An Innovative Approach in Developing Standard Professionals
Involving Graduate Software Engineering Students in Implementing and Improving International Standards

Presented by Professor Claude Y. Laporte, Eng., Ph.D.
Project Editor of ISO/IEC 29110 Standard for Very Small Entities
April 22th 2015
Content

• Introduction

• An ISO standard, ISO/IEC 29110, developed specifically for Very Small Entities (VSEs)

• Examples of the involvement of students in the implementation and improvement of standards
  – Canada, Peru, Ireland and Haiti

* VSEs are enterprises, organizations, projects or departments having up to 25 people
... studies have shown that software specialists spend about **40 to 50 percent** of their time on **avoidable rework** rather than on what they call value-added work, which is basically work that’s done right the first time ...

**If we (you) do not change anything, we (you) cannot expect the situation to improve !**

(Charette, IEEE Spectrum, Sept. 2005)
Laws of Nature Supporting Engineering

**Hooke’s Law**
\[ \sigma = E \cdot \varepsilon \]

**Gravitational Law**
\[ \vec{F} = GM_A M_B \]

**Name a Law of Nature that is a Foundation for Software Engineering**

**Boyle-Mariotte’s Law**
\[ p_1 x V_1 = p_2 x V_2 \]

**Curie’s Law**
\[ E = -\mu \cdot \vec{B} \]

**Coulomb’s Law**
\[ F_{12} = \frac{q_1 q_2}{4\pi \varepsilon_0} \frac{r_2 - r_1}{|r_2 - r_1|^3} \]

**Refraction Law**
\[ \eta_1 \cdot \sin(\theta_1) = \eta_2 \cdot \sin(\theta_2) \]

**Ohm’s Law**
\[ V = RI \]
Standards - A ‘Must’ in the Absence of Software Engineering Laws of Nature

‘Set of mandatory requirements established by consensus and maintained by a recognized body to prescribe a disciplined uniform approach or specify a product, that is, mandatory conventions and practices.’ (ISO/IEC/IEEE 24765)

www.computer.org/sevocab
Components of Project Cost

Cost of Quality

Cost of Conformance

Cost of Performance

Cost of Non Conformance

Appraisal Costs
- Reviews
- Inspections
- Testing
- Verification
- Audits

Prevention Costs
- Training
- Methodologies
- Tools
- Data gathering

- Generation of plans
- Software Development

- Fixing defects
- Re testing
- Re-reviews
- Updating source code
- Modifying documents

Adapted from (Haley et al., 1995)
# Cost of Quality

## Data from Professional Software Engineers

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Cost of performance</td>
<td>41%</td>
<td>44%</td>
<td>34%</td>
<td>31%</td>
<td>34%</td>
<td>29%</td>
<td>43%</td>
<td>45%</td>
<td>45%</td>
<td>34%</td>
<td>40%</td>
<td>44%</td>
<td>36%</td>
</tr>
<tr>
<td>Cost of reworks</td>
<td>30%</td>
<td>26%</td>
<td>23%</td>
<td>41%</td>
<td>34%</td>
<td>28%</td>
<td>29%</td>
<td>30%</td>
<td>25%</td>
<td>32%</td>
<td>31%</td>
<td>25%</td>
<td>29%</td>
</tr>
<tr>
<td>Cost of appraisals</td>
<td>18%</td>
<td>14%</td>
<td>32%</td>
<td>21%</td>
<td>26%</td>
<td>24%</td>
<td>18%</td>
<td>14%</td>
<td>20%</td>
<td>27%</td>
<td>20%</td>
<td>19%</td>
<td>20%</td>
</tr>
<tr>
<td>Cost of prevention</td>
<td>11%</td>
<td>16%</td>
<td>11%</td>
<td>8%</td>
<td>7%</td>
<td>14%</td>
<td>10%</td>
<td>11%</td>
<td>10%</td>
<td>8%</td>
<td>9%</td>
<td>12%</td>
<td>15%</td>
</tr>
<tr>
<td>Quality *</td>
<td>71</td>
<td>8</td>
<td>23</td>
<td>35</td>
<td>17</td>
<td>43</td>
<td>19</td>
<td>48</td>
<td>35</td>
<td>60</td>
<td>55</td>
<td>72</td>
<td>44</td>
</tr>
</tbody>
</table>

