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Developing and implementing Systems Engineering and Project Management processes in a small public transportation company

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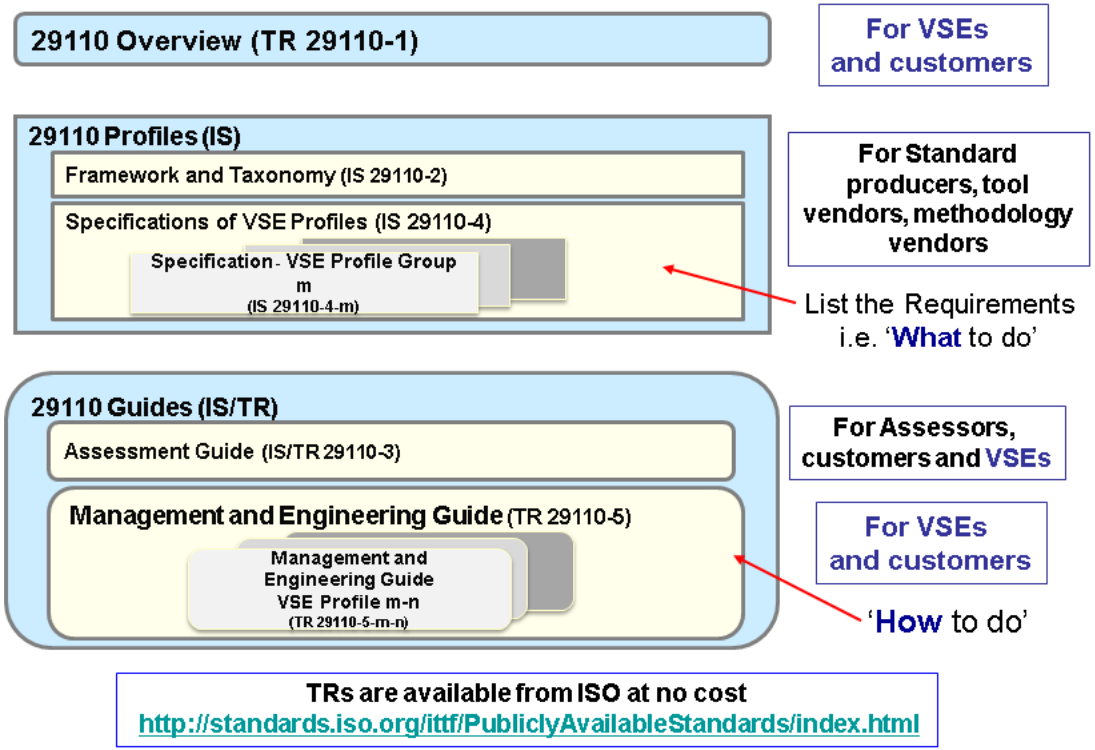
Outline

- ISO/IEC 29110 Standards and Guides for VSEs
- CSiT Business Objectives
- Adoption and implementation of ISO/IEC 29110 for SE
- Overview of CSiT processes
- 3rd Party VSE Process Audit
- Next steps for CSiT
- Recommendations to VSEs

Very Small Entity (VSE)

Enterprise, organization, project or department of up to 25 people

ISO/IEC 29110 for VSEs



Generic* Profile Group

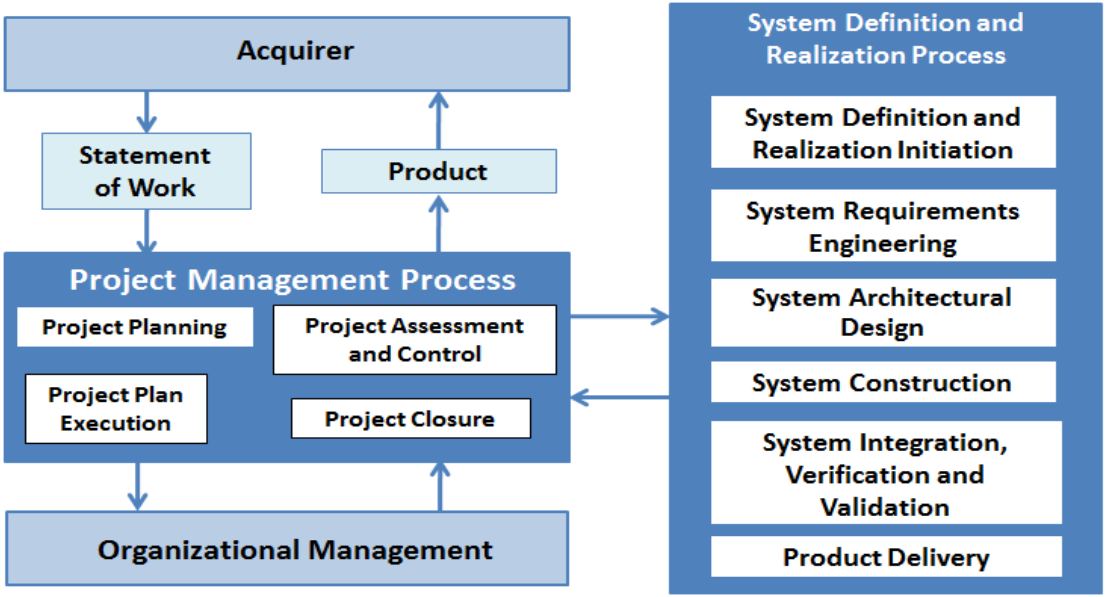
Pre-tailored sets of Objectives/Activities/Artefacts

