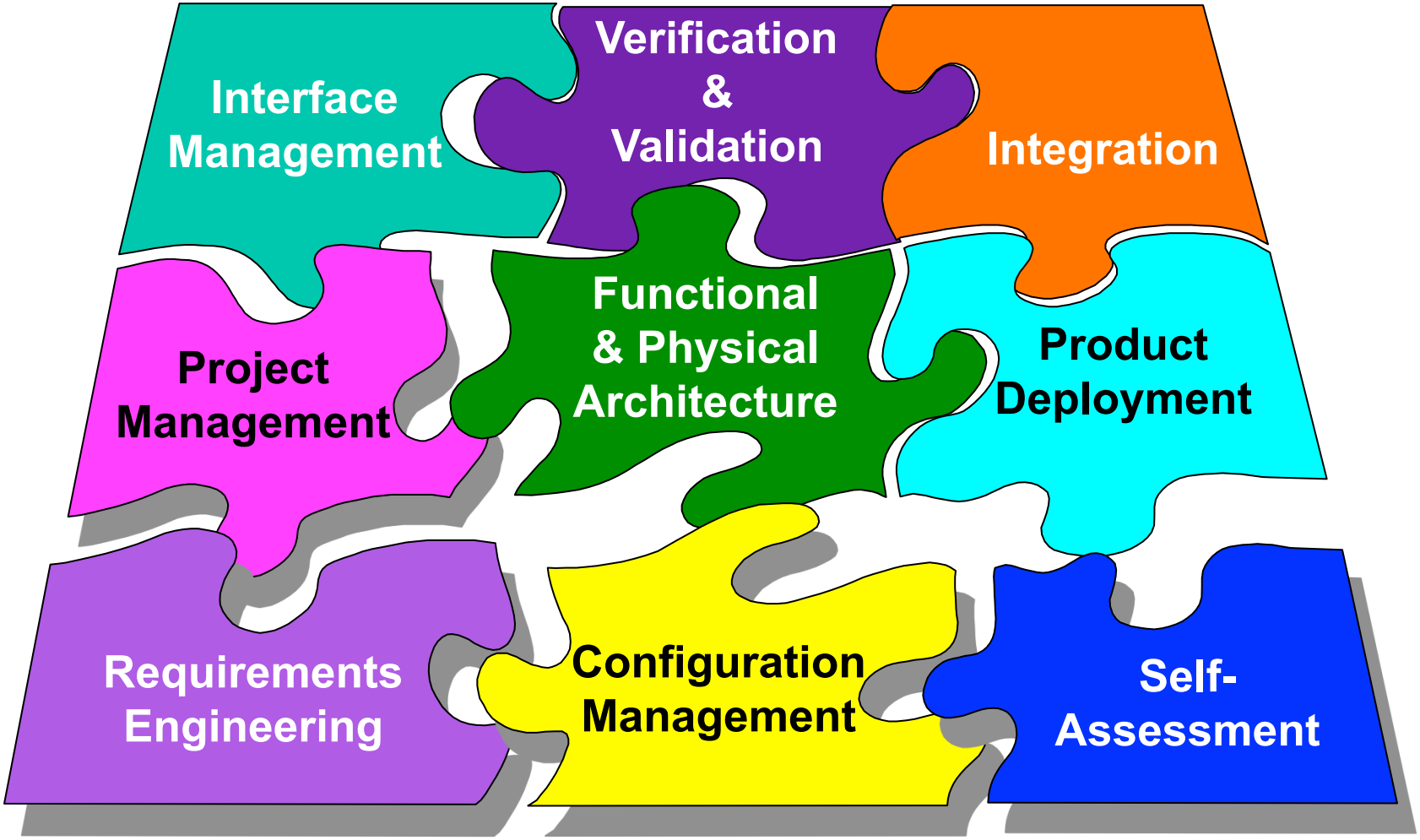


Deployment Packages (DPs)