* Quality = Number of Defects/ 1,000 Lines of Code
Software Defect Injection

Defects (%)

System Development Phase

(Selby, 2007)
Software Defect Detected when Injected in Same Phase

Defects Detected / Defects Injected (%)
Size of Enterprises

- European Union
  - 92.2% are micro enterprises (between 1 and 9 employees)*

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

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

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

* Moll, R., Being prepared – A bird’s eye view of SMEs and risk management, ISO Focus +, February 2013
** OECD: Organisation for Economic Co-operation and Development
Very Small Entities (VSEs)

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

**VSEs** are enterprises, organizations, [projects or departments](#) having up to 25 people.
Content

• Introduction

• An ISO standard, ISO/IEC 29110, developed specifically for Very Small Entities

• Examples of the involvement of students in the implementation and improvement of standards
  – Canada, Peru, Ireland and Haiti
ISO Working Group 24

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.
Development of International Standards for VSEs

1. Recognition of Needs and Problems
2. Basic and Applied Research
3. Development
4. Commercialization
5. Diffusion and Adoption
6. Consequences

• Phase 1 - Recognition of Needs and Problems (2004)
• Phase 2 - Basic and Applied Research (2005-2006)
• Phase 3 - Development (2006-2010)
• Phase 4 - Commercialization (2010)
• Phase 5 - Diffusion and Adoption (2006 - )
• Phase 6 - Consequences (2011 - )

Adapted from (Rogers, 2003)
Requests from VSEs

• Certification and Recognition
  • Only 18% are 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% are asking for more guidance and examples
  • 55% are requiring lightweight standards that are easy to understand and apply and come with templates.
The Strategy of WG 24
to develop standards and guidelines for VSEs

• Use the notion of ‘Profile’ to develop a roadmap with a few profiles and standards to meet the needs of VSEs.
  – A profile is an ‘assemblage’ from one or more base standards to accomplish a particular function.
  – A Profile Group (PG)
    • A collection of profiles
• Focus first on VSEs developing Generic software (Profile Group)
  • i.e. VSEs that do not develop critical software products.
• Use the Mexican national standard MoProsoft as a reference to start the development of profiles,
• Use two types of standards, as inputs, for the development of standards for VSEs:
  – Process standards, such as ISO 12207, that define the activities required to achieve identified objectives or outcomes;
  – Product standards, such as ISO 15289, that define the structure and content of artefacts produced by the processes;
• Develop a set of documents to describe and specify the profiles.
ISO/IEC 29110 Standards and Guides for Very Small Entities (VSEs)

- **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.
ISO/IEC 29110 Documents Targeted by Audience

29110 Overview (TR 29110-1)

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)

29110 Guides (IS/TR)
- Assessment Guide (IS/TR 29110-3)
- Management and Engineering Guide (TR 29110-5)
  - Management and Engineering Guide
    VSE Profile m-n
    (TR 29110-5-m-n)

For VSEs and customers

For Standard producers, tool vendors, methodology vendors

List the Requirements i.e. ‘What to do’

For Assessors, customers and VSEs

‘How to do’

TRs are available from ISO at no cost
http://standards.iso.org/ittf/PubliclyAvailableStandards/index.html
ISO/IEC 29110 Entry/Basic Profiles Management and Engineering Guide

Software Implementation Process
- Initiation
- Analysis
- Design
- Construction
- Integration and tests
- Delivery

Project Management Process
- Planning
- Execution
- Evaluation
- Closure

Organizational Management

Software Configuration

Statement of Work

Customer

Available in English, French, Spanish, Portuguese

Adapted from (Varkoi 2010)
Project Management Process
Example of one Task of the Planning Activity

