Engineering for Industry
Department of Software and IT Engineering

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An Innovative Approach to the Development of Project Management Processes for Small-Scale Projects in a Large Engineering Company

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Presented by Claude Y Laporte
Project Editor of ISO/IEC 29110
July 15th 2015

TETRA TECH

Content

- Importance of Very Small Entities (VSEs)*
- ISO/IEC 29110 Standards for VSEs
- Application of ISO/IEC 29110 at a Canadian division of **TETRA TECH**
- Next Steps

* **VSEs** = **V**ery **S**mall **E**ntities are enterprises, organizations, projects or departments having up to 25 people.

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)

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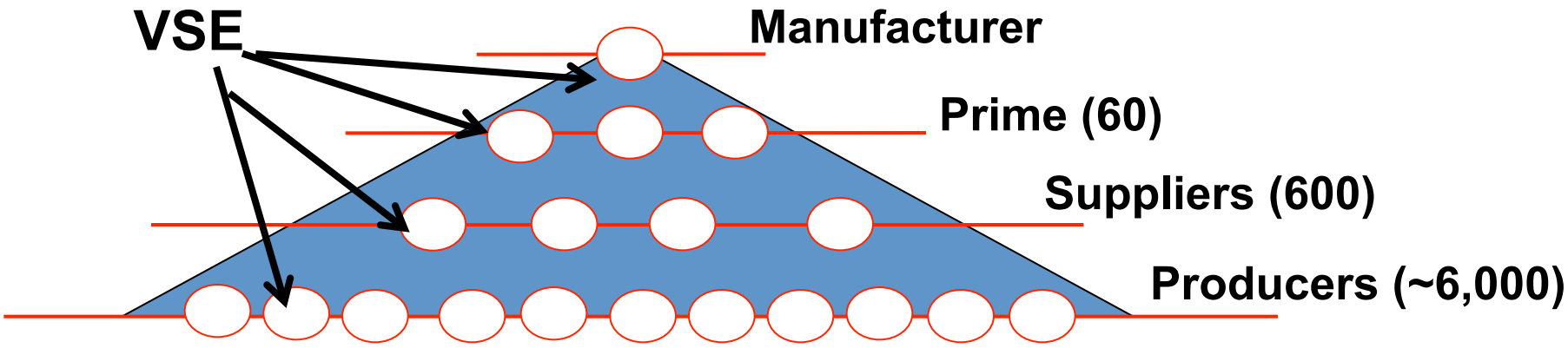
The Importance of VSEs



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

There are VSEs in most organizations

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

ISO Working Group 24

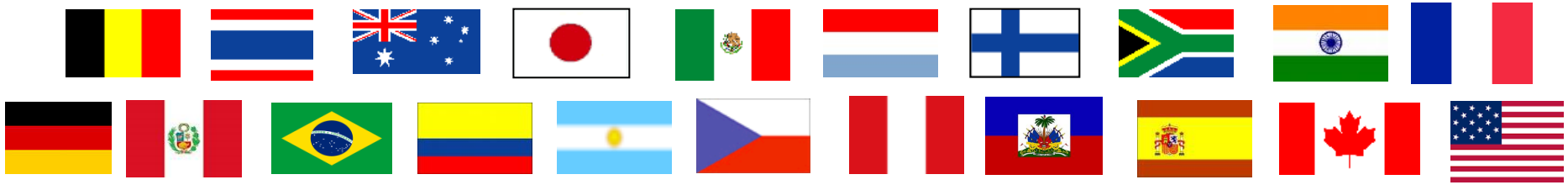
ISO JTC1 IEC
INFORMATION TECHNOLOGY STANDARDS

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 | AFIS Association Française d'Ingénierie Système | IEEE

Participation of INCOSE to WG 24 since 2005

Requests from VSEs from the Survey conducted by WG24

- **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.
- **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