- **Entry Profile** – 6 person-month projects or start-ups
- **Basic Profile** – one project at a time
- **Intermediate Profile** – multiple projects, multiple teams
- **Advanced Profile** – sustain and grow as independent competitive system development business

Available Now | Planned for 2017

* Generic = non-safety/security critical systems

SE - Basic Profile



The Organization

- CSiT is a Canadian company
- Established in 2011 in Montréal
- Provides multi-modal Integrated Communications Systems and Information Integration for Transit Systems
- http://csit.co

The Context

- Public transportation customers often require a CMMI® maturity level from suppliers
  - e.g. CMMI-DEV Level 2
- In 2012, **CSiT** had staff of 4 people
  - Implementing full CMMI® Level 2 Capability was much too demanding
- In 2016, staff has grown to 10 people

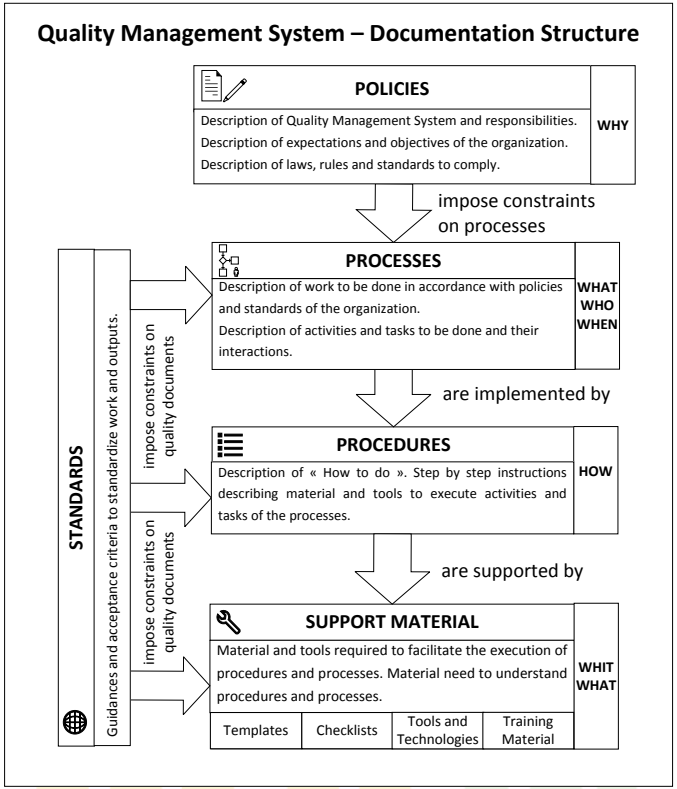
The Strategy

- Implement draft version of Systems Engineering ISO/IEC 29110 Basic Profile
  - Establish a process foundation
  - Other frameworks to complete process descriptions
    - INCOSE SE Handbook
    - PMBOK® Guide (PMI)
    - CMMI-DEV®
- Perform gap analysis between CMMI® Maturity Level 2 and ISO/IEC 29110 SE Basic Profile
- Implement practices needed for CMMI-DEV® Maturity Level 2 Process Areas.

The Guidelines

- Avoid additional processes and too many documents:
  - Process guideline
    - Add task, not described in Basic Profile, only if it adds value to the context and projects of the company or provides an alignment with CMMI® level 2
  - Documentation guidelines
    - Group documents into a single one whenever possible
    - Each section of a template must be relevant and applicable
      - If a section does not provide added value, remove it