<table>
<thead>
<tr>
<th>Role</th>
<th>Task List</th>
<th>Input Products</th>
<th>Output Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM</td>
<td><strong>PM.1.1 Review</strong> the Statement of Work</td>
<td>Statement of Work</td>
<td>Statement of Work [reviewed]</td>
</tr>
<tr>
<td>TL</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## ISO/IEC 29110 - Document Content

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
</table>
| 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 requestor contact information  
  - Impacted system(s)  
  - Impact to operations of existing system(s) defined  
  - Impact to associated documentation defined  
  - Criticality of the request, date needed | Customer, Project Management, Software Implementation |

The applicable statuses are: *initiated, evaluated, and accepted*
5. Diffusion

Deployment Packages (DPs)

• A Deployment Package (DP) is 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.
• By deploying and implementing a Deployment Package, a VSE can see its concrete step to achieve or demonstrate coverage to Part 5.
• Deployment Packages are designed such that a VSE can implement its content, without having to implement the complete framework at the same time.
• Each DP is reviewed and edited by at least 2 persons
Content of Deployment Packages

1. Technical Description
   - Purpose of this document
   - Why this topic is Important?

2. Definitions
   - Generic Terms
   - Specific Terms

3. Relationships with ISO/IEC 29110 Part 5

4. Description of Processes, Activities, Tasks, Steps, Roles and Products

5. Template(s)

6. Example(s)

7. Checklist(s)

8. Tool(s)


10. References

11. Evaluation Form
Deployment Packages for the Software Basic Profile

Construction and Unit testing

Verification and Validation

Integration and Tests

Architecture and Detailed Design

Product Delivery

Requirements Analysis

Version Control

Self-Assessment

Deployment Packages are free on internet
1. Introduction

2. The ISO/IEC 29110 family of standards and guides developed specifically for Very Small Entities (VSEs)

3. Examples of the involvement of students in the implementation and improvement of ISO/IEC 29110 standards and guides
   - Students participating to pilot projects in an organization
   - Students participating, as employees, to an implementation in their own organizations
   - Students launching their own start-ups
   - Students becoming professors
   - Students providing feedback/comments on draft ISO/IEC 29110 documents
An IT Start-Up

• **Start-up Company of 2 People**
  • Involved in the development of *web services for travelers*
  • To help travelers throughout the life cycle of a trip from its initial planning to sharing the experience of the traveler with friends.

[Image of swicetrip website]

http://swicetrip.com/

Adapted from (Laporte et al 2014)
An IT Start-Up

- Allocation of ISO/IEC 29110 documents the two-people VSE

<table>
<thead>
<tr>
<th>Role</th>
<th>Identification of team member</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyst</td>
<td>A</td>
</tr>
<tr>
<td>Designer</td>
<td>B</td>
</tr>
<tr>
<td>Programmer</td>
<td>A/B</td>
</tr>
<tr>
<td>Project Manager</td>
<td>B</td>
</tr>
<tr>
<td>Technical Leader</td>
<td>A</td>
</tr>
<tr>
<td>Work Team</td>
<td>A/B</td>
</tr>
</tbody>
</table>

- As the VSE grows, the set of roles will be attributed amongst all people of the VSE.

<table>
<thead>
<tr>
<th>Name of document</th>
<th>Main author</th>
<th>Reviewer (if applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change Request</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Correction Register</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Maintenance Documentation</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Meeting Record</td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>Product Operation Guide</td>
<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Progress Status Record</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>Project Plan</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Project Repository</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>Project Repository Backup</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>Requirements Specification</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Software</td>
<td>A/B</td>
<td></td>
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<tr>
<td>Software Components</td>
<td>A/B</td>
<td></td>
</tr>
<tr>
<td>Software Configuration</td>
<td>A/B</td>
<td></td>
</tr>
<tr>
<td>Software Design</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Software User Documentation</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Statement of Work</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Test Cases and Test Procedures</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Test Report</td>
<td>A</td>
<td></td>
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<tr>
<td>Traceability Record</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>Verification Results</td>
<td>A/B</td>
<td></td>
</tr>
<tr>
<td>Validation Results</td>
<td>A/B</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from (Laporte et al 2014)
• Total Effort of 990.5 Hours