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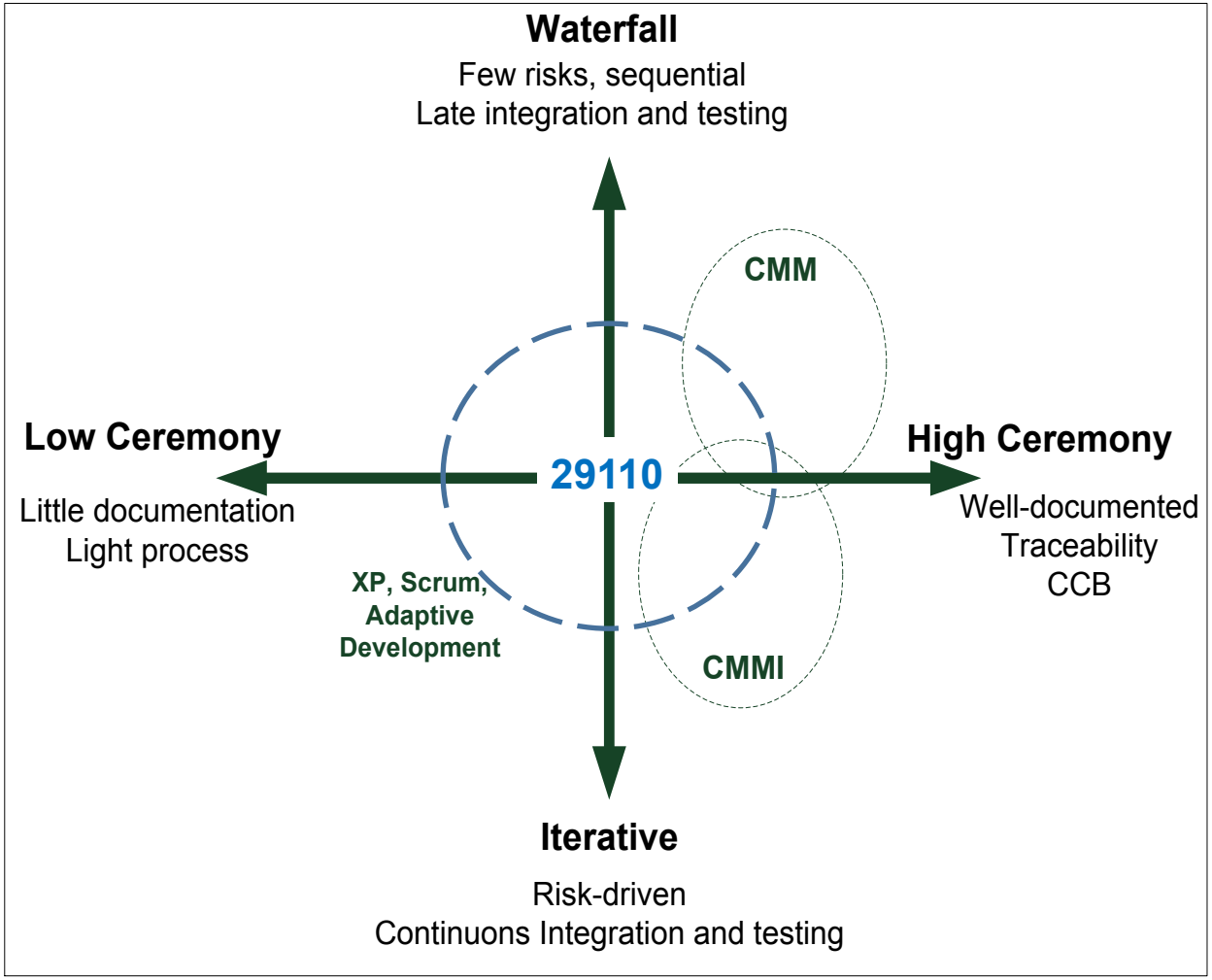
Strategy of WG 24

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 15288/12207, 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.

Wide Spectrum of Development Approaches



Adapted from (Kroll & Kruchten 2003)

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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 with more than one team;
- **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

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'