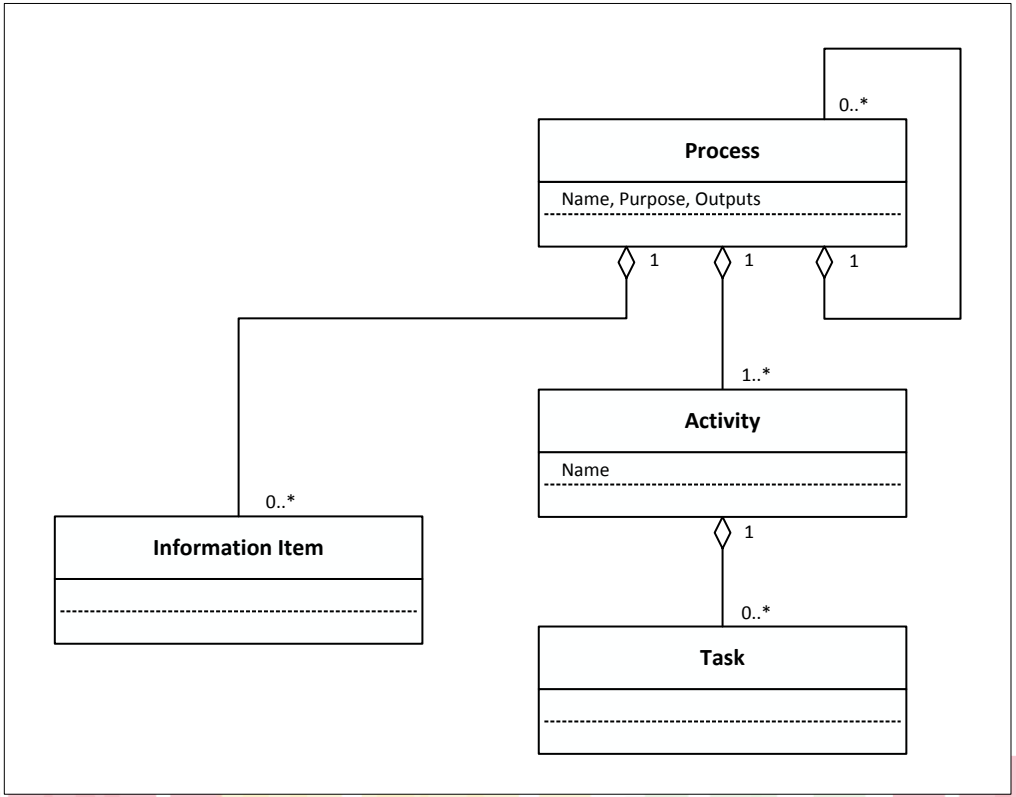
Documentation Structure



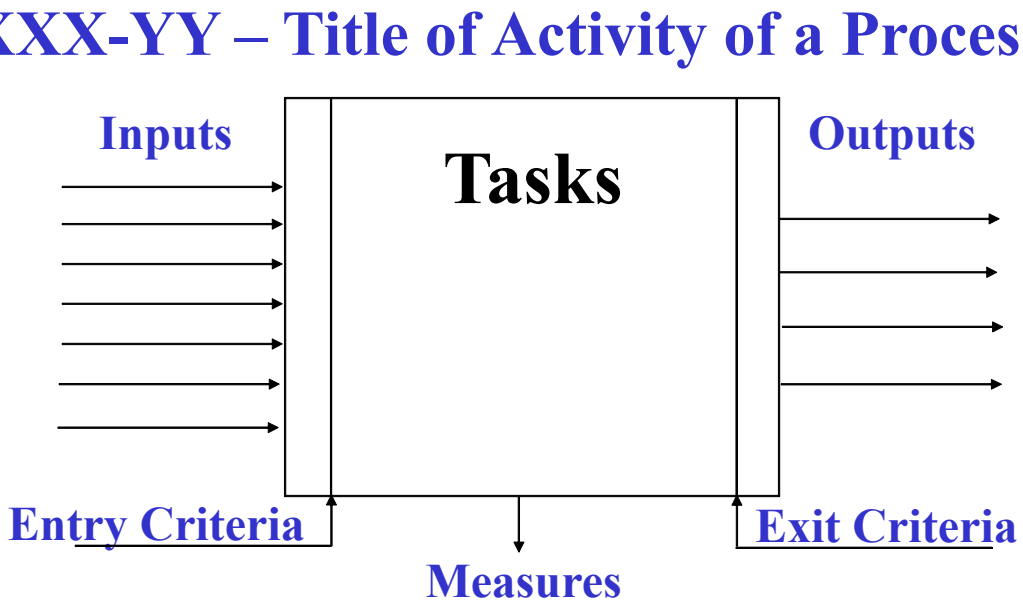
Process Classification

	Light Process	Standard Process	Full Process
Type of Project	Proof of Concept, Prototype Concept validation or Product Deployment at Customer Site **Small** Project	Typical Project Product intended to be installed at Customer Site **Medium** Project	Project when CMMI level 2 is required by a Customer Product Testing or Product Deployment at Customer Site **Large** Project
Framework to be used	ISO/IEC TR 29110-5-6-1 **Entry** Profile + CMMI - Supplier Agreement Management	ISO/IEC TR 29110-5-6-2 **Basic** Profile + CMMI - Supplier Agreement Management	**CMMI** (Level 2)