<table>
<thead>
<tr>
<th>Phase of development cycle</th>
<th>Prevention (Hours)</th>
<th>Execution (Hours)</th>
<th>Review (Hours)</th>
<th>Rework (Hours)</th>
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</thead>
<tbody>
<tr>
<td>Installation of the work environment</td>
<td>89</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project management and Project progress</td>
<td></td>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deployment</td>
<td></td>
<td>8,5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development of Project Plan</td>
<td></td>
<td>35</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Software Specification and Prototyping</td>
<td>199,5</td>
<td>7</td>
<td>18</td>
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<tr>
<td>Development of the Architecture</td>
<td>42.5</td>
<td>1.5</td>
<td>3,5</td>
<td></td>
</tr>
<tr>
<td>Construction (Prototype and code)</td>
<td>361</td>
<td>47</td>
<td>96,5</td>
<td></td>
</tr>
<tr>
<td>Development of Test Plan</td>
<td>12.5</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Development of product and User guide</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Project closure</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>89</strong></td>
<td><strong>716</strong></td>
<td><strong>60.5</strong></td>
<td><strong>125</strong></td>
</tr>
</tbody>
</table>

• Percentage of rework of 12.6 %
  • i.e. 125 hours/990.5 hours

Adapted from (Laporte et al 2014)
An IT Start-Up

% of Total Project Cost

Start of Initiative

Cost of Non Conformance (Rework)

Appraisal & Prevention Costs

IT Start-up: 12.6%

Adapted from (Haley et al., 1995)
An IT Start-Up

• Development of a Social Network Website Using the New ISO/IEC 29110 Standard Developed Specifically for Very Small Entities

• Software Quality Professional – September 2014


(Laporte et al. 2014)
An IT Start-Up

• VSE founded in 2013 by a software engineering graduate of ÉTS
  • One site in Canada
  • One site in Tunisia

• Business domains
  • Software development services, Web solutions, mobile applications
  • Consulting services to implement ERP solutions

• ISO/IEC 29110 is also used a foundation to implement CMMI® DEV level 2 practices
  • Requested by some military contracts

• The VSE has 15 employees in 2015
Pilot Project in a Large Engineering Firm

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

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

- Used ISO/IEC 29110 (Entry and Basic profiles) to document their small and medium project management processes.

Adapted from (Laporte et col. 2013)
## Business Objectives Targeted for the Improvement Project

<table>
<thead>
<tr>
<th>Identification Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>O-1</td>
<td>Facilitate the integration of new project managers.</td>
</tr>
<tr>
<td>O-2</td>
<td>Reach an overall customer satisfaction level 80%.</td>
</tr>
<tr>
<td>O-3</td>
<td>On average projects should reach cost and schedule targets within 5%.</td>
</tr>
<tr>
<td>O-4</td>
<td>Reduce overload of staff by 10%.</td>
</tr>
<tr>
<td>O-5</td>
<td>Reduce schedule slippage to less than one week and 5% of initial cost for mismanaged risks of projects.</td>
</tr>
<tr>
<td>O-6</td>
<td>Reduce rework by 10%.</td>
</tr>
<tr>
<td>O-7</td>
<td>Reduce non billable hours by 10%.</td>
</tr>
</tbody>
</table>

Adapted from (Laporte et col. 2013)
Pilot Project in a Large Engineering Firm

- Actual project management process for medium projects was evaluated against ISO/IEC 29110 Basic Profile