TRs available from ISO at no cost

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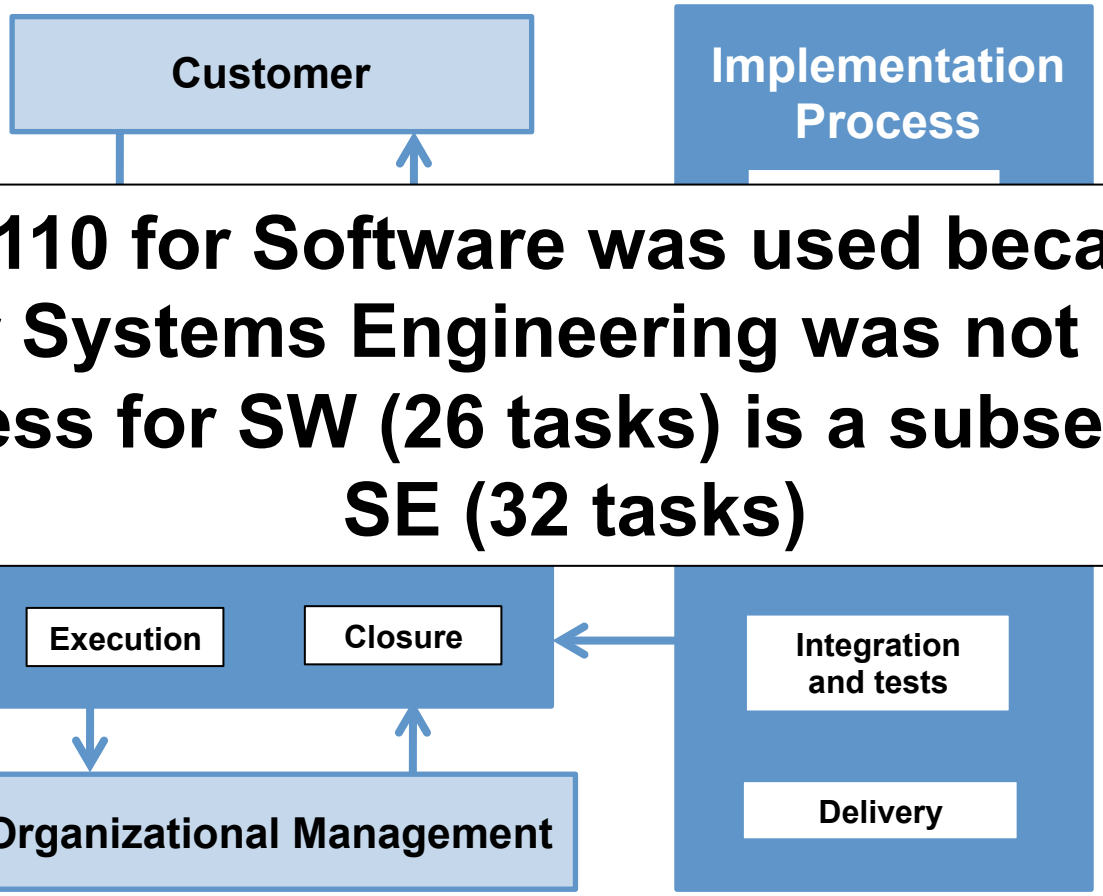
Management and Engineering Guide for Software Engineering



ISO 29110 for Software was used because ISO 29110 for Systems Engineering was not published. PM process for SW (26 tasks) is a subset of PM for SE (32 tasks)

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

One Task of the Requirement Analysis Activity

Role	Task	Input Product	Output Products
CUS AN	**SI.2.4** Validate and obtain approval of the *Requirements Specification* Validate that *Requirements Specification* satisfies needs and agreed upon expectations, including the user interface usability. The results found are documented in a *Validation Results* and corrections are made until the document is approved by the CUS.	*Requirements Specification [verified]*	*Validation Results* *Requirements Specification [validated]*

TETRA TECH

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Context

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

Business Objectives Targeted by this Improvement Project	
ID	**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%

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Problems that slow down the achievement of business objectives

Problem ID	Description
P-1	Difficulty in integrating new project managers
P-2	Lack of knowledge of existing tools
P-3	Difficulty faced by new project managers to understand the ways of doing business of the division
P-4	Projects in difficulty due to poor time management
P-5	Projects in difficulty due to poor management of resources

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Prioritization of Business Objectives

Objective ID	Objective Description	Estimated Benefits [1-10]	Estimated Cost [1-10]	Priority (Benefits/Cost)
O-1	Facilitate the integration of new project managers.	5	10	0.50
O-2	Achieve a global customer satisfaction level of 80 %.	7	4	1.75
O-3	Meet the deadlines and costs planned for the projects, within a margin of 5%.	10	10	1.0
O-4	Reduce resource overload by 10 %.	6	6	1.0
O-5	Reduce time delays to one week and cost overruns to 5 % of the initial budget.	10	7	1.43
O-6	Reduce corrective work during the quality control phase by 10 %.	8	88	1.0
O-7	Reduce non-chargeable time for resources by 10 %.	5	8	.63