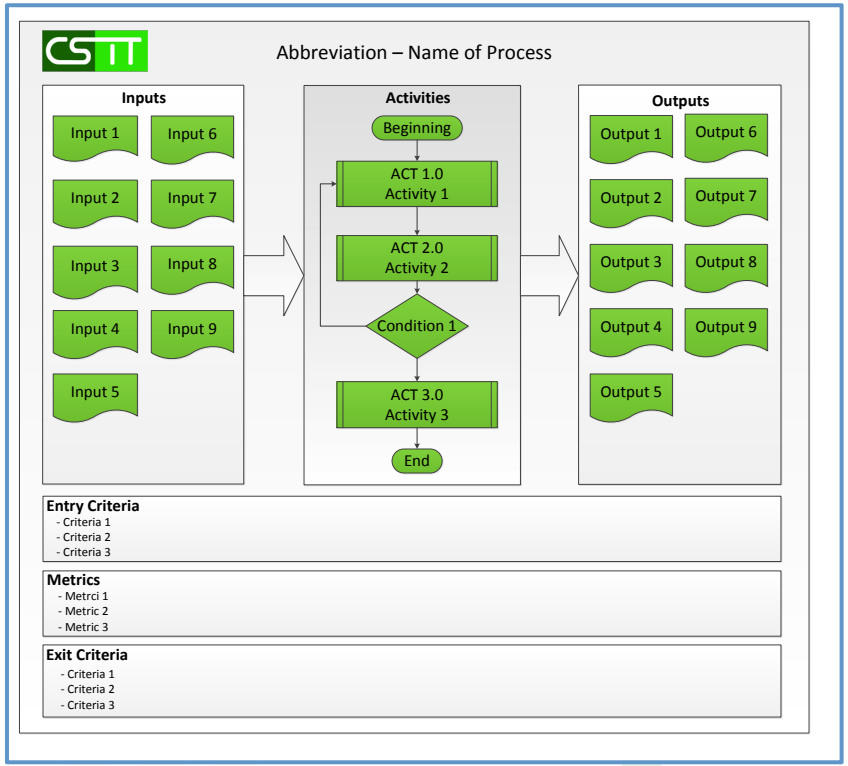
Process Architecture



Process Documentation



Graphical Depiction



Textual Depiction

Name of Activity	
Objective:	
Rationale:	
Roles:	
Entry Criteria	•
	•
Inputs	
Outputs	
Exit Criteria	•
	•
Metrics	
Tasks	1. Task 1
	2. Task 2
	3. Task 3
	4. Task 4

Work Product Acceptance

- Work Product Peer Review type selection
  - For internal work product and deliverables
- Four types of reviews are used
  - Personal Review, Desk-Check, Walkthrough, Inspection

	VERIFICATION					VALIDATION		ACCEPTANCE AND SIGNATUR		
Delivrables and Internal Work Products	Peer Review			Tests		Tests		Acceptance		
Description	Peer Review ? (Y=Yes, N=No)	Type of Review (P=Personnal, D=Desk-Check, W=Walkthrough, I=Inspection)	Output Documents ANN = Annotations RR = Review Report MoM = Minutes of Meeting CHKL = Checklist	Type of Test U = Unit I = Integration S = System	Output Document UTR = Unit Test Report ITR = Integration Test Report STR = System Test Report	Type of Test F = Factory S = On Site	Output Document FTR = Factory Test Report STR = Site Test Report	Internal Approval (signature) (Y=Yes, N=No)	Delivered to Customer? (Y=Yes, N=No	Acceptance requir form Customer? (Y=Yes, N=No)
Technical – System Requirement Specification	Y	D, W	RR then MoM	N/A	N/A	N/A	N/A	Y	Y	O