- A set of artifacts developed to facilitate the implementation of a set of practices, of the selected framework, in a VSE.
  - Deployment packages are not intended to preclude or discourage the use of additional guidelines that VSEs find useful.
- DPs are designed such that a VSE can implement its content, without having to implement the complete framework at the same time.
- When implementing a DP, a VSE can see its concrete step to achieve or demonstrate coverage to the Management and Engineering guide.
- Each DP is written/edited by at least 2 persons



DPs for the SE Basic Profile



DPs will be available at no cost on Internet

VSE WG DP Leads

Deployment Package	DP Leads
Requirements Engineering	Ronald Houde
Project Management	Ken Ptack
Functional and Physical Architecture	Sascha Ackva
Configuration Management	Joe Marvin
Verification and Validation	Angela Robinson
Product Deployment	Joe Marvin
Interface Management	Ronald Houde
Integration	Jim Armstrong
Self-Assessment	TBD

Tools to Support ISO 29110

- Tools based on Atlassian Tool Suite
  - Multilingual (e.g. English, French, Spanish)

http://www.nuum.ca

ISO 29110 Public Web Site

- Members of WG
- Introduction
- Survey of VSEs
- Network of Centers
- Generic Profiles
- Deployment Packages
- Pilot Projects
- Education DPs
- Publications
- Certification
- Spanish Page
- ISO 20000

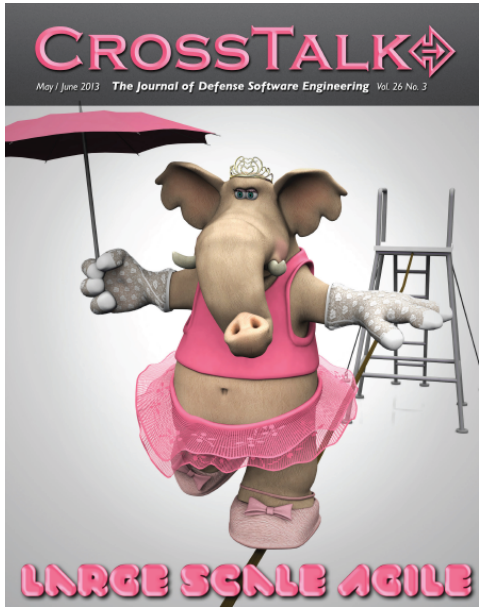
http://profs.etsmtl.ca/claporte/English/VSE/index.html