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Projects were classified in 3 categories

	Small Project	Medium project	Large project
Duration of project			
Size of team			
Number of engineering specialties involved			
Engineering fees			

- A very large percentage of projects are small and medium-scale projects
- This improvement project targeted mainly small and medium scale projects

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Criteria and weights used to select a framework

1. Adapted for the management of small-scale projects (**3**)
2. Ease of integration with existing organizational processes (**3**)
3. Tools are available to facilitate the use of the framework (**2**)
4. Known to the management of the organization (**2**)
5. Recognized by the company's customers (**2**)
6. Accreditation/ Certification available (**1**)
7. Readily available (**1**)

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Justification of the scores

Frameworks	Score	Decision	Justification
CMMI® for Development	18	Not selected	• Not well known by the management and its customers. • Sponsors showed little interest in this document.
CMMI® for Services	16	Not selected	• Not well known by the management and its customers. • Sponsors showed little interest in this document.
PMBOK® Guide	31	Selected for large-scale projects	• Known document of the management and its customers. • Sponsors have expressed interest in this document. • Not specifically designed for small projects. Will be used only to complete the documentation for the large-scale projects process.
PRINCE2®	13	Not selected	• It is a repository little used in Canada. • Sponsors have little interest in this repository.
ISO/IEC 29110	29	Selected for small and medium-scale projects	• Specially designed for small projects. • Concepts of project management of this repository are in line with those described in the PMBOK Guide. • Unknown from management and its customers. • This framework will be used for the development of project management processes for small and medium scale projects.

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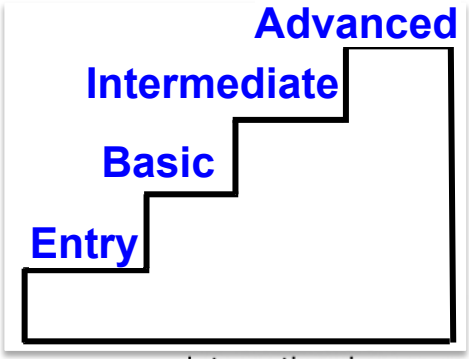
Frameworks for Small and Medium Scale Projects

	Small Project	Medium project	Large project
Duration of project	Less than 2 months	Between 2 and 8 months	More than 8 months
Size of team	Equal or less than 4 people	Between 4 and 8 people	More than 8 people
Number of engineering specialties involved	One specialty	More than one specialty	Many specialties
Engineering fees	Between 5,000$ and 70,000$	Between 50,000$ and 350,000$	Over 350,000$
Percentage of projects	**70%**	**25%**	**5%**

- Small projects used ISO 29110 Entry Profile
- Medium projects used ISO 29110 Basic Profile
- Large projects used the Guide to the PMBOK® Guide to complete the documentation of the large-scale PM process



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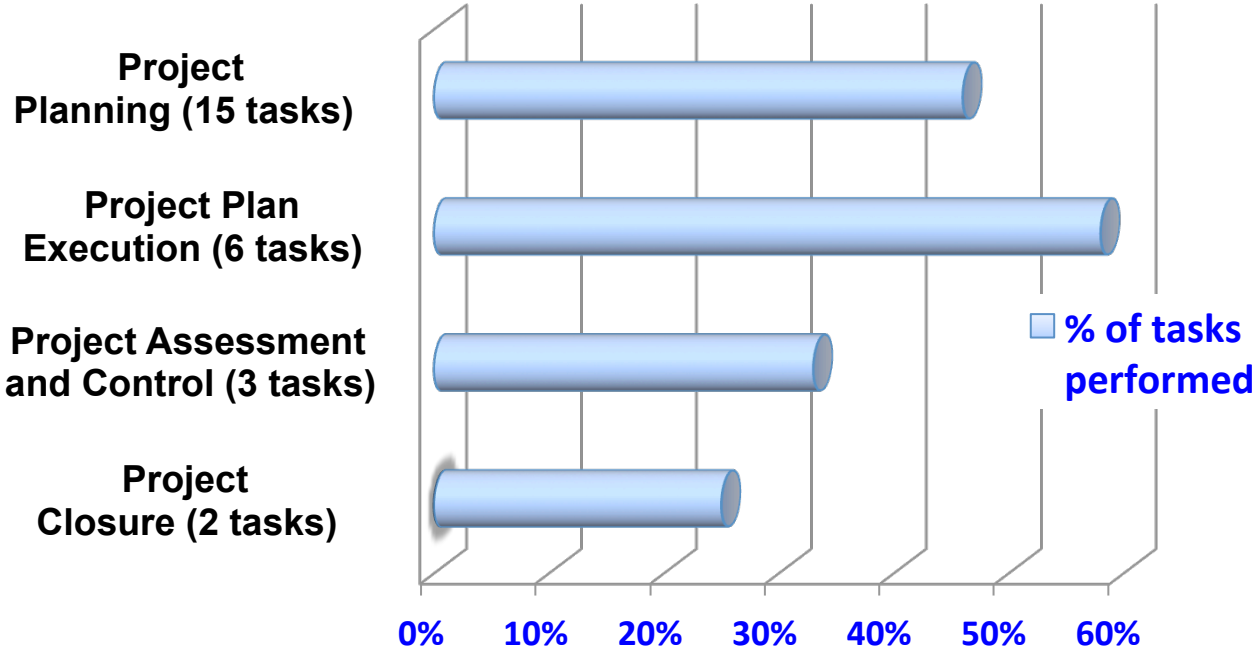
Evaluation of Actual Medium-Scale PM Process