Measures

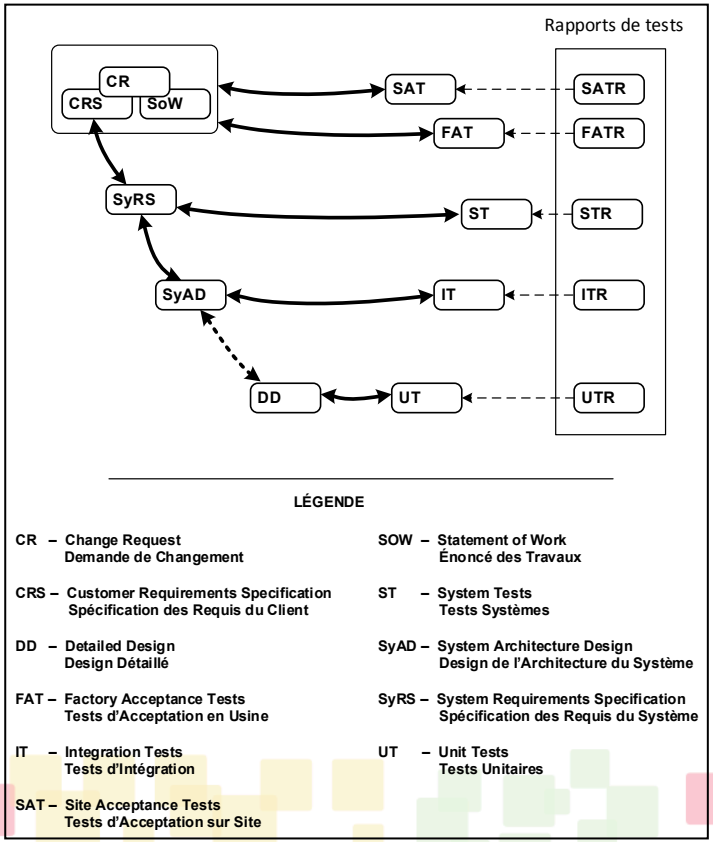
- "Goal - Question – Metric" Approach

Goal	Question	Metric
Improve the level of quality of a product	What the level of quality?	Number of defects per requirement
		Number of defects per development phase
		Effort (hours) to implement, monitor, prevent and correct defects of a product
Reduce delivery time	What is the progress of the projects?	Earned Value (CPI, SPI)
	What is the level of workload of employee	Workload per employee as a percentage
Optimize the development time	What is the number of hours of each phase of development?	Number of hours worked per development phase

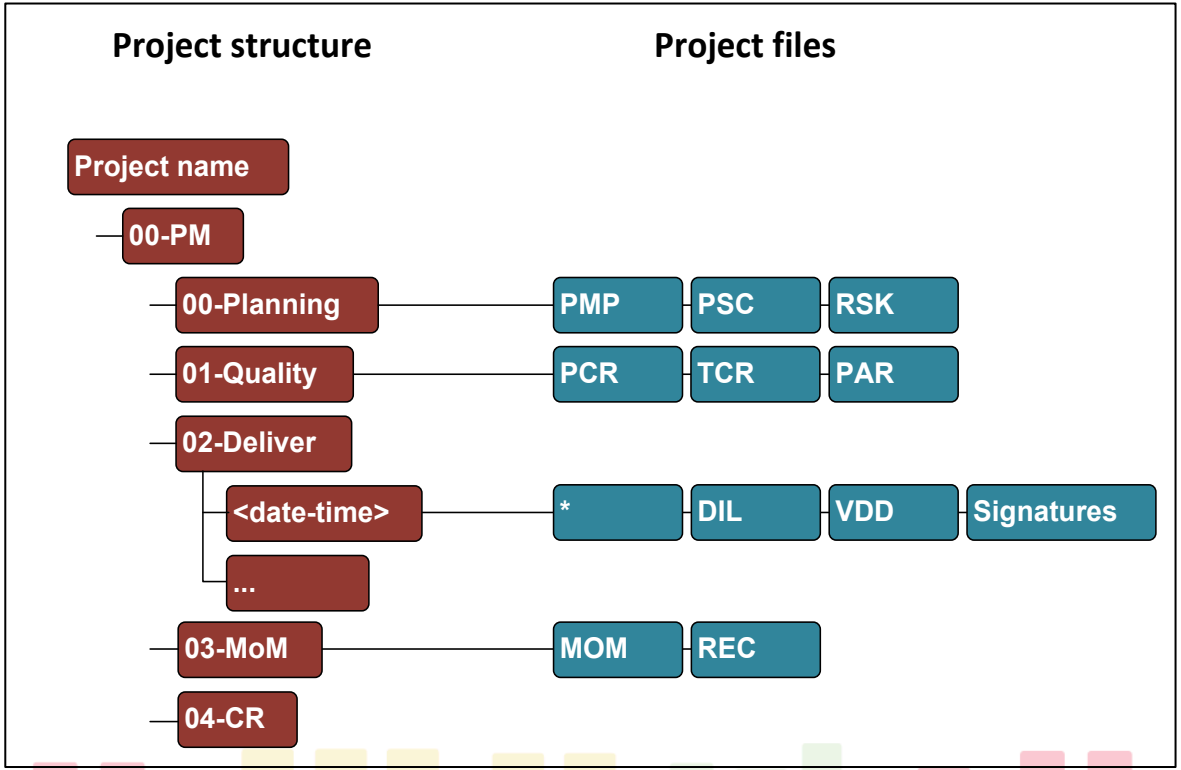
Measures Examples

Measure ID	Measures	Reasons
MET-01	Number of errors detected by document type and by phase of the development cycle	To know the overall quality of each work product
MET-02	Number of hours worked for each phase of the system development cycle	To be able to use the performance of past projects to estimate new projects
MET-03	The cost of each project	
MET-04	The attributes of each project: • Number of change requests; • Level of risk; • Predominance hardware/software.	
MET-05	Distribution of effort related to the production, review and correction of deliverables	To be able to analyze the efficiency of processes on product quality
MET-06	Resources spent versus those that were planned in the project plan	To be able to analyze if the project is successful, to identify gaps and take the necessary remedial action