Adapted from (Laporte et col. 2013)
Pilot Project in a Large Engineering Firm

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Management &amp; Administration</th>
<th>R &amp; D</th>
<th>Engineering</th>
<th>Procurement</th>
<th>Inbound Logistics</th>
<th>Production / Operations</th>
<th>Outbound Logistics</th>
<th>Marketing &amp; Sales</th>
<th>Service</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td>59 600$</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Year 2</td>
<td>50 100$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year 3</td>
<td>50 100$</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- Costs and Benefits of using ISO/IEC 29110

Adapted from (Laporte et al. 2013)
ISO Focus of February 2013

- Application of ISO/IEC 29110 in Project Management
- Translated in French, English, Spanish and German

5. Diffusion

Pilot Project in a Large Engineering Firm

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Pilot Project in a Large Engineering Firm

- 25th Annual International Council on Systems Engineering (INCOSE) Symposium
- July 2015 - Seattle
An Enterprise in the Automotive Field

• An enterprise of about 140 employees that designs and sells electric powertrain systems in the automotive field.
• Their products are embedded software that controls the operation of engines in real time and software that controls the interactions between the components of a vehicle.
• A compliance study was conducted to establish the difference between the processes in place and those proposed by the ISO/IEC 29110.
• An action plan has been developed to organise the software process improvement activities.
• An analysis of differences between ISO/IEC 29110 and ISO 26262, a standard for the automotive industry, was also conducted.
• An economic impact assessment was conducted using the methodology developed by ISO.
• A pilot project is running until May 2015.
ISO/IEC 29110 adapted for a Technical College

- A student from the graduate program in Software Engineering worked in collaboration with an IT professor of a technical college
- He developed course material (e.g. templates) for a software design course.

Adapted from (Trudeau et al 2014)
ISO/IEC 29110 in Perú

• Start-up of 4 people
• Created in 2012 by two alumni of the UPC university Software Engineering program (Lima)
• Specializes in providing software development services and automation of business processes with information system solutions.
• Decided to implement ISO/IEC 29110
  – Project selected was the Legal Consultation System for an insurance company
• Implemented ISO/IEC 29110 using an Agile approach
  – The project had 6 sprints of 1 week each
  – Total effort of the project: 882 hours
• In 2014, the company had 10 people

http://bitperfect.pe
## ISO/IEC 29110 in Perú

<table>
<thead>
<tr>
<th>Task</th>
<th>Prevention (hours)</th>
<th>Execution (hours)</th>
<th>Review (hours)</th>
<th>Correction of defects (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment installation (Windows azure, management tools, development environment and project repository)</td>
<td>14</td>
<td></td>
<td></td>
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<tr>
<td>Project plan development</td>
<td></td>
<td>15</td>
<td>3</td>
<td>7</td>
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<tr>
<td>Project plan execution and project assessment and control</td>
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<td>108</td>
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<tr>
<td>Project plan execution (sprint planning and execution)</td>
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<tr>
<td>Project assessment and control: sprint review, sprint retrospective</td>
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<tr>
<td>Specification development</td>
<td></td>
<td>107</td>
<td>28</td>
<td>58</td>
</tr>
<tr>
<td>Statement of work</td>
<td>12</td>
<td>3</td>
<td>7</td>
<td></td>
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<tr>
<td>Specifying user stories and product backlog</td>
<td>95</td>
<td>25</td>
<td>51</td>
<td></td>
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<tr>
<td>Architecture development</td>
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<td>10</td>
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<td>14</td>
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<tr>
<td>Test plan development</td>
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<tr>
<td>Code development and code testing</td>
<td>253</td>
<td>70</td>
<td>62</td>
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<tr>
<td>User guide and maintenance document development</td>
<td>14</td>
<td>5</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Software product deployment</td>
<td>14</td>
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<tr>
<td>Project closure</td>
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</tr>
<tr>
<td><strong>Total (Hours)</strong></td>
<td><strong>14</strong></td>
<td><strong>585</strong></td>
<td><strong>124</strong></td>
<td><strong>159</strong></td>
</tr>
</tbody>
</table>
ISO/IEC 29110 Certification in Perú