- Against Basic Profile of ISO 29110



- PM tasks were not performed systematically
- PM practices varied from project manager to project manager

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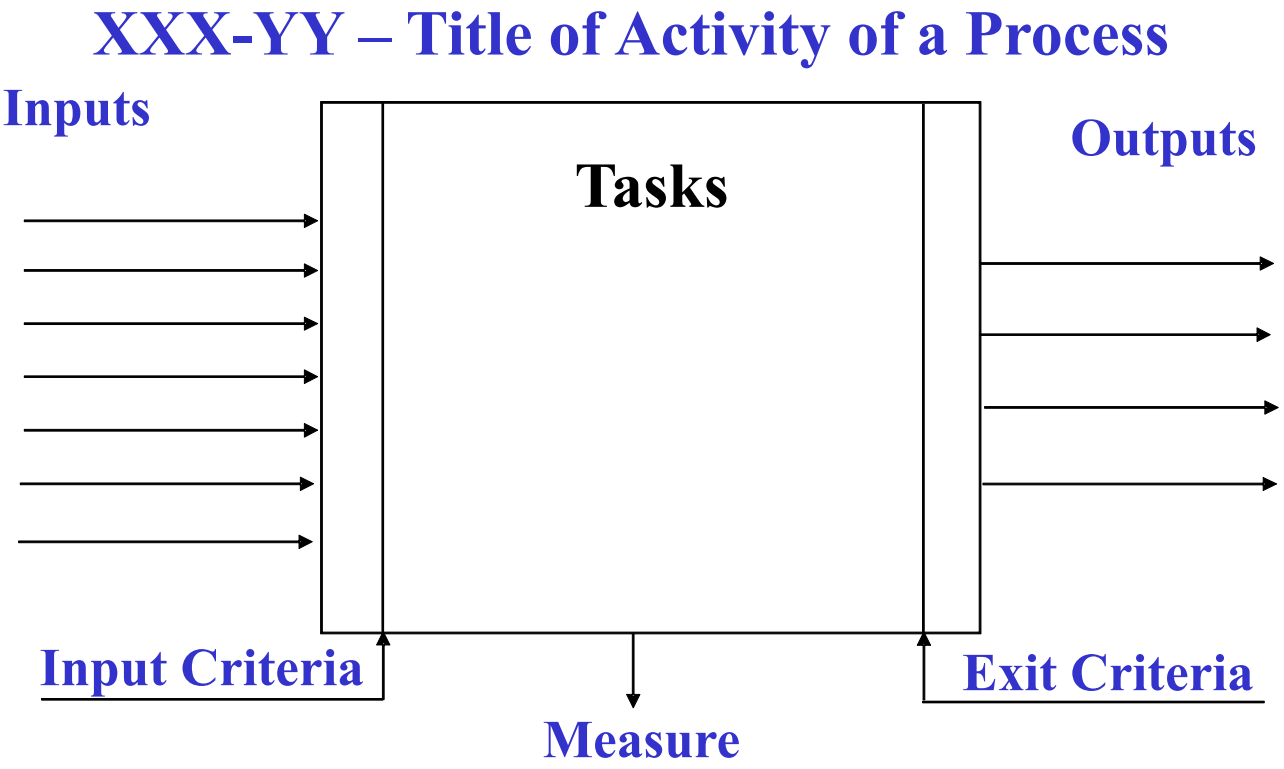
Documentation of Processes- 1