Work Product Relations



Documentation Structure



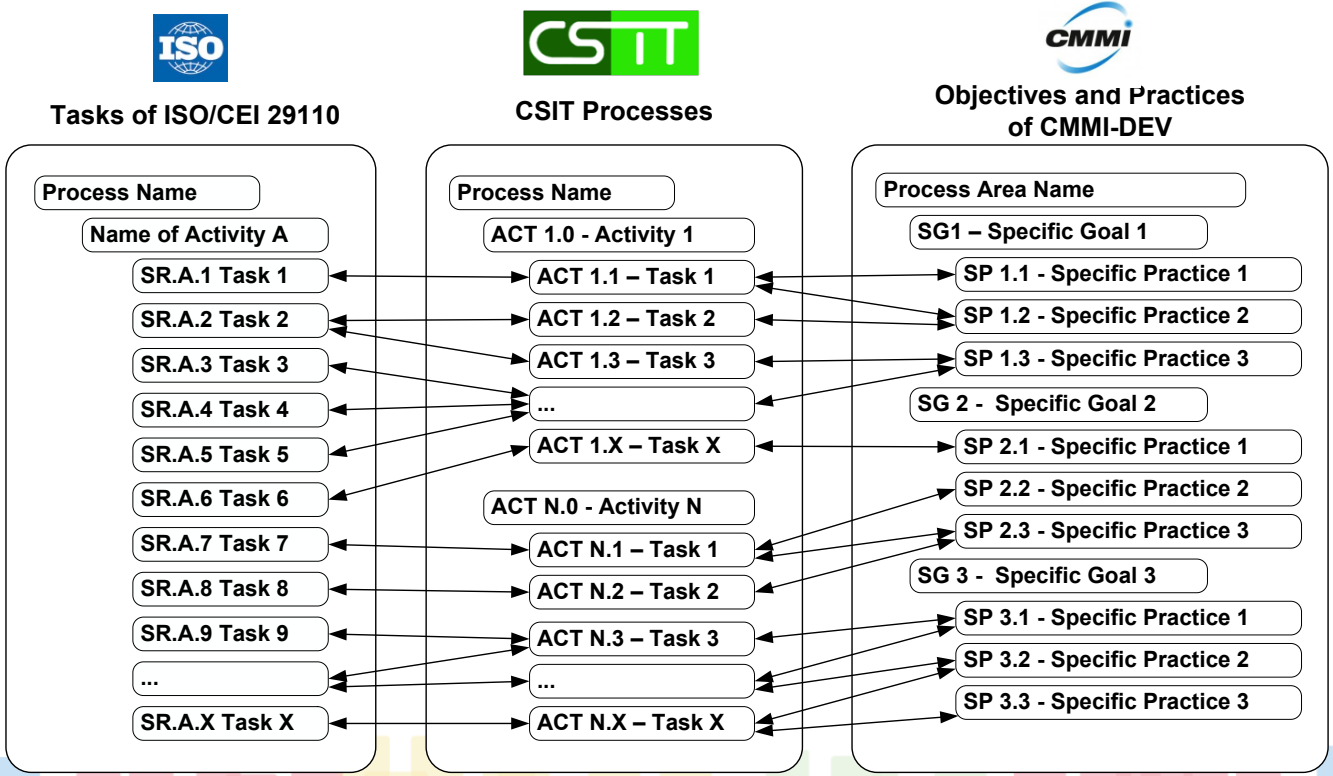
Supplier Management

- ISO/IEC 29110 Basic Profile does not describe a Supplier Management process
  - This process to be covered in Intermediate profile
- CSiT mostly integrates COTS hardware components, so Supplier Management is key
- The process put in place contains a detailed description about planning and managing acquisitions from suppliers
- The CMMI® for Development, ISO 15288, the INCOSE SE Handbook and the PMBOK® Guide used to define

Supplier Management

- Additional templates were created
  - Request For Proposal
  - Supplier Selection Matrix
  - Purchase Order
  - Purchase Agreement
- New sections added to Project Plan Work Product
  - List of acquisitions and potential suppliers
  - Acquisition plan/strategy
  - Supplier management plan

Framework Cross-Mapping



ISO/IEC 29110 3rd Party Audit

- Audit requested by CSiT to obtain Letter of Conformity with ISO/IEC 29110 Systems Engineering Basic Profile
- Initiation/revision and analysis of CSIT's process documentation by Auditor
- Consultation with a Systems Engineering technical expert
- Written agreement between the Auditor and CSiT outlines:
  - Scope of audit
  - Official contacts
  - Costs
  - Planned dates for filing the documents and the audit itself
  - Wording of some elements of the Letter of compliance, if applicable, etc.
- Confidentiality Agreement is signed by the auditor
- Review of the documentation submitted to the auditor by CSiT

3rd Party Audit (cont'd)