- Bit Perfect Solutions
- First Peruvian VSE to be awarded an ISO/IEC 29110 certificate of conformity – July 2014
- VSE audited by a Brazilian auditor in accordance with the official Brazilian Normalization Organization (ABNT)

http://bitperfect.pe
Implementation and Certification of ISO/IEC 29110 in an IT Start-up in Perú

Software Quality Professional – March 2015


(Garcia et al. 2015)
ISO/IEC 29110 in Haiti

• A student of the Graduate Program in software engineering of Montréal has done his project on the implementation of ISO/IEC 29110 in two VSEs of Haiti

• He returned to Haiti, as a software engineering professor, at the Institut Universitaire Quisqueya-Amérique (INUQUA)

• Over 14 software VSEs of Haiti have been evaluated against ISO/IEC 29110 as part of a software quality assurance course
  – Fourteen teams of students made these evaluations.

• For the summer session of 2014, at least 80 students will evaluate the development processes of other VSEs using the ISO/IEC 29110 standard.

http://www.inuka.edu.ht/
Evaluating Sentiment Towards ISO/IEC 29110 in Ireland

• Qualitative study was conducted in 10 software product VSEs
  – Were in start-up phase or recently formed (< 24 months)

• Software lifecycle standard is a low priority issue:
  – Low to no demand for standards compliance from clients
  – The perception that the software lifecycle standards are designed
    for the big companies rather than for VSEs
  – The view of standards as a ‘sales tool’ only

• A potentially significant way to develop standards professionals
  – Having professional graduate students involved in the
    application and improvement of international standards in VSEs
Development of ISO/IEC 29110 Profiles and DPs in Systems Engineering

• Project done under sponsorship of INCOSE/AFIS
  – International Council on Systems Engineering (INCOSE)
  – Association Française d’ingénierie système (AFIS)
• Goals
  – To improve or make product development efficient by using Systems Engineering methodology
  – To elaborate tailored practical guidance to apply to VSEs in the context of prime or subcontractor, of commercial products
  – To contribute to standardization
The Systems Engineering Basic Profile

Acquirer

Statement of Work

Product

System Definition and Realization Process

System Definition and Realization Initiation

System Requirements Engineering

System Architectural Design

System Construction

System Integration, Verification and Validation

Product Delivery

Project Management Process

Project Planning

Project Plan Execution

Project Assessment and Control

Project Closure

Organizational Management

Published by ISO in August 2014 and available at no cost from ISO
Deployment Packages for the Systems Engineering Basic Profile

- Interface Management
- Verification & Validation
- Integration
- Functional & Physical Architecture
- Product Deployment
- Project Management
- Requirements Engineering
- Configuration Management
- Change Management

Deployment Packages are free on internet

Adapted and translated from (Fanmuy 2011)
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
  – Perform a gap analysis between CMMI® level 2 and the SE Basic Profile
  – Implement the practices needed for a CMMI® level 2 assessment.

• Graduate student who largely contributed to this project also made many important comments to draft versions of ISO/IEC 29110 for Systems Engineering.

http://csit.co

Adapted from (Tremblay et al 2015)
Countries Teaching ISO/IEC 29110

- Argentina
- Belgium
- Brazil
- Canada
- Czech Republic
- Finland
- Germany
- Haiti
- Ireland
- Japan
- Mexico
- Peru
- Thailand
- Uruguay
Conclusion

• Most countries have a large majority of very small organisations
• ISO/IEC 29110 is specifically developed for entities having up to 25 people
• Many countries are teaching, using the freely available ISO/IEC 29110 documents, at the college, graduate and/or undergraduate levels
• Graduate students can learn, apply and recommend improvements to engineering standards:
  • If standards are teachable, understandable and usable
• Freely available documents are highly desirable in academia
  • ISO/IEC 29110 Technical reports are available at no cost from ISO web site
• Once in industry, these students can make valuable contributions with their knowledge and experience, especially in VSEs
For more details, see the article published in the March/April 2015 issue.
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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