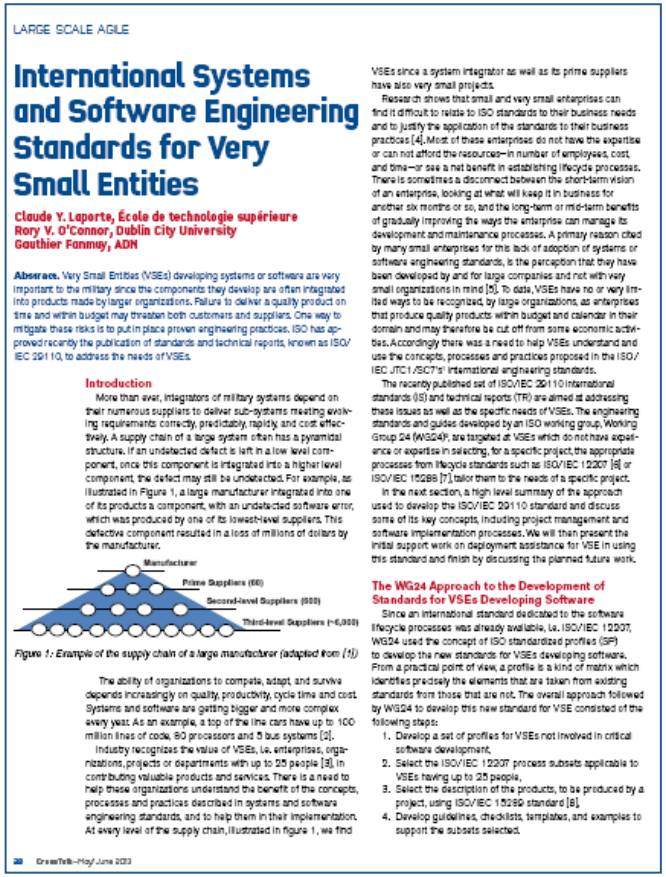
Communications

- **Conferences, Symposium and Workshops**
  - Brazil, Canada, Colombia, United States, France, India, Italy, Mexico, Peru, Thailand,
  - EuroSPI, PROFES, SPICE, SEI (Pittsburgh, Austin, Guadalajara), INCOSE Symposium (Amsterdam, Rome), INCOSE International Workshops (Arizona, Florida),
  - Project Management Institute (PMI), ITSMF, SPIN.
- **Wikipedia**
  - English: http://en.wikipedia.org/wiki/ISO_29110
  - French : http://fr.wikipedia.org/wiki/ISO_29110
  - Spanish: http://es.wikipedia.org/wiki/ISO_29110
  - Portuguese: http://pt.wikipedia.org/wiki/ISO_29110
  - Czech: http://cs.wikipedia.org/wiki/ISO_29110

Communications

- **CrossTalk - US Department of Defense Journal of Software Engineering** (free)
  - May/June 2013 Issue
  - About 325,000 readers





LARGE SCALE AGILE

International Systems and Software Engineering Standards for Very Small Entities

Claude Y. Laporte, École de technologie supérieure
Rory V. O'Connor, Dublin City University
Gauthier Fanmuy, ADN

Abstract. Very Small Entities (VSEs) developing systems or software are very important to the military since the components they develop are often integrated into products made by larger organizations. Failure to deliver a quality product on time and within budget may threaten both customers and suppliers. One way to mitigate these risks is to put in place proven engineering practices. ISO has approved recently the publication of standards and technical reports, known as ISO/IEC 29110, to address the needs of VSEs.

Introduction

More than ever, integrators of military systems depend on their numerous suppliers to deliver sub-systems meeting evolving requirements correctly, predictably, rapidly, and cost effectively. A supply chain of a large system often has a pyramidal structure. If an undetected defect is left in a low level component, once this component is integrated into a higher level component, the defect may still be undetected. For example, as illustrated in Figure 1, a large manufacturer integrated into one of its products a component, with an undetected software error, which was produced by one of its lowest-level suppliers. This defective component resulted in a loss of millions of dollars by the manufacturer.

Figure 1: Example of the supply chain of a large manufacturer (adapted from [1])

The ability of organizations to compete, adapt, and survive depends increasingly on quality, productivity, cycle time and cost. Systems and software are getting bigger and more complex every year. As an example, a top of the line cars have up to 100 million lines of code, 80 processors and 5 bus systems [2].

Industry recognizes the value of VSEs, i.e. enterprises, organizations, projects or departments with up to 25 people [3], in contributing valuable products and services. There is a need to help these organizations understand the benefit of the concepts, processes and practices described in systems and software engineering standards, and to help them in their implementation. At every level of the supply chain, illustrated in figure 1, we find VSEs since a system integrator as well as its prime suppliers have also very small projects.

Research shows that small and very small enterprises can find it difficult to relate to ISO standards to their business needs and to justify the application of the standards to their business practices [4]. Most of these enterprises do not have the expertise or can not afford the resources–in number of employees, cost, and time–or see a net benefit in establishing lifecycle processes. There is sometimes a disconnect between the short-term vision of an enterprise, looking at what will keep it in business for another six months or so, and the long-term or mid-term benefits of gradually improving the ways the enterprise can manage its development and maintenance processes. A primary reason cited by many small enterprises for this lack of adoption of systems or software engineering standards, is the perception that they have been developed by and for large companies and not with very small organizations in mind [5]. To date, VSEs have no or very limited ways to be recognized, by large organizations, as enterprises that produce quality products within budget and calendar in their domain and may therefore be cut off from some economic activities. Accordingly there was a need to help VSEs understand and use the concepts, processes and practices proposed in the ISO/IEC JTC1/SC7's' international engineering standards.

The recently published set of ISO/IEC 29110 international standards (IS) and technical reports (TR) are aimed at addressing these issues as well as the specific needs of VSEs. The engineering standards and guides developed by an ISO working group, Working Group 24 (WG24)', are targeted at VSEs which do not have experience or expertise in selecting, for a specific project, the appropriate processes from lifecycle standards such as ISO/IEC 12207 [6] or ISO/IEC 15288 [7], tailor them to the needs of a specific project.