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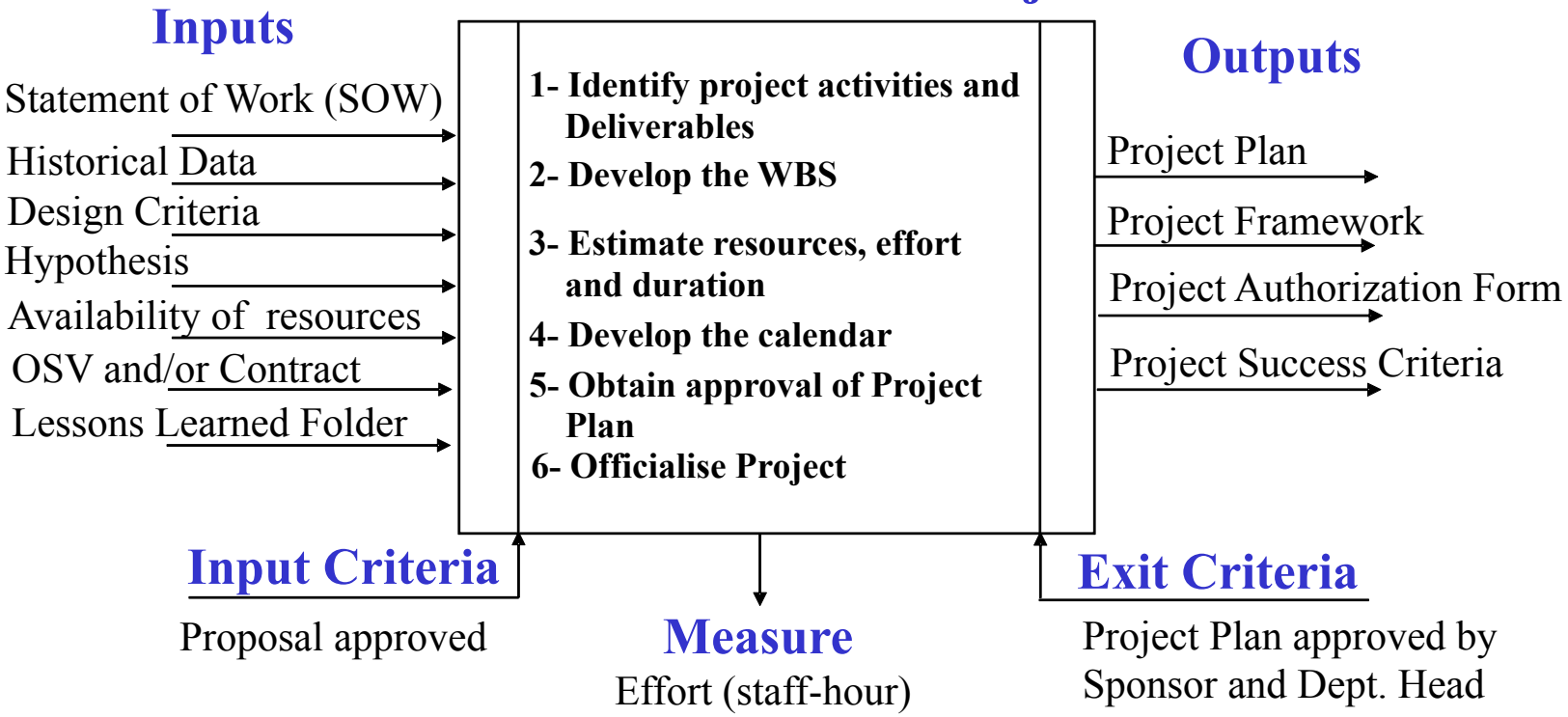
Documentation of PM Processes - 2

SPP- 01 – Plan the Project



SPP= Small-scale Project Process

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Documentation of PM Processes - 3