- If documentation is complete and satisfactory, on-site audit performed to review work product objective evidence (duration approximately 8 hours)
- Auditor produces Audit Report with findings and recommendations
- Report submitted to Review Committee for verification
- Review committee examines the documents produced by the auditor
- Issuance of a letter, by the organization that manages the compliance program attesting the conformity based on ISO/IEC 29110 documents audited
  - Letter of compliance subject to period of validity (typically one year)
  - Letter of compliance is typically valid for a period of 12 months

3rd Party Audit (final)

- The VSE may request another audit cycle if corrections required
  - The application is abbreviated as background information about the VSE has already been documented
- CSiT Audit conducted successfully in April/May 2016

Next Steps

- Complete detailed description of all processes
- Ongoing
  - Adjust processes based on the feedback and lessons learned gathered from completed projects
  - Adapt processes and templates to better match different types of project
- Add necessary practices to achieve CMMI-DEV Maturity Level 2 in due time

Recommendations to VSEs

- Define vision and objectives of improvement project
- Choose a framework that meets the needs of the VSE
- Adapt the framework to the context of the VSE
- Do not seek a perfect definition of the first version of the processes, group/aggregate documents as required
- Define objectives of measures/indicators
- Develop and use Checklists
- Conduct a Pilot Project

Day-to-Day Benefits

- Standardized work and consistent deliverables across projects
- Avoids reinventing the wheel for each project
- Work is done in a systematic and disciplined way
- Better quality of deliverables and products
- Better project management and project monitoring
- Reduction of project risks
- Better communication within the team because the semantic of communication is standardized

Business Benefits

- Better credibility to bid on tenders
- Access to markets that require certification of a quality system in line with the business practices of the company
- Better recognition of the quality of work done and products developed.
- Better trust from customers and business partners
- An important step towards CMMI-DEV maturity
  - A CMMI level is a requirement of some customers

Summary

- ISO/IEC 29110 for SE easy to understand and implement
- A young engineering firm can apply proven engineering practices from ‘Big League’ standards (e.g. ISO 15288)
- ISO/IEC 29110 is a solid foundation for CMMI level 2 and level 3 practices
- CSiT has rapidly grown in maturity while preserving its agility
- SE VSEs should consider the adoption of ISO/IEC 29110


감사합니다
Natick
Grazie
Danke
Ευχαριστίες
Dalu
Obrigado
Thank You
Köszönöm
Tack
Спасибо
Dank
Gracias
谢谢
Merci
Seé
ありがとう

Back up

Enterprises around the World

- Micro enterprises (up to 9 employees) account for 70% to 90% of enterprises in OECD* countries

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

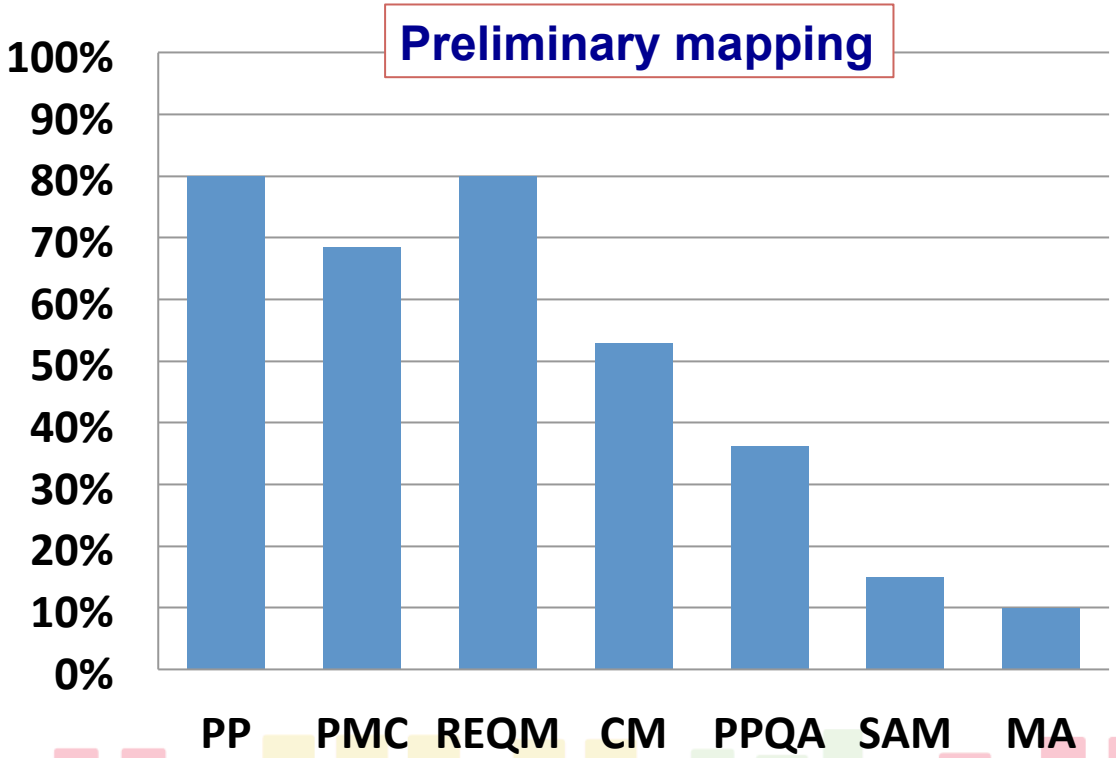
* Independent companies only, excluding legally independent companies that are part of large enterprises.