In the next section, a high level summary of the approach used to develop the ISO/IEC 29110 standard and discuss some of its key concepts, including project management and software implementation processes. We will then present the initial support work on deployment assistance for VSE in using this standard and finish by discussing the planned future work.

The WG24 Approach to the Development of Standards for VSEs Developing Software

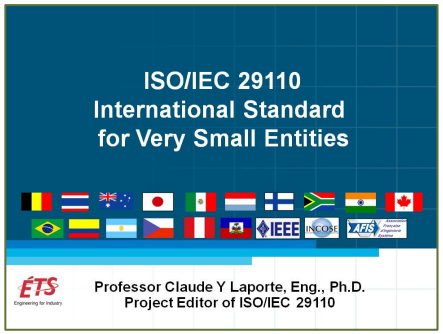
Since an international standard dedicated to the software lifecycle processes was already available, i.e. ISO/IEC 12207, WG24 used the concept of ISO standardized profiles (SP) to develop the new standards for VSEs developing software. From a practical point of view, a profile is a kind of matrix which identifies precisely the elements that are taken from existing standards from those that are not. The overall approach followed by WG24 to develop this new standard for VSE consisted of the following steps:

1. Develop a set of profiles for VSEs not involved in critical software development,
2. Select the ISO/IEC 12207 process subsets applicable to VSEs having up to 25 people,
3. Select the description of the products, to be produced by a project, using ISO/IEC 15289 standard [8],
4. Develop guidelines, checklists, templates, and examples to support the subsets selected.

http://www.crosstalkonline.org/

Videos about ISO/IEC 29110

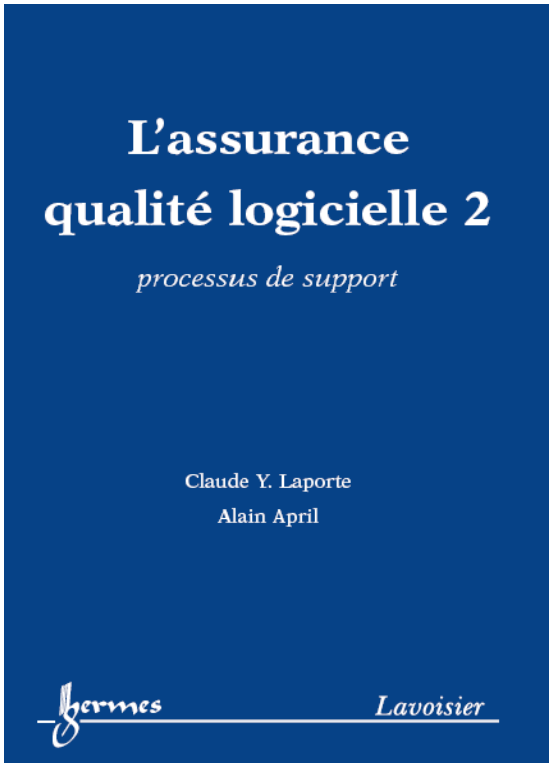
- **Planet ISO (On YouTube)**
  - http://www.youtube.com/user/PlanetISO
  - Video in **Spanish** (Portuguese subtitles)
    - http://www.youtube.com/watch?v=HiFRhNSIPq8
    - Video in **English**
    - http://www.youtube.com/watch?v=viP7WLaFC8E
  - Video in **French**
    - http://www.youtube.com/watch?v=w8wCIyDqYLI&feature=g-upl