Procedure: <Name of Process or Procedure>	**Phase:** <Name of phase where the procedure is used>
Process/Procedure Owner: <Owner of this process/procedure>	
Description: a brief description, background and purpose of the process/procedure	
Entry Criteria: • <entry criteria>	**Exit Criteria:** • <exit criteria>
Inputs: • <work products as input>	**Outputs**: • <work products as output>
Roles: • <list of all the actors and their responsibilities>	
Reference(s) • <Document required to use this procedure>	
Assets: • <Tools; methodologies; references; guidelines; checklists; other procedures>	
Tasks: • <Itemized list of tasks (summarized) which need to be accomplished to satisfy this process/procedure (using an active verb and a noun)>	
Measures: • <Measures captured during execution of process/procedure>	

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Documentation of PM Processes - 4

- **Checklists Developed**
  - PM process of small projects
  - PM process of medium projects
  - PM process of large projects
  - Preparation of service offerings
  - Preparation of detailed project planning
- **Project Management Forms and Templates**
  - To guide Project Managers in the execution of management tasks and enable a consistency of results.
  - To guide Project Managers unfamiliar with some project management practices.

Testing the Solutions Developed

- Pilot projects have been performed
  - To validate that the proposed solutions were consistent, feasible, complete and acceptable to PMs
- Three pilot projects were performed
- Lessons learned have identified minor adjustments to the processes and tools
- PMs evaluated the proposed processes, identified problems and potential improvements.
  - PMs also indicated that they would like to have examples of how to implement the tools.

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Deployment Strategy - 1

- A 2-phase strategy was developed for the deployment to all PMs in the division (i.e. about 30 PMs).
- Components of the deployment strategy
  - Communication
  - Training
  - Diffusion of the processes and their supporting documents

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Deployment Strategy - 2

- **First phase – Inform PMs**
  - To reduce questioning and to mitigate the negative impacts of 'unknowns'
    - emails were sent;
    - Articles were published in the monthly Newsletter;
    - Messages have been added to the intranet.
    - One-day training sessions have been prepared for PMs
- **Second phase - Distribute process documents to all PMs**
  - A section of the intranet was created as a main access point to project management documents
  - The intranet also contains information relevant to project management
    - Links to websites, the identification of project management standards and other information such as projects management books.

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Cost/Benefit analysis

- The "*ISO methodology to Assess and Communicate the Economic Benefits of Standards*"
  - Key Objectives are to provide:
    - A set of methods that measure the impact of standards on organizational value creation
    - Decision makers with clear and manageable criteria to assess the value associated with using standards
    - Guidance on developing studies to assess the benefits of standards within a particular industry sector

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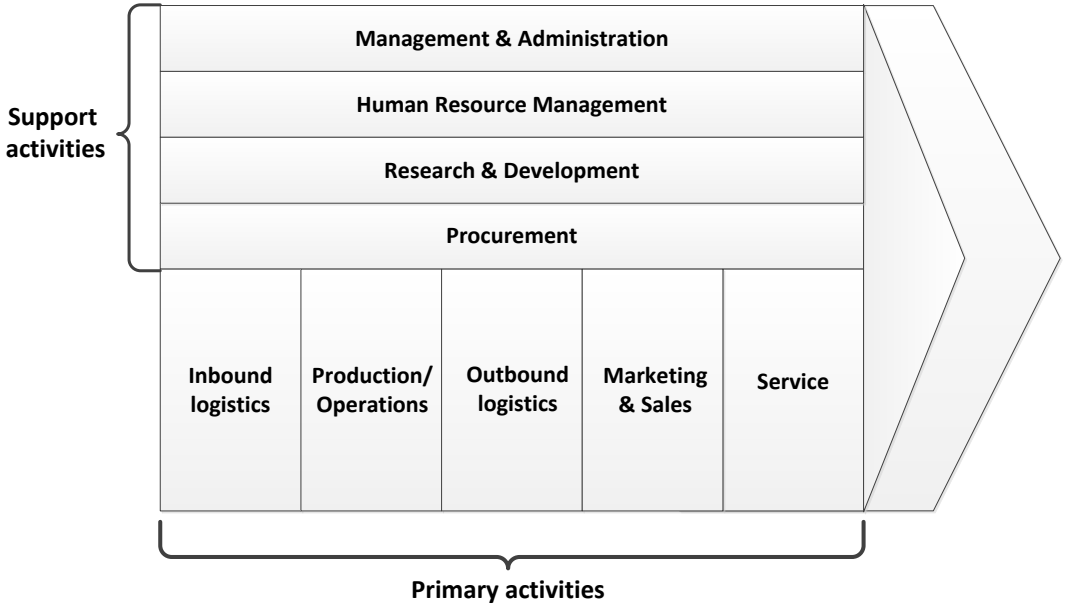
Cost/Benefit analysis