* OECD: Organisation for Economic Co-operation and Development
** Statistics About Business Size (including Small Business). US Census Bureau (www.census.gov/econ/smallbus.html)
*** Moll, R., Being prepared – A bird's eye view of SMEs and risk management, ISO Focus +, February 2013

Motivations of CSiT

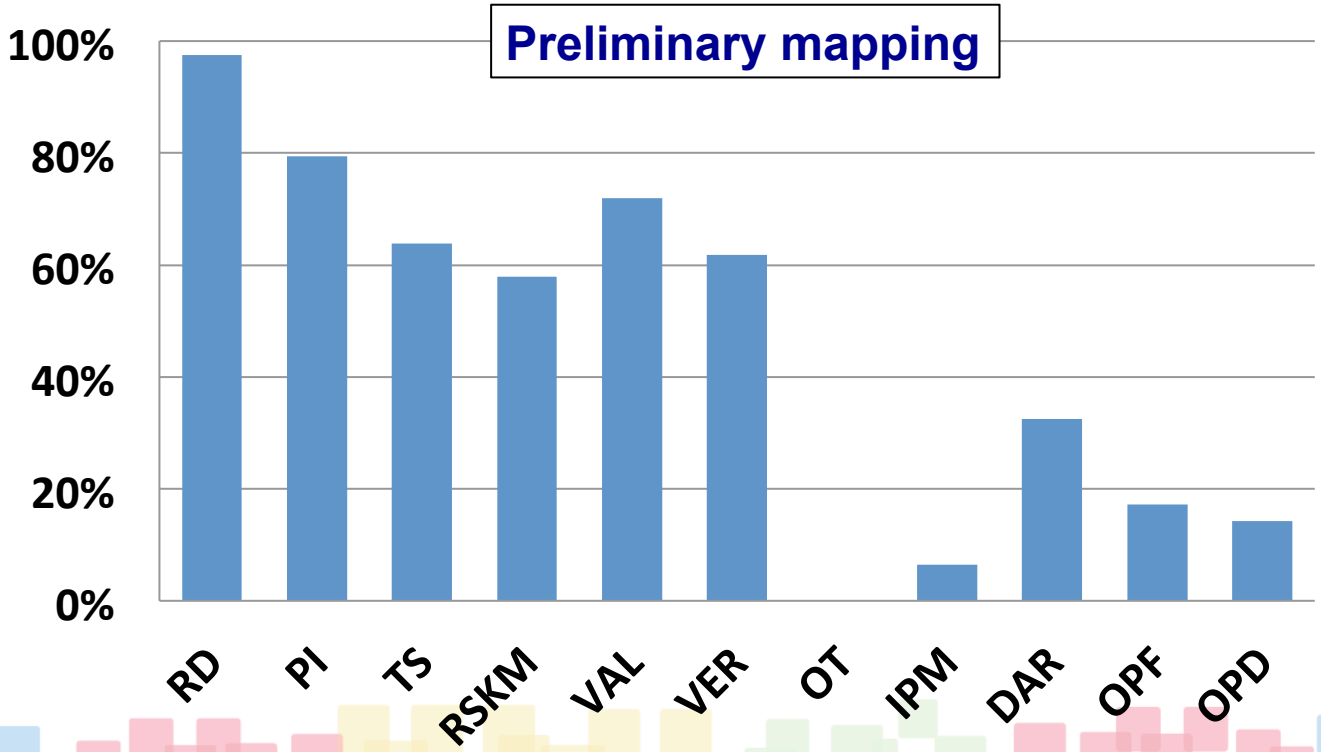
- A first step towards the implementation of level 2 practices of the CMMI®;
- Systematic work, disciplined and quantifiable, typical of engineering environments;
- Greater credibility to bid on tenders;
- Increased trust from clients;
- More rigorous, better quality of developed products;
- More uniform work products and deliverables;
- Reduction of long-term production costs;
- Improved efficiency and business productivity;
- Not reinventing the wheel of each project;
- Formalization of the management of contracts and agreements with suppliers;
- Increasing competitiveness;
- Reduction of risks.

Coverage of CMMI-Dev Level 2 Specific Practices by ISO 29110 – Systems Engineering - Basic Profile



Personal communication (N. Tremblay 2015)

Coverage of CMMI-Dev Level 3 Specific Practices by ISO 29110 – Systems Engineering - Basic Profile



Personal communication (N. Tremblay 2015)

ISO 29110 Project Management Process and System Definition and Realization Process