Software Quality Assurance Textbooks

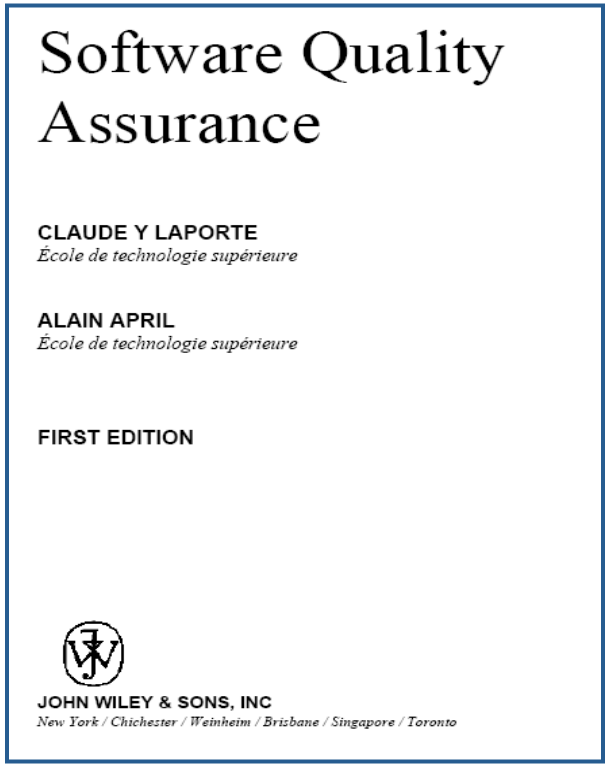
In French (Published in 2011)

400 pages



386 pages

In English (2014)



ISO 29110 is presented in many chapters of the Textbooks

Engineering Company - 1

- Canadian division of over 500 employees spread over 10 offices
- Offers a range of services in the production of hydro-electric, wind, geothermal, solar or biomass-related energy
- Company established 10 years ago

Business Objectives Targeted by the Improvement Project	
Identification Number	**Description**
O-1	Facilitate the integration of new project managers
O-2	Reach an overall customer satisfaction level 80%
O-3	On average projects should reach cost and schedule targets within 5%
O-4	Reduce overload of staff by 10%
O-5	Reduce schedule slippage to less than one week and 5% of initial cost for mismanaged risks of projects
O-6	Reduce rework by 10 %
O-7	Reduce non billable hours by 10%

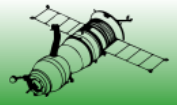
(Laporte and col. 2013)

Engineering Company - 2

- Engineering projects were divided in 3 categories

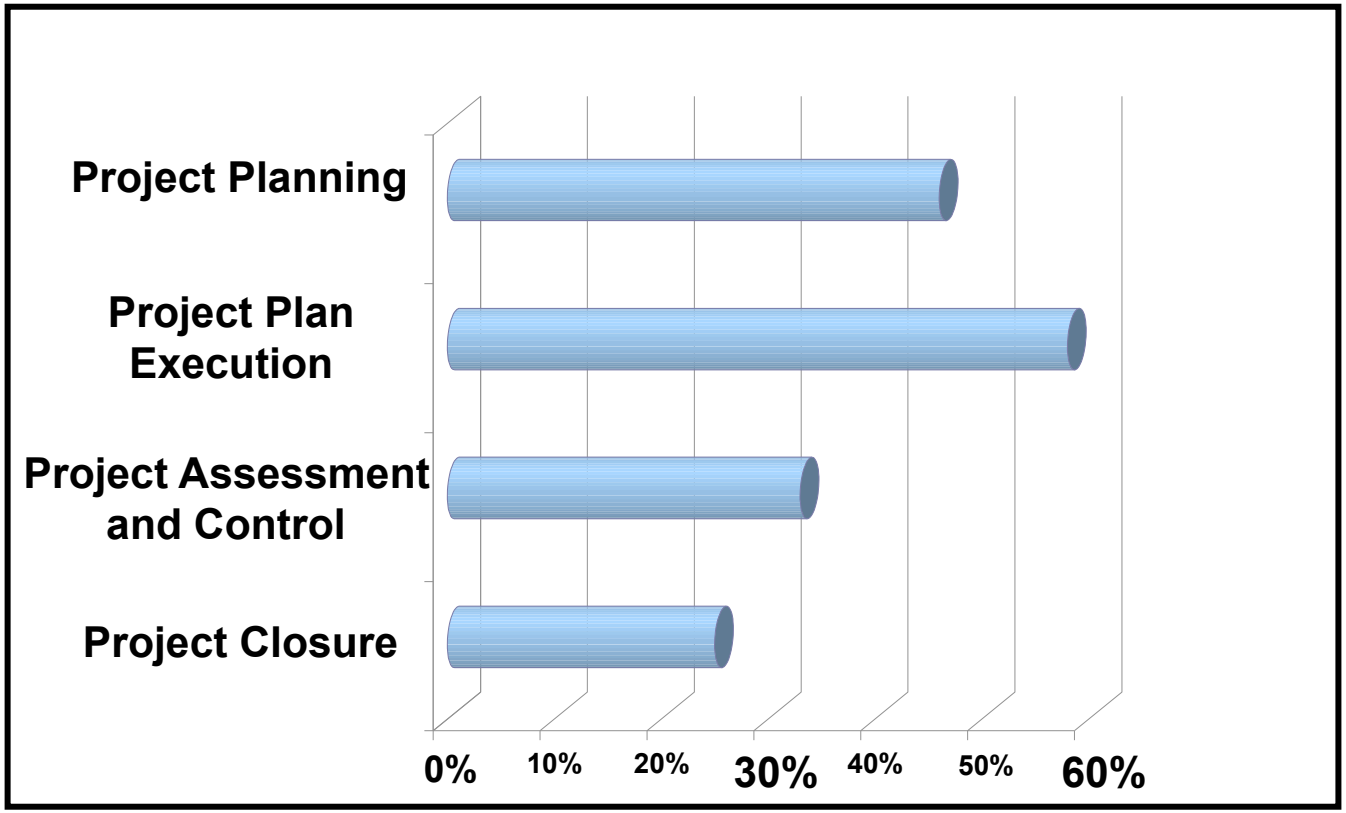
	Small Project	Medium project	Large project
Duration of Project			
Size of Team			
Number of Eng. Specialties Involved			
Engineering Fees			