- The approach used by the engineering division, to estimate the cost and benefits, comprised four steps:
  - Understanding the company's value chain
  - Analyzing the value drivers
  - Determining the impacts of standards
  - Assessing and consolidating results



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Subset of Value drivers

Value driver	Description	Performance indicators	Importance
Quality of the design process	Quality in terms of execution time, costs and quality of deliverables	Time spent on corrective engineering work. Cost overruns related to quality control.	Very important (company viability)
Efficiency versus costs	Ability to complete the work at minimum cost	Meeting budgets allocated to each sub-project. Meeting overall project budget.	Very important (company viability)
Project management capacity	Capacity to manage projects according to plans	Cost Performance Index (CPI)	Very important (completing projects is the company's core activity)

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Improvement of Internal Information Transfer

Impact ID	Description of Impacts		Evaluator # 1	Evaluator # 2
Production	**Improvement of internal information transfer**			
	What is the overall cost overrun of projects?	Estimation based on the Profitability Report	555,500 $	555,500 $
	What percentage of the project was in trouble due to a problem of information transfer?		25%	20%
	How much does the project management process can improve the transfer of information?		80%	75%
		Financial impact	**111,100 $**	**83,325 $**

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Cost/Benefit Analysis

- Anticipated costs and benefits
  - Over a period of three years
  - Over 6 dimensions
    - Internal information transfer, staff training, cost of staff, quality of deliverables, management of quality and internal standardization

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

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Conclusion

- ISO/IEC 29110 enabled an engineering consulting firm to develop PM processes for their small and medium-scale projects that offered a structured approach to its project managers.
- Tools developed proved very useful and helped the project managers rapidly integrate the knowledge required to execute the PM processes.
- Managers of the company's other divisions have shown an interest to implement the PM processes within their respective divisions.
- The new systems engineering ISO/IEC 29110 will be used to redefine and improve the existing engineering process of the Canadian division.

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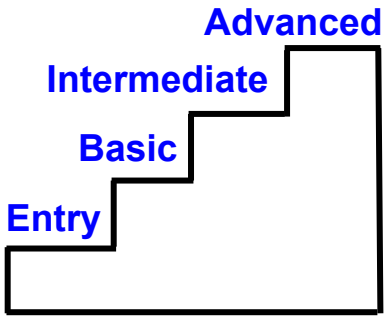
Next Steps for ISO WG 24 and INCOSE VSE WG - 1

- **SE 'Entry' Profile**
  - Should be published late 2015/early 2016
  - Develop Deployment Packages (~ 2) to support Entry
- **SE Profile Specifications Document**
  - Should be published late 2016/early 2017
  - Once published, VSEs could be formally audited
- **SE 'Intermediate' and 'Advanced' Profiles**
  - Should start development early 2016
  - Develop Deployment Packages to support the 2 profiles
- **Mappings between ISO 29110 to ISO 9001 and CMMI-DEV**
- **Conduct more pilot projects and document case studies**



Next Steps for ISO WG 24 and INCOSE VSE WG - 2

- **ISO/IEC 29110 'Service Delivery' Profile**
  - Project approved in May 2015
  - Objective
    - To guide VSEs in providing services after the delivery of a product
  - Two new documents will be developed
    - A Guide (TR) and a profile specification (IS)
    - A VSE will be able to be audited against the specifications
  - A set of 'Service' requirements will be imported from existing standards/frameworks
    - e.g. ISO/IEC 15288, ISO 9001

French and German Translations

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«When an organization selects a standard that fits its context well, and plans the adoption thoughtfully, it's most likely to achieve the standard's advertised benefits»

S. Garcia, SEI

(Garcia, S., How Standards Enable Adoption of Project Management Practice, IEEE Software, Sep/Oct 2005)


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

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- **Public site of WG 24**
  - **Free access to Deployment Packages, presentation material and articles:**
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