(Laporte and col. 2013)


Engineering Company - 3

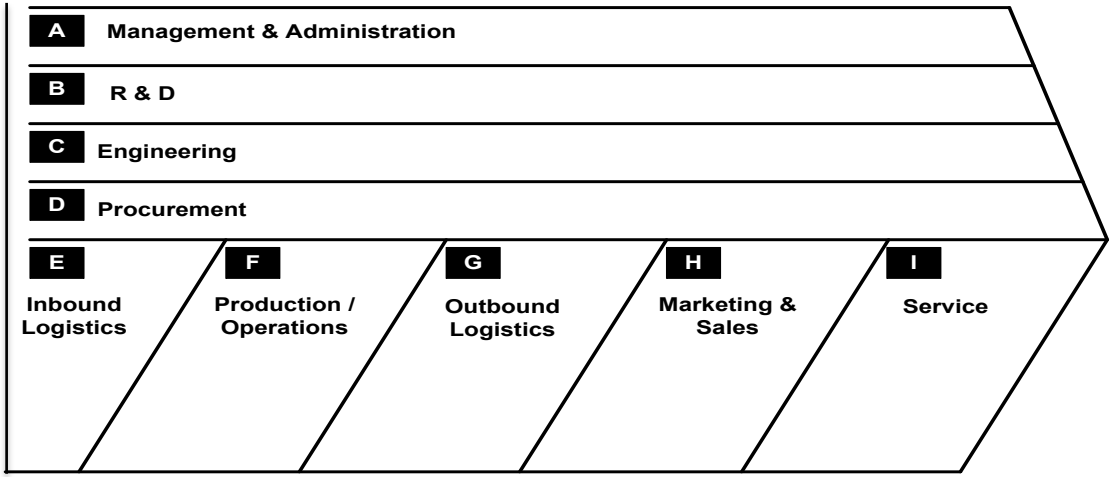
- Project Management process for medium projects was initially evaluated against Basic Profile of ISO 29110



(Laporte and col. 2013)

Engineering Company - 4

- Cost/Benefit analysis using the ISO method to evaluate the *Economic Benefits of Standards*
- Value chain



- Costs and Benefits

	Year 1	Year 2	Year 3	Total
Cost to Implement and Maintain	59 600$	50 100$	50 100$	159 800$

(Laporte and col. 2013)

Engineering Company - 5

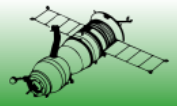
- **ISO Focus+ of February 2013 (freely available)**
  - **Application of ISO/IEC 29110 in Project Management**
  - Translated in French, English, Spanish and German

http://www.iso.org/iso/home/news_index/iso_magazines/isofocusplus_index.htm

(Laporte and col. 2013)

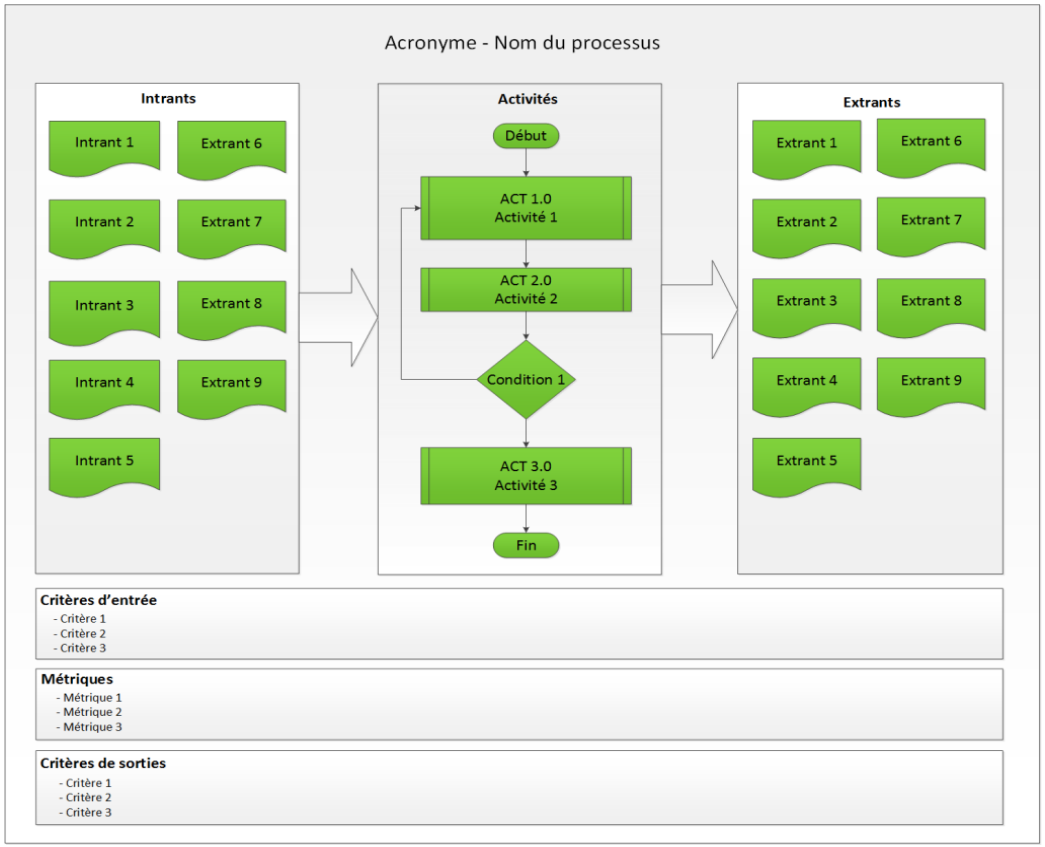
Start-up in Transportation

- Public transportation customers often require a CMMI® maturity level for system and sub-system suppliers.
- In 2012, the VSE was composed of 4 people (7 presently).
  - Implementing the CMMI® Level 2 Process Areas was too demanding at that time.
- Strategy
  - Implement the draft version of Systems Engineering ISO/IEC 29110 Basic profile as a foundation
    - Used other frameworks to complete process descriptions
      - e.g. INCOSE Handbook, PMBOK Guide of PMI and CMMI
  - Perform a gap analysis between CMMI level 2 and the SE Basic Profile
  - Implement the practices needed for a CMMI level 2 assessment.

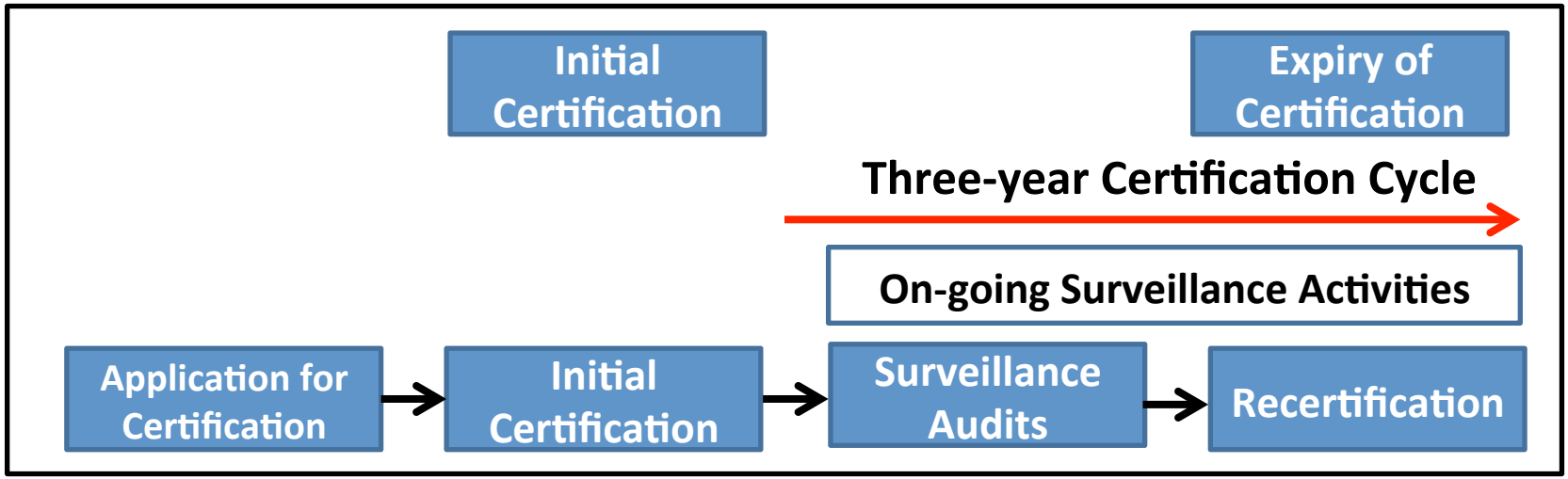

Start-up in Transportation

- Graphical process description using simple Input/ Task/ Output notation complemented with Entry/Exit criteria and Measures.



ISO/IEC 29110 Certification

- Based on ISO Standards on Conformity Assessment
  - e.g. ISO/IEC 17065 – Requirements for bodies certifying products, processes and services
- Four-Stage Certification Process



Next Steps for ISO and INCOSE WGs

- **Finalize the SE Entry Profile**
  - Should be published in 2015
  - Develop Deployment Packages (2)
- **Finalize the SE Profile Specifications Document**
  - Should be published in 2015
  - Once published, VSEs could be formally audited
- **Develop the SE Intermediate and Advanced Profiles**
  - Should start development in 2015
  - Develop Deployment Packages
- **Conduct pilot projects and document case studies**

Conclusion

- ISO 29110 has been specifically developed for VSEs (company, organization, project, department) developing systems and/or software,
- ISO 29110 is intended to help VSEs who have neither the expertise, nor the budget or the time to adapt existing standards (e.g. ISO 15288) to their needs,
- ISO and INCOSE WGs have worked together to develop a set of DPs to help VSEs in implementing and using ISO 29110,
- ISO 29110 is expected to bring many benefits to VSEs, their clients and their business partners,
- Other profiles (Intermediate and Advanced) and their DPs will start to be developed in 2015.

감사합니다 Natick

Grazie Danke Ευχαριστίες Dalu Obrigado

Thank You Köszönöm

Tack

Спасибо Dank Gracias

谢谢 Merci Seé

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- **Public site of WG 24**
  - **Free access to Deployment Packages, presentation material and articles:**
    - **http://profs.logti.etsmtl.ca/claporte/English/VSE/index